بسم الله الرحمن الرحيم

<u>مقابل هذا المجهود ارجو منكم الدعاء لي بالمغفرة ولابنائي الهداية والنجاح والتوفيق</u>

أرجو ان يساعد هذا المجهود على مساعدة ابنائنا طلبة ال IGCSE للثانوية البريطانية وتحصيلهم على افضل واحسن واعلى الدرجات انشاء الله.
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<u>In the name of god</u>

Pry for me and my sons to success, mitigating and proselyting

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IGCSE

PHYSICS

Answers to Examination Papers

June1993 - Nov. 2002

Contents

JUNE

1993

Paper 2

1. Average speed = distance / time
   = 124 / 4 = 31 km / h

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2. a - Volume of extra oil = 97 - 46 = 51 cm^3
   b - Mass " " " = 344 - 297 = 47 g
   c - Density of oil = $\frac{M}{V}$

   $= \frac{47}{51} = 0.92 \ g / cm^3$

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3. Turning forces are found in <u>second</u> and <u>third</u> boxes only.

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4. <u>Solid</u> : Spacing is very small,
   molecules vibrate about their fixed positions.
   <u>Liquids</u> : Spacing is small (but larger than solids),
   molecules can vibrate and can move to exchange their places.
   <u>Gases</u> : Spacing is very large,
   molecules move freely in random directions.

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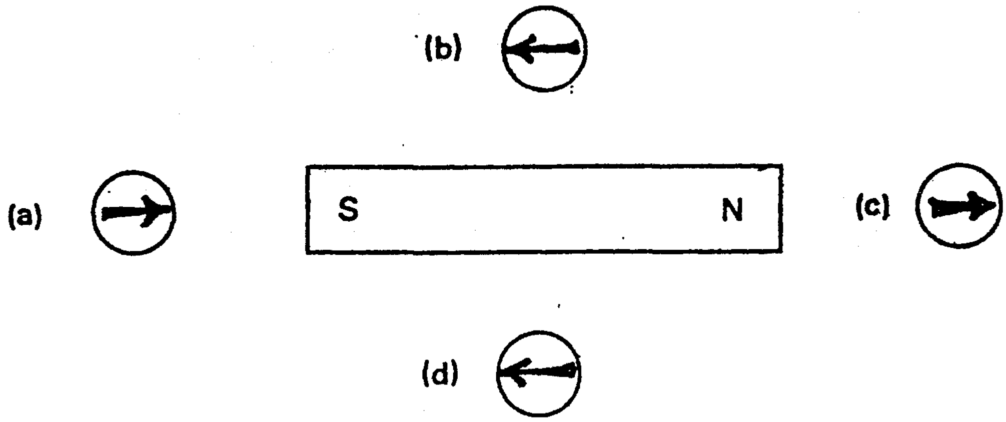
5. Because the current is flowing in one direction in the coil, the coil will be affected by two opposite forces on its sides which will cause it to turn until it comes to rest in a vertical position (because the forces are now equal and opposite but acting on the same line thus their moment is zero).

   In order to keep the rotation continuously, the two slip rings should be replaced by a commutator.

6.



7. electrons - energy - voltage

8. correct statements are : (b) and (e)

9. a - (i) Kinetic en^rgy and gravitational potential energy
(ii) Chemical energy
(iii) Internal energy (Heat).
b - When the high tide approaches, the water level rises and sea water fills a lake behind a dam, where water is trapped by the closed dam. At low tide, the water flows out and can be used to turn turbines and generators to produce electrical energy.

10. a - (i) 29 °C

(ii) When the temperature rises, the mercury in the thermometer's bulb expands and rises through the capillary tube. The length of the mercury thread increases and the reading on the scale increases.

(iii) 0 °C and 100 °C

b - (i) When Colin holds the flask, the air gains some heat energy from his hands. When air molecules gain more energy they will move faster and their intermolecular distances will increase resulting in an increase in the volume of air.

Since the volume of the flask is almost constant, the extra volume of air escapes from the tube as bubbles of air.

(ii) When the air cools down, air molecules loose some of their kinetic energy, their motion slows down and the intermolecular distances decrease. The volume of air thus decreases (because the remaining air molecules occupy less volume at the initial temperature) and water goes up the tube reducing the volume of air.

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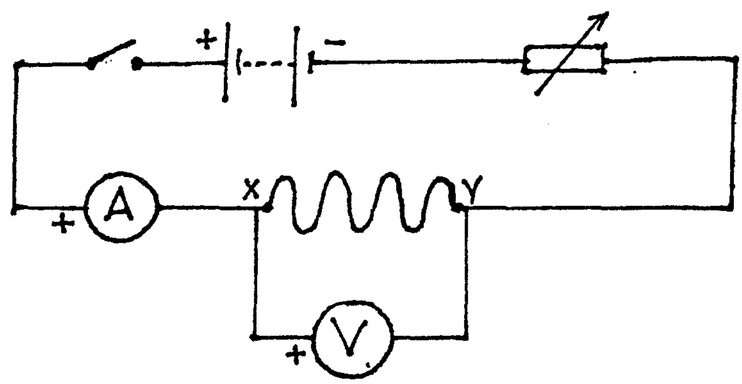
11. a - (i) A very high current will flow through the switch circuit, this will overheat the wire and its insulation will melt. It may produce a spark which may start a fire. The battery would be completely damaged.

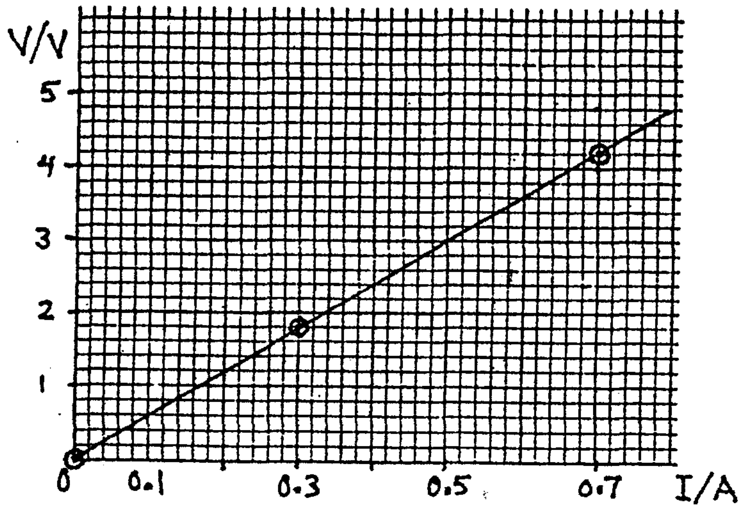
(ii)



b - (i) $R = V/I = 4.2/0.7 = 6\ \Omega$

(ii) $V = IR = 0.3 \times 6 = 1.8\ V$

(iii)



c - more than 0.7 A

$(I = V/R = 4.2/4.5 = 0.93\ A)$

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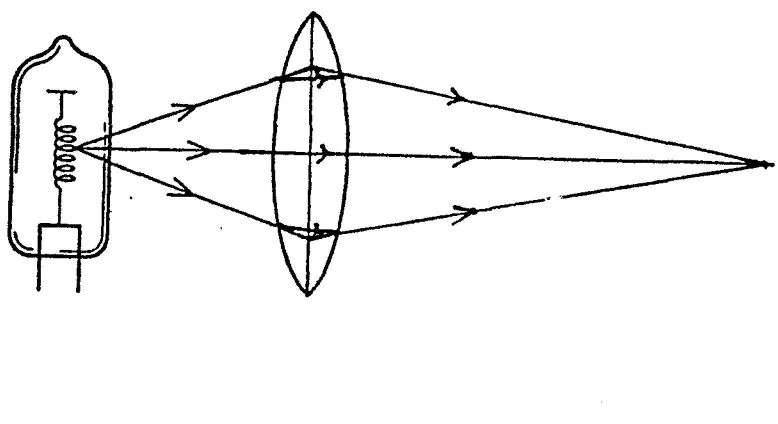
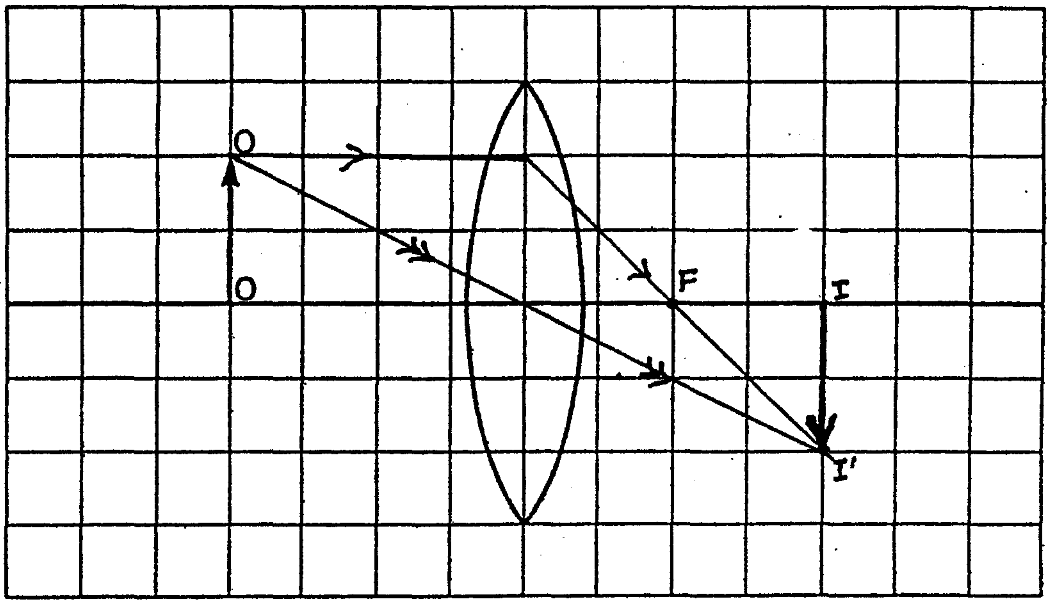
12. a -



b - (i)



(ii) REAL , SAME SIZE , UPSIDE DOWN

(iii) ... Smaller and it moves towards the lens.

Paper 3

1. a - (i) Potential energy of the plane $= m\ g\ h$

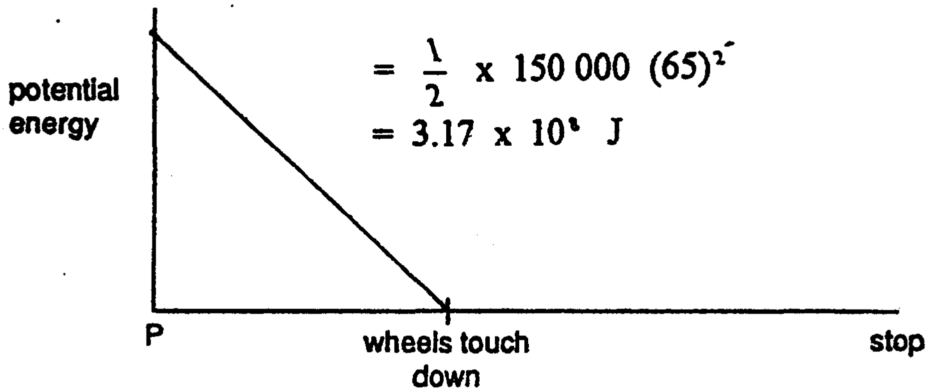
$= 150\,000 \times 10 \times 500$

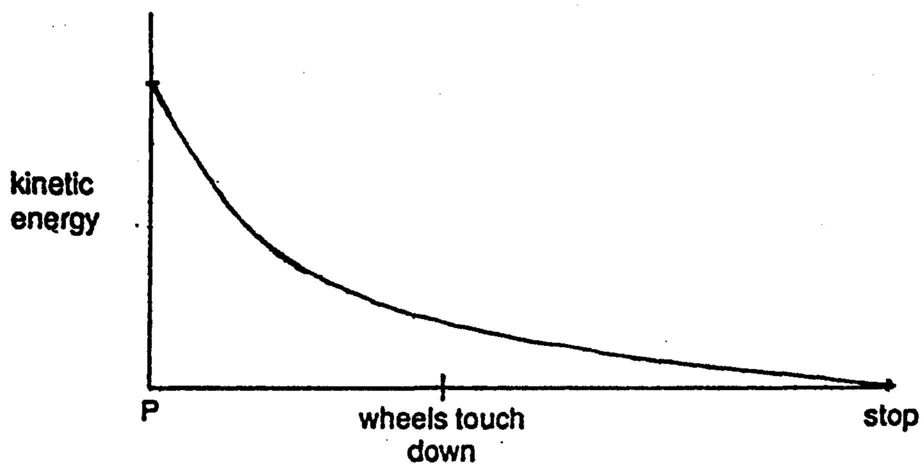
$= 7.5 \times 10^8$ J

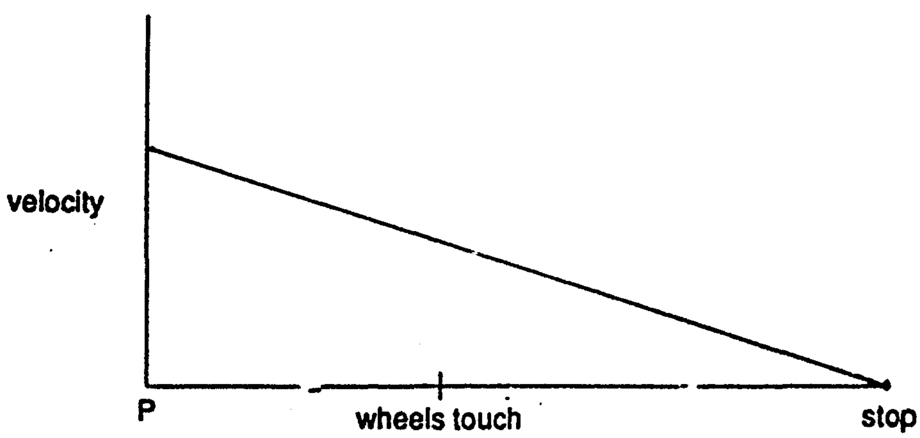
(ii) Its kinetic energy $= \frac{1}{2}\ m\ V^2$

$= \frac{1}{2} \times 150\,000\ (65)^2$

$= 3.17 \times 10^8$ J







Potential Energy of the plane decreases gradually as its height decreases. The P.E. reaches zero at the point of the wheels touch down because the height of the plane from the ground is zero.

Kinetic Energy of the plane decreases gradually, but it does not reach zero except when the plane reaches a complete stop. The curve representing the K.E. is a parabola because the K.E. is proportional to V^2.

Velocity of the plane decreases gradually until it becomes zero when the plane comes to a complete stop.

c - During the deceleration of the plane, the pendulum moves to the right towards the front of the plane. This is because the pendulum maintains its momentum or inertia while the plane is decelerating. When the plane completely stops, the pendulum returns back making few oscillations before it finally stops in its vertical position.

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2. a - (i) Chest freezer: When the chest freezer is opened, the cool air remains inside it because cool air is denser and cannot move up to escape from the freezer. Thus food remains cool.

Upright freezer: When the upright freezer is opened, the denser cool air moves down escaping out of the freezer, and it is replaced by warm air from the room. - This can warm up the food.

(ii) Thermal capacity $= m\ c$

$= (V.\rho)\ c$

$\therefore$ Thermal capacity of food $= 80 \times 500 \times 3500 = 1.4 \times 10^8$ J / k

" " " air $= 20 \times 1 \times 1000 = 2.0 \times 10^4$ J / k

The thermal capacity of food is very much greater than that of air, therefore, the amount of heat carried by air can be neglected. Elena's statement is correct.

b - (i) 1) When a liquid evaporates, it absorbs the latent heat from the surroundings in order that it can change to a vapour. Evaporation produces cooling of the surroundings.

2) When a vapour condenses, it gives out its latent heat energy to the surroundings. Condensation causes heating of environment.

(ii)

$$\text{efficiency} = \frac{\text{Power output}}{\text{Power input}} \times 100$$

$$35 = \frac{(1.6 \times 10^{8})}{\text{Power input}} \times 100$$

$$\therefore \text{Power input} = 4.57 \times 10^{8} \text{ W}$$

$$P \times t = m \times L$$

$$(4.57 \times 10^{8}) \times 1 = m \times 550\,000$$

$$\therefore m = 831 \text{ kg/s}$$

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3. 1) Molecules are in random motion which explains the fact that the gas exerts the same pressure on the different walls of the container.

2) Kinetic energy of molecules increases when temperature rises explains the fact that the pressure of the gas increases when it is heated, because the velocity of molecules increases leading to greater and harder collisions with the walls.

3) Molecules have mass explains the fact that any object has a mass.

4) There are attractive forces between molecules explains the fact that when a spring is stretched it returns back to its original length when the stretching force is removed.

5) The molecules of a gas are much further apart than the molecules of a liquid explains the fact that gases can be compressed easily while liquids are almost incompressible.

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4. a - Refractive index of glass $= \dfrac{\sin i}{\sin r} = \dfrac{\sin 40}{\sin 26.3}$

$= 1.45$

b - Refractive index $= 1 / (\sin \text{ critical angle})$

$1.45 = 1 / \sin C$

$\therefore$ critical angle $C = 43.6°$

Fourth and fifth rays have angles of incidence greater than the critical angle, thus they are totally internally reflected.

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5. a - (i) Normal working current $I = P / V$

$= 3 / 2 = 1.5 \text{ A}$

(ii) 1) Total resistance $= 10 + 2 = 12 \ \Omega$

2) P.D. between R and Q $= I R$

$= \left(\dfrac{12}{12}\right) 2 = 2 \text{ V}$

(iii) No, lamp does not work normally, because the current in the circuit is small and it is divided between the $2 \ \Omega$ resistor and the lamp, thus the current passing in the lamp would be too small for its normal operation.

b - (i) $I = P / V$

for A: $I = 1000 / 250 = 4 \text{ A}$

for B: $I = 2000 / 250 = 8 \text{ A}$

for C: $I = 3000 / 250 = 12 \text{ A}$

(ii) current through the fuse $= 4 + 8 + 12 = 24 \text{ A}$

1) This large current through the connecting wires may cause overheating of the wires, which damages the insulation and may cause short circuits and fire.

2) This large current needs a fuse with a high rated value. The high rated fuse is not a good protection to the circuit when one appliance only is in use and the others are switched off.

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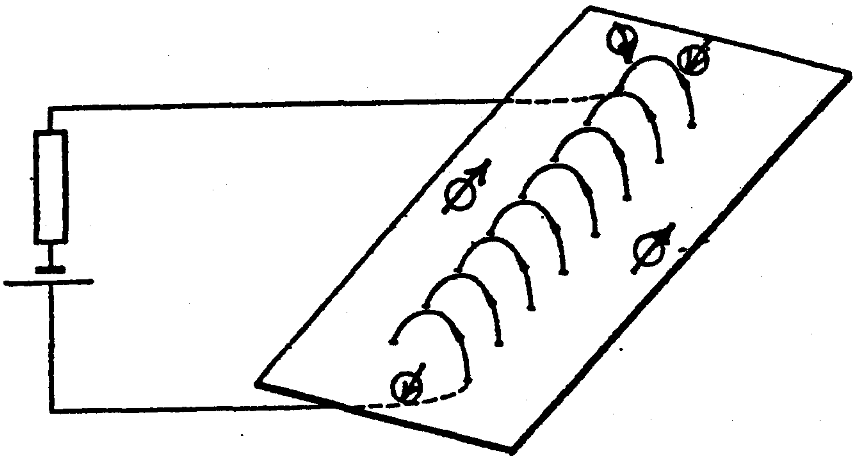
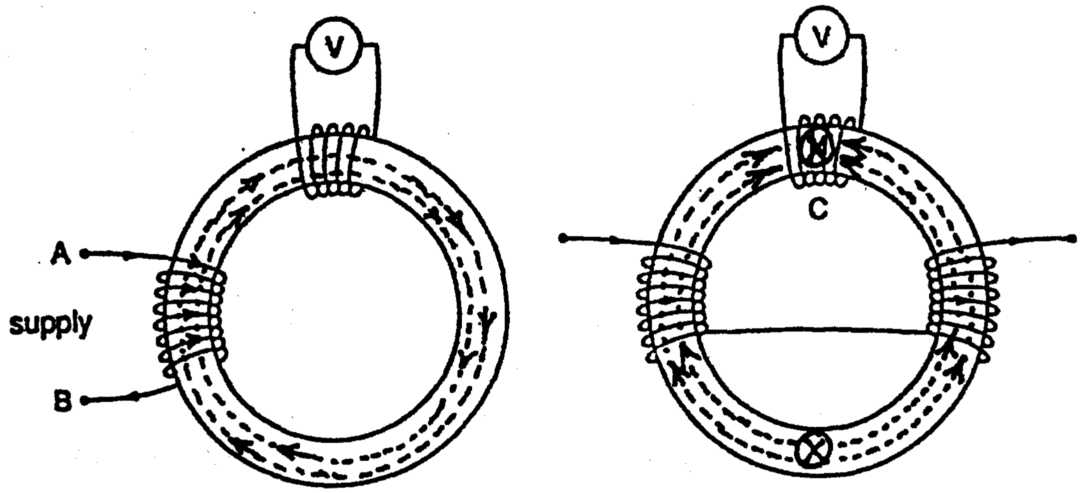
6. a -



b -



c - (i) There is no deflection in voltmeter because the magnetic flux through C does not change (because the current is direct).

(ii) There is no deflection because the two magnetic fields are equal and opposite producing a neutral point at C .

d - When there is a fault, the magnetic field due to coil D_1 is greater than that of D_2 and there is a net changing magnetic flux through C . This induces an a.c. current in coil C and magnetizes the soft-iron core which attracts the armature at P and opens the circuit.

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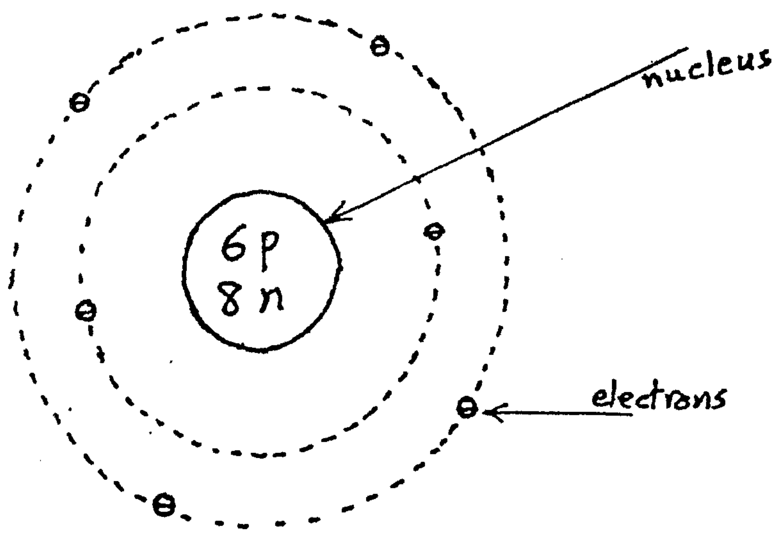
7. a -



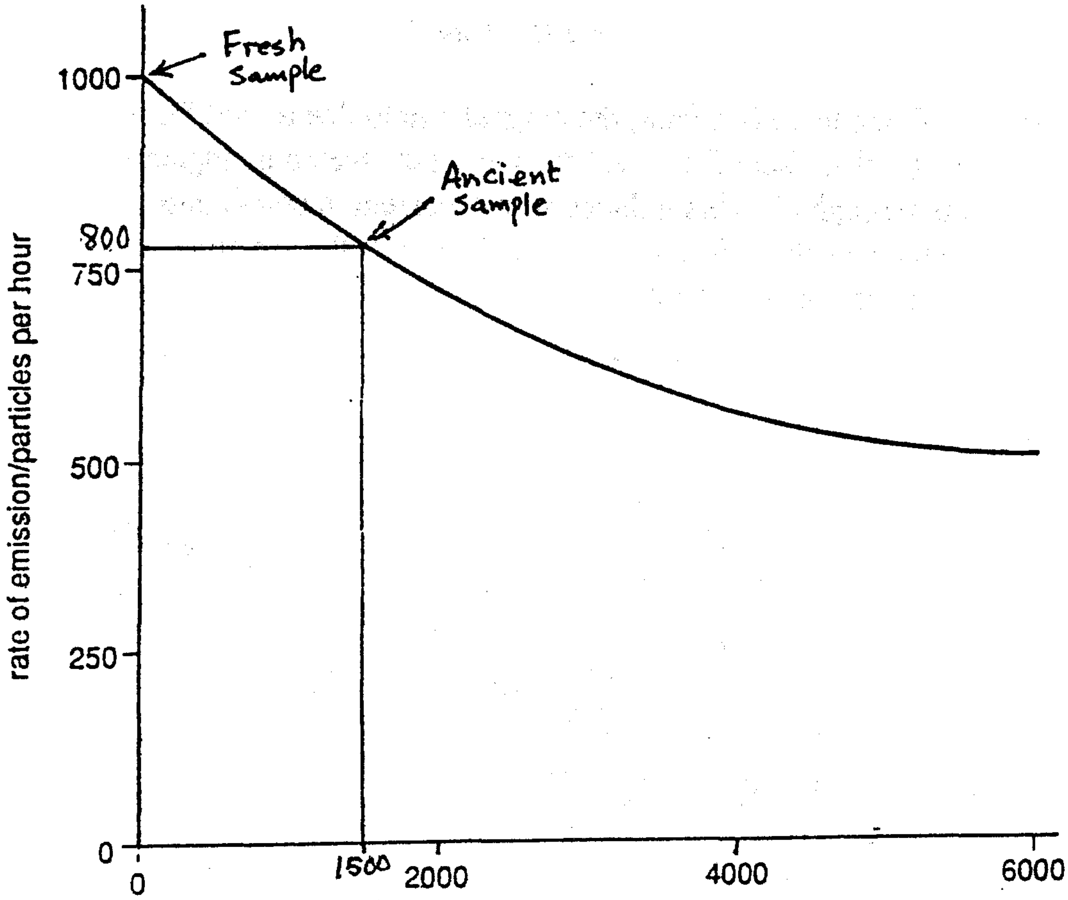
b - 1) Most of alpha particles passed through the metal foil in straight lines which indicates that most of the atom is empty space.

2) Some of the positive alpha particles are deflected side-ways due to the repulsion with the positive nucleus.

3) Few particles were scattered back which indicates that the nucleus is very small but very massive.

c - (i) The net count-rate for living sample = 1300 - 300 = 1000 c/h

" " " " " ancient sample = 1100 - 300 = 800 c/h



The age of the ancient sample is 1500 years.

(ii) 1) The fraction of ^{14}C is extremely small compared to ^{12}C, thus the amount of radiations is very small and hard to detect.

2) The half-life of ^{14}C is very long (5600 years) which means that the activity rate is very small and very hard to detect.

d - 1) The nuclear radiations cannot be detected by human senses, they need special detectors which are developed only lately.

2) The amounts of radioactive materials on earth are relatively small and their radiations cannot be noticed or detected easily.

Paper 6

1. 1) Place a metre rule in a vertical position on the bench by the help of a set square and keep it very close to the strip.
   2) Determine the height of the upper edge of the marked strip from the right side, then repeat to determine the height of the upper edge from the left side.
   3) If the two heights are equal this shows that the strip is horizontal.

   (85 mm mark is the midpoint between 80 and 90 marks)
   s = 23 mm
   d (card) = 100 mm
   d (diag) = 74 mm

   d (diag) / d (card) = 74 / 100 = 0.74

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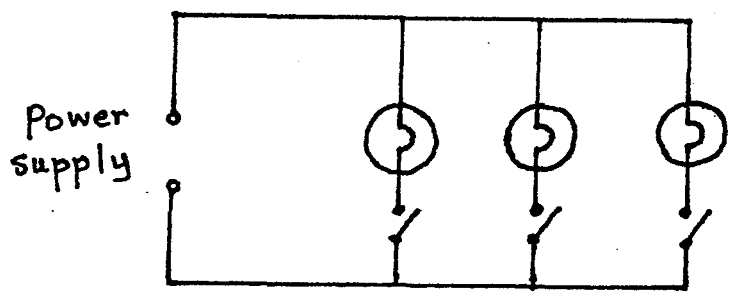
2. a -



b - (i) I is directly proportional to the number of lamps used.
(ii) When 2 lamps are used, I = 0.5 A
" 6 " " " , I = 1.5 A
Since the current has increased 3 times, the resistance should decrease by 3 times (R is inversely prop. to I)
∴ Resistance = 3000 / 3 = 1000 Ω

c - (i) An error may have occurred when taking the reading.
(ii) The lamp no. 8 was placed farther away from the LDR, therefore, not all its light can reach the LDR.
(iii) The relation between the current I and the number of lamps may not continue as a straight line, it may continue as a curve and reach saturation.

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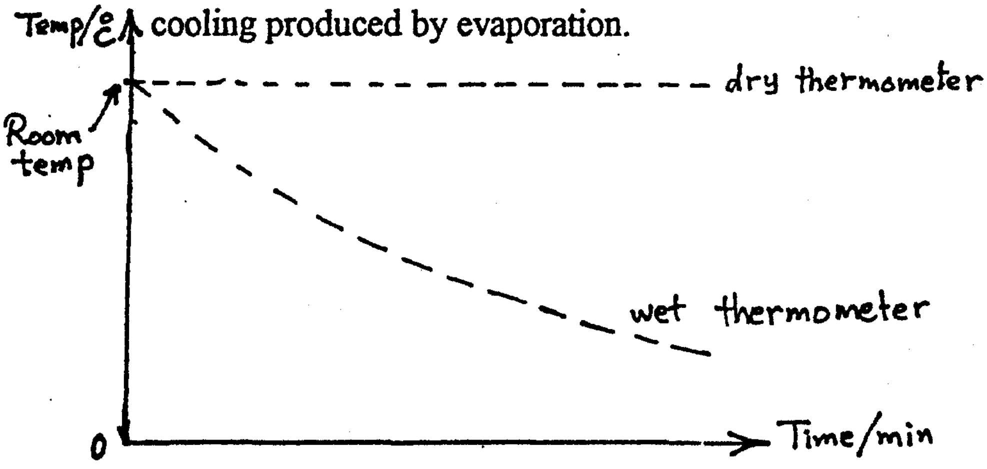
3. 1) Hang the bare thermometer in a clamp and notice that it reads the room temperature.
2) Dip the covered thermometer in the water at room temperature so that it also reads the same room temperature as the dry thermometer and hang it in the other clamp.
3) Start the stopwatch and record that the two thermometers are recording the same room temperature at the start.
4) Record the temperatures of the two thermometers at equal time intervals (say every two minutes).
5) After evaporation is completed, draw a graph of the results to notice that temperature of the dry thermometer remained constant, but that of the wet thermometer decreased due to the cooling produced by evaporation.



b- Temperature = 24.9 °C ≅ 25 °C

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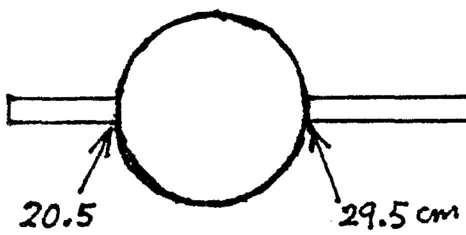
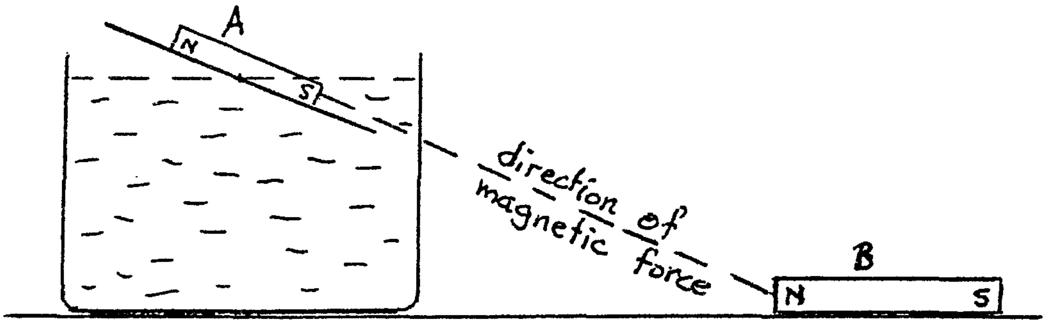
4. a - Place two pieces of wood, having the same thickness as the rule, below the vessel on both sides of the rule.
   A sticky tape can be used to attach the vessel from both sides to the metre rule.

   b - Place the vessel on the metre rule such that its diameter starts at the mark 20.5 cm and ends at the mark 29.5 cm.



   c - (i) Wood is a non-magnetic material which does not affect the magnetic field or magnetic force between the two magnets.

   (ii) The magnetic force between the two magnets will have a vertical component which can tilt the waxed cardboard disc, which may dip in the water. Magnet A may also move on the disc and slip in the water.

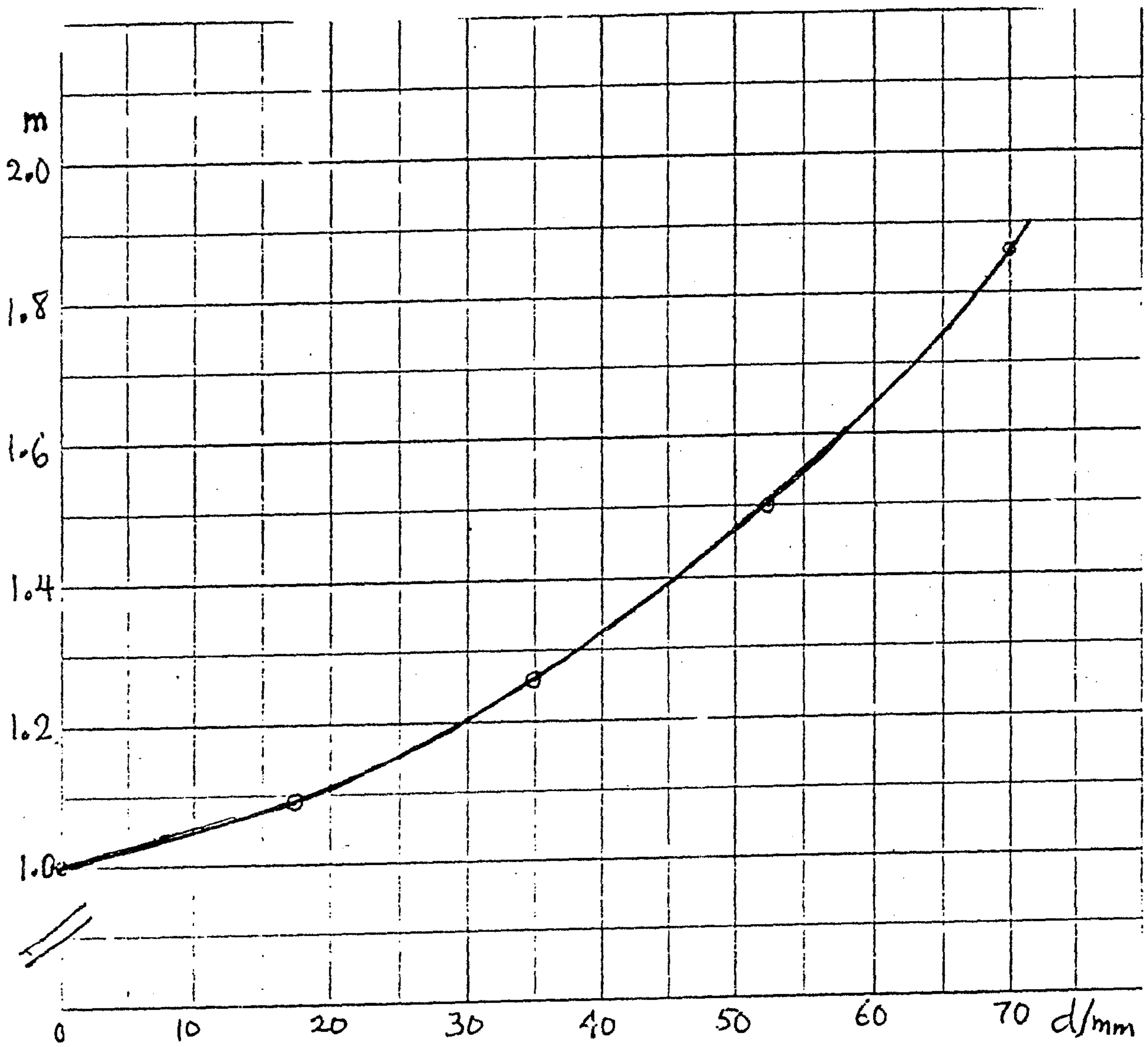


June 93 ... Paper 6

5. a - (i) 1.00 - 1.09 - 1.26 - 1.50 - 1.86

(ii) m is a ratio of two quantities having the same dimensions, therefore, m is dimensionless.

b -



c - (i) If the water touches the edge of the rule, the scale of the rule would be also magnified and the apparent width cannot be determined.

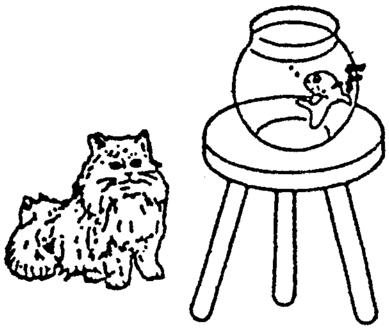
(ii) Water should be as deep as possible so that its surface would be near the scale, thus the apparent width of the image could be measured accurately by the nearby scale.

d - 1) Open the dividers such that one of its pins touches the centre of the black strip and the other pin touches the cylinder wall in a direction perpendicular to the rule.

2) Place the dividers on a rule and take two reading at the two pins. The difference between the two readings equals the distance d.

e - The length of the cylinder ℓ has no curvature (it is a straight line) therefore, it has no magnification.

f - The fish appears largest when d becomes maximum, i.e., at the farthest point from the cat.



NOV.

1993

Nov. 93

1	B	11	D	21	C	31	A
2	C	12	B	22	D	32	B
3	B	13	D	23	B	33	C
4	C	14	A	24	A	34	A
5	B	15	C	25	D	35	D
6	A	16	B	26	C	36	B
7	A	17	C	27	C	37	B
8	B	18	D	28	C	38	A
9	A	19	D	29	D	39	D
10	B	20	D	30	B	40	B

Paper 2

1. accelerating

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2. a - $R = B + W$
   b - moment of B equals moment of W (first box)

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3. a - Combined resistance $= 60 + 40 + 20$
   $= 120\ \Omega$
   b - $I = \frac{V}{R} = \frac{6}{120} = 0.05\ A$
   $V = IR = 0.05 \times 20 = 1\ V$

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4. a - We see bright specks moving in random directions against a dark background (this is due to the reflections of light on the smoke particles).
   b - The large smoke particle is surrounded by a large number of very small energetic air molecules which move very fast and hit the smoke particle from different directions causing it to move erratically (zig-zag motion).

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5. a - by radiation
   b - The hot air expands and becomes less dense so it rises up and leaves the projector case through the holes. It is replaced by cool air coming from the room (convection currents).
   c - The hole below the lamp allows the outside cool air to enter the projector case which helps the lamp to lose heat.
   d - At the large hole below the lamp, to increase the flow of cool air into the projector's case.

6.

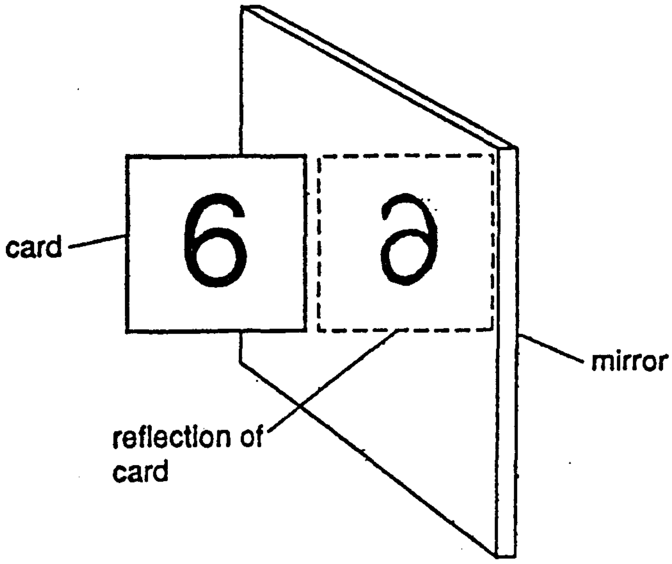

Fig. 6.1

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7. a - (second box)
   b - Carla's Attempt.

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8. a - (i) 84 (ii) 84
   (iii) 210 - 84 = 126
   b - protons and neutrons

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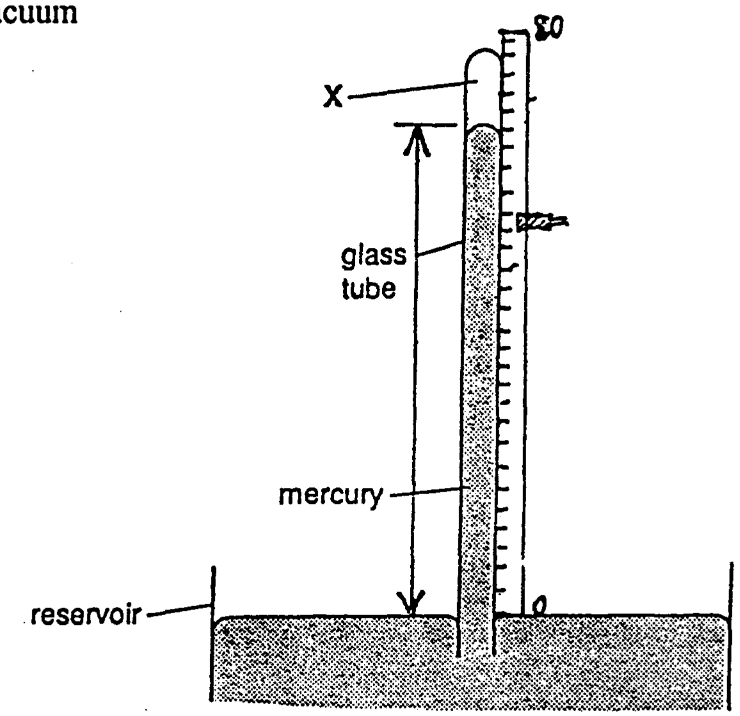
9. a - (i) P = F / A , The pressure is inversely proportional to the base area.

   The person wearing boots, with small area, produces a large pressure on the snow and he is likely to sink into snow. The person wearing skis, with large area, produces less pressure and he is <u>less</u> likely to sink.

(ii) $P = \dfrac{F}{A} = \dfrac{630N}{0.42m^2} = 1500\ N/m^2\ (Pa)$

b - (i) Vacuum

(ii)



(iii) 1) Move the scale until it touches the glass tube, and
2) lower the scale until the zero mark just touches the surface of mercury in the reservoir.

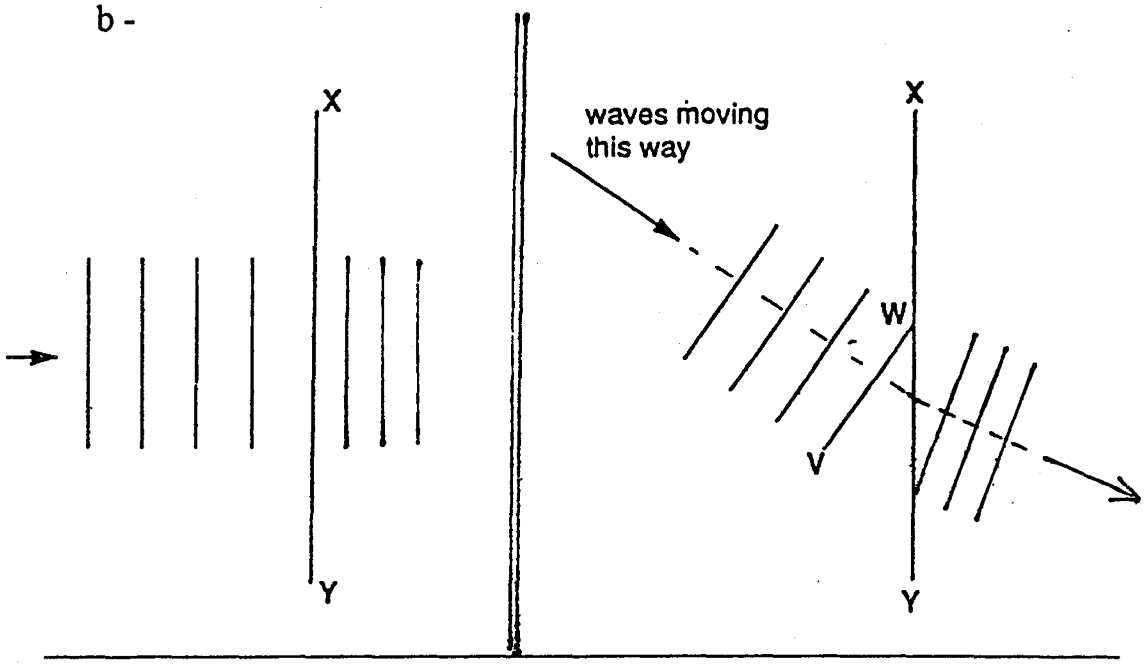
(iv) The mercury level in the tube rises,
" " " " " reservoir falls down a little.

(v) Lower the scale again until it just touches the surface of mercury in the reservoir.

10.a - (i) B shows the wavelength
D " " amplitude

(ii) Light waves (and all EM waves)

b -



11.a - (i) Move the magnet rapidly through the coil inwards then outwards.

(ii) The galvanometer will be deflected momentarily during the motion.

b - (i) The square frame is the core

(ii) soft iron

(iii) The primary a.c. voltage produces a continuously changing magnetic field in the primary coil. This changing magnetic field passes through the iron core to the secondary coil where it induces an a.c. voltage in the secondary coil causing the lamp to light up.

(iv) $$\frac{V_1}{V_2} = \frac{N_1}{N_2}, \text{ or } \frac{V_1}{12} = \frac{500}{100}$$

$$\therefore V_1 = \frac{500 \times 12}{100} = 60 \text{ V}$$

(v) Alternating

12.a - Line B

b - Red, orange, yellow, green, blue, indigo, violet

c - Dispersion of light

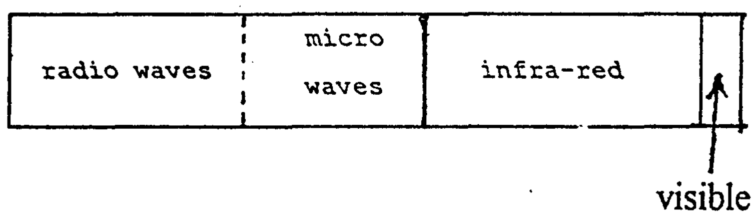
d - (i) radio, infrared, visible, ultra-violet, X-rays, gamma rays.

(ii) infra-red : from the sun or electric fire
used for heating and in T.V. remote control

gamma ray : from radioactive elements
used for sterilization or treatment of cancer

ultra - violet : from the sun or mercury lamps
cause sun-tan and produce vitamins in the skin

(iii)



Paper 3

1. a- (i) because y is deeper that x
   (ii) The pressure at x produces a downward force, and
   " " " y " an upward force which is greater, therefore, the resultant force is upward.
   (iii) The resultant upward force is greater than the weight of the bubble, therefore, it will rise up to the surface.

   b - (i) 1) V (total) $= 100 + 50 = 150 \text{ cm}^3$
   2) $m = \rho \times V$
   $= 1 \times 150 = 150 \text{ g} = 0.15 \text{ kg}$
   3) $W = m g$
   $0.15 \times 10 = 1.5 \text{ N}$
   4) upward force $= W = 1.5 \text{ N}$
   (ii) 5) " " $= 1.5 \text{ N}$
   6) Weight of liquid displaced $= 1.5 \text{ N}$
   7) mass of hot liquid $= \dfrac{W}{g} = \dfrac{1.5}{10} = 0.15 \text{ kg}$
   $= 150 \text{ g}$
   total Volume $= \dfrac{m}{\rho} = \dfrac{150}{0.9} = 166.7 \text{ cm}^3$
   8) Volume of hot liquid displaced by the balloon
   $= 166.7 - 50 = 116.7 \text{ cm}^3$

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2. a - 1) Place a mark (or small piece of gummed paper) on the end of the wire below the magnifying glass and record its reading on the scale (R_1)
   2) Place a weight of several newtons (W) on the variable weights and record the new reading of the mark (R_2)
   3) The extension of the wire $= R_2 - R_1$
   4) " " " " " per newton of weight $= \dfrac{(R_2 - R_1)}{W}$

   b - 30 N load produces an extension of 5 cm
   20 N " " " " " χ
   $$\chi = \frac{20 \times 5}{30} = 3.33 \text{ cm}$$

Case (a)

Spring 1 : The extension = $\frac{3.33}{2}$

= 1.67 cm

because it is extended by half the load only, i.e., a load of 10 N produces an extension of 1.67cm

Spring 2 : (same value and same reason as above)

Case (b)

Spring 1 : extension = 3.33 cm

because it is extended by the whole 20 N load

Spring 2 : (same value and same reason as above)

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3. a - (i) Work done = F x d
$= 100 \times 8000 = 800\,000$ J

(ii) Energy used = m g h
$= (60 \times 10 \times 4) \times 4 = 9600$ J

(iii) Work done = F x d
$= 50 \times 8000 = 400\,000$ J

(iv) Work done = F x d
$= (70 \times 50) \times 20 = 70\,000$ J

Total work done $= 800\,000 + 9600 + 400\,000 + 70\,000$
$= 1\,279\,600 \text{ J} \cong 1.3 \times 10^6$ J

b - Work efficiency $= \frac{1.3\times10^6}{2(6.5\times10^6)} = 0.1$

The work done by the student during the day is only one tenth of the energy obtained from his meals. His food is more than enough.

c - Energy given off during one day = P x t
$= 100 \times (24 \times 60 \times 60)$
$= 8.64 \times 10^6$ J

$$\frac{\text{energy given out as heat}}{\text{energy intake from meals}} = \frac{8.64\times10^6}{13\times10^6} = 0.66$$

This value could be reduced by wearing heavier clothes to reduce heat loss from his body,

or by warming up the environment which reduces the heat lost from his body.

---

4. a - (i) speed of sound wave = f x λ

$$330 = 256 \times \lambda$$

$$\text{wavelength} = \frac{330}{256} = 1.29 \text{ m}$$

(ii) In 1 sec. the source produces 256 waves

in 0.01 sec. " " " χ "

$\chi = 256 \times 0.01 = 2.56$ waves

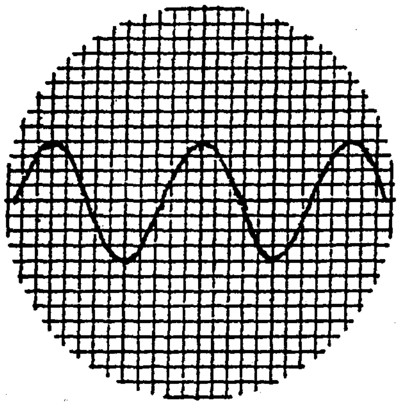


Fig. 4.2

(iii) 1) No waves are shown on the screen because sound cannot travel in vacuum.

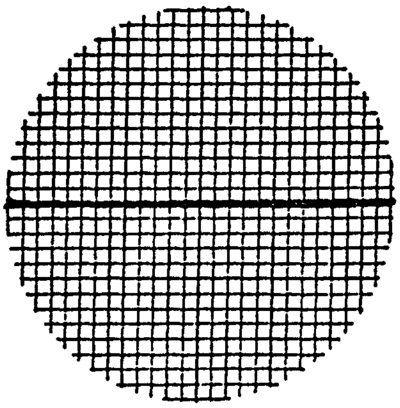


Fig. 4.3

2) **The same source has the same frequency, thus the number of waves on the screen is the same (2.56 waves), though the amplitude will be damped.**

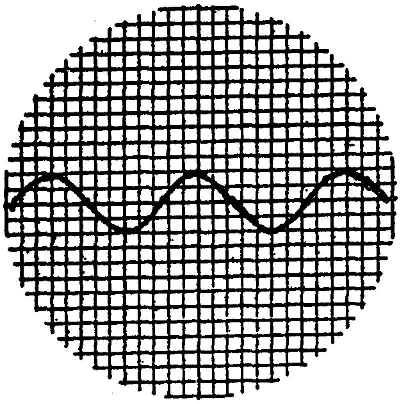


Fig. 4.4

(iv) The total power = Power per unit area x total area

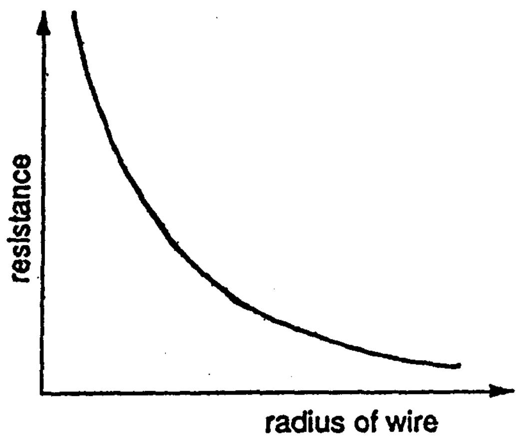
$$= (1.0 \times 10^{-12} \frac{W}{m^2}) \times (1.2 \times 10^5 \ m^2)$$

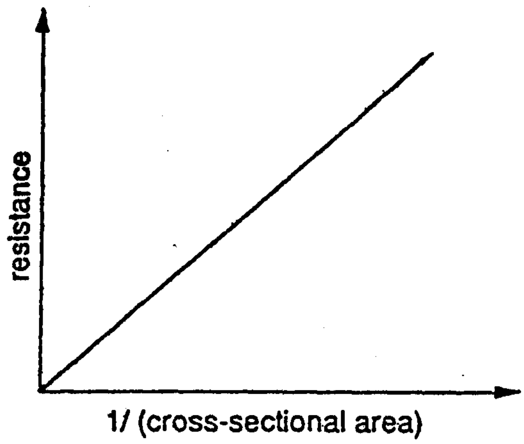
$$= 1.2 \times 10^{-7} \ W$$

The calculated power is less than the power emitted by the bird because some of the emitted power is absorbed by the air.

5. a (i) $$R = \frac{V}{I} = \frac{0.55}{0.25} = 2.20 \ \Omega$$

(ii)





b - 1) The arrangement of Fig. 5.3 is better, because the thermometer measures the temperature of the test wire as it reaches a steady state due to heat production and heat loss.

2) The arrangement of Fig. 5.4 is not correct, because the thermometer is measuring the temperature of the oil not that of the wire. This temperature depends on the mass of oil used and on its type (its specific heat).

c - (i) $$I = \frac{V}{R} = \frac{250}{500} = 0.5 \ A$$

(ii) $$P = IV = 0.5 \times 250 = 125 \ W$$

6. a - (i) a momentary deflection in the galvanometer.
Reason : The magnetic field produced in coil no. 1 induces a momentary current in the coil no. 2.
(ii) no deflection in the galvanometer, it remains at zero.
Reason : The magnetic field in coil no. 1 remains constant, it does not induce any current in 2 because it does not change.
(iii) a momentary deflection in the opposite direction.
Reason : When the magnetic field of coil no. 1 disappears, it induces a momentary current in coil 2 in opposite direction.

b - There will be a continuous steady deflection in the voltmeter of circuit no. 2.
Reason : The a.c. supply produces a continuously changing magnetic field in coil no. 1 which induces an a.c. voltage in circuit no. 2 which will cause a steady deflection in the voltmeter.

c -

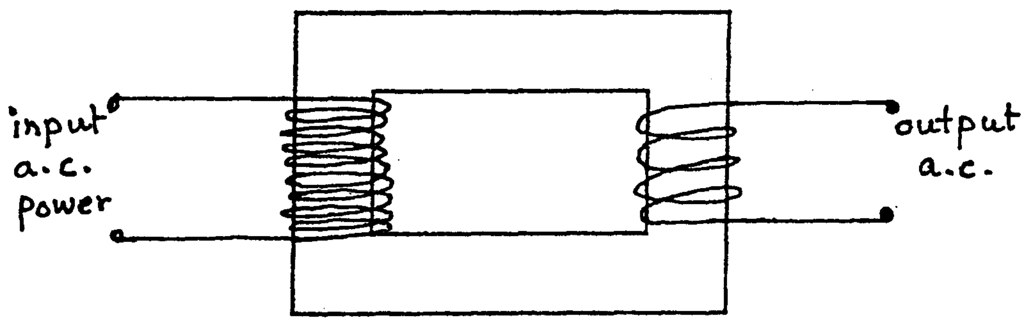


Fig. 6.3

1) The d.c. battery is replaced by an a.c. supply.
Advantage : a.c. supply produces a continuously changing magnetic field which produces continuous a.c. voltage in the secondary coil.
2) A soft iron core is linking the primary and secondary coils.
Advantage : All the magnetic flux of the primary coil can reach the secondary coil through the iron core thus increasing induced e.m.f.

d - Circuit (b) is less expensive ; when the switch is open, no current can flow in the primary or secondary circuits.
In circuit (a), the open switch stops the current in the secondary coil only, but the current continues to flow in the primary circuit.

---

7. a - 1) Record the counting rate without a source to determine the background rate.
2) Record the counting rate with the source in front of the detector (with no absorbers).
3) Place the absorber between the source and the detector, then determine the new counting rate with the absorber.

b - (i) Beta rays
(ii) 1) Alpha-radiation is rejected, because in its case the curve should drop to zero suddenly when aluminium is used.
2) Gamma-radiation is rejected, because in its case the curve does not drop to the background by aluminium absorbers.
(iii) This is due to background radiations.

c - 1) $$\text{Efficiency} = \frac{\text{output power}}{\text{input power}} \times 100$$

$$30 = \frac{7.5 \times 10^7}{\text{input power}} \times 100$$

$$\text{input power} = \frac{7.5 \times 10^7 \times 100}{30} = 2.5 \times 10^8 \text{ W}$$

2) This power is produced due to conversion of mass into energy.

$$E = m\,C^2$$

$$P = \frac{m}{t}\,C^2$$

$$\frac{m}{t} = \frac{P}{C^2} = \frac{2.5 \times 10^8}{(3 \times 10^8)^2} = 2.8 \times 10^{-9} \text{ kg/s}$$

Paper 6

1. a - (i) $t_1 = 1.50$ s

(ii) $t_{20} = 20.50$ s

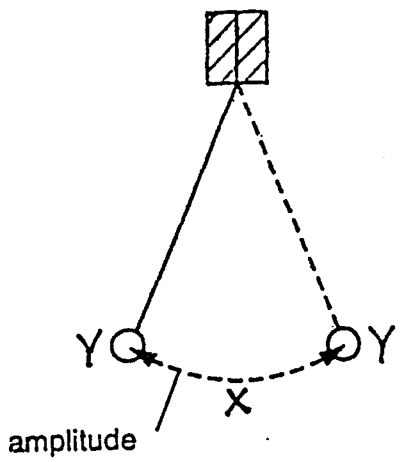
$$T = \frac{20.50}{20} = 1.025 \text{ s} = 1.03 \text{ s}$$

(iii) so that the error in measurement would be divided by the number of oscillations which reduces the error and gives a more accurate result.

b - (i) maximum speed is at the central point.

(ii) minimum speed (zero) at the two extreme points.

c - This is the rest position from which the motion starts. One complete oscillation is started when bob passes through its rest position (the line on the cord) then it returns back passing through the same point in the <u>same</u> direction.



---

2. a - $\propto = 27°$

b - 1) Place a ruler on the bench in a vertical position, by the help of a set square, such that it is adjacent to the point A.

2) Take the reading of the scale at the point A, with the line of sight of the eye perpendicular to the ruler to avoid the error due to parallax.

3) Notice that the zero mark of the scale should be touching the bench, if there is any zero error it should be taken care of.

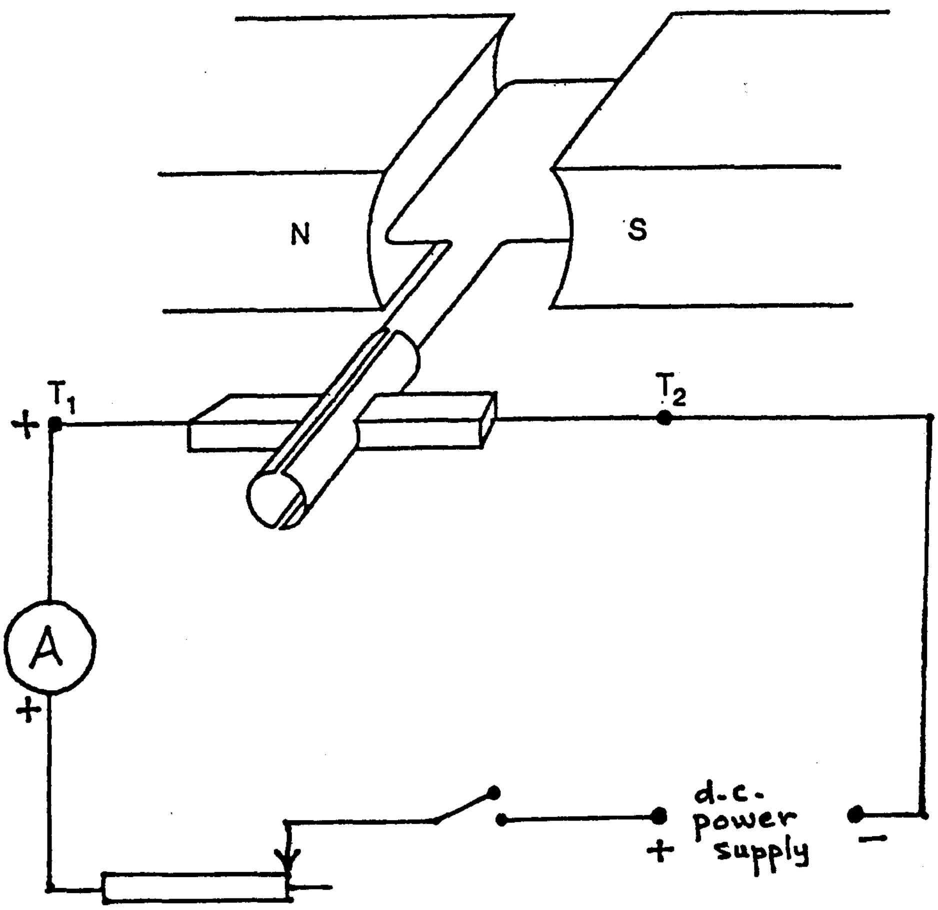
4) Repeat the above steps three times, then get the average value of the three measurements.

Nov. 93 ... Paper 6

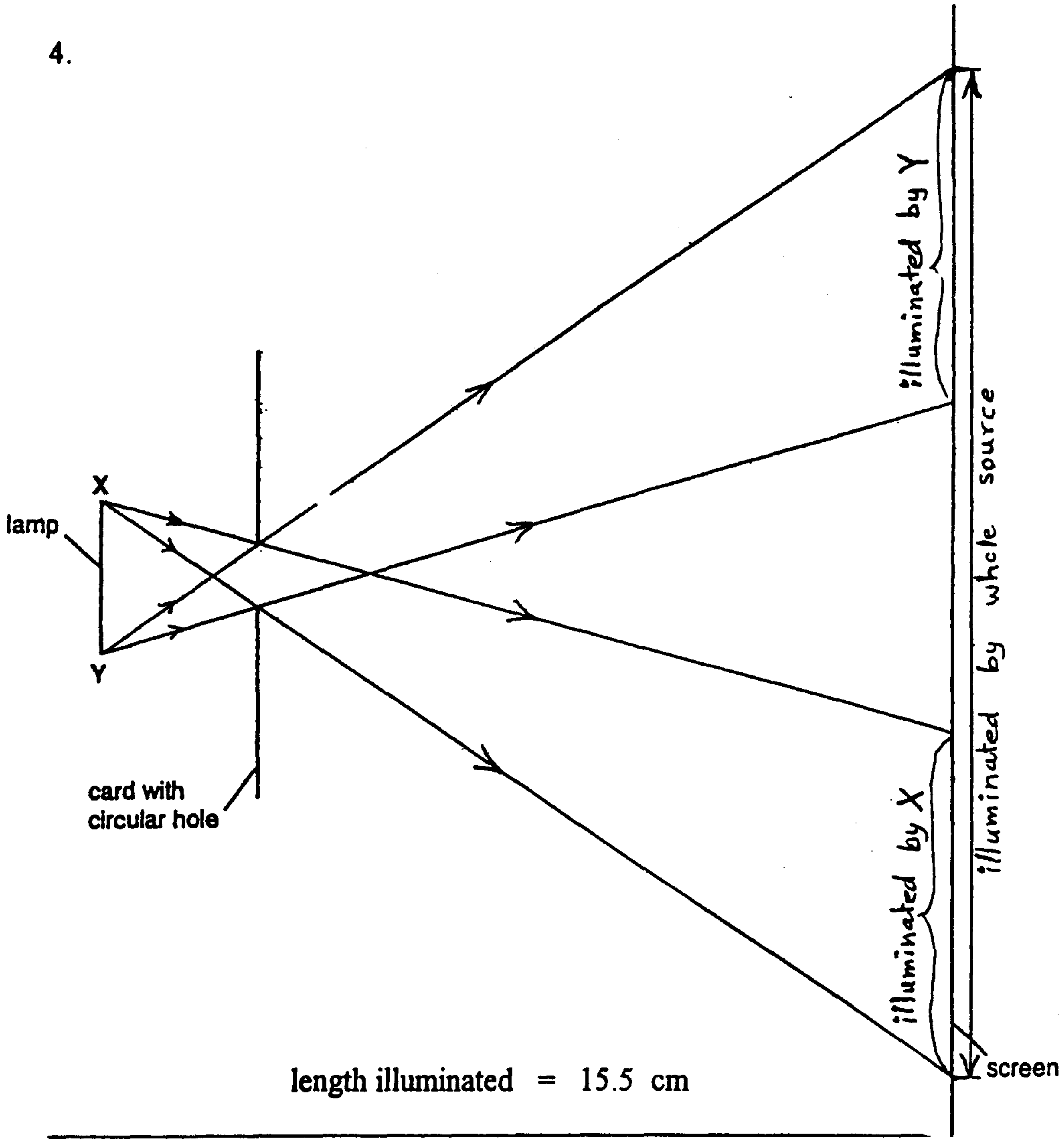
c - (i) The number of spaces = 29 - 1 = 28
The time taken = 28 x 0.02 = 0.56 s

(ii) The spacing of the dots on the tape is increasing, which indicates that the speed is increasing and the trolley is accelerating. The rate of the velocity change is not constant, thus the acceleration is not constant but it is gradually increasing.

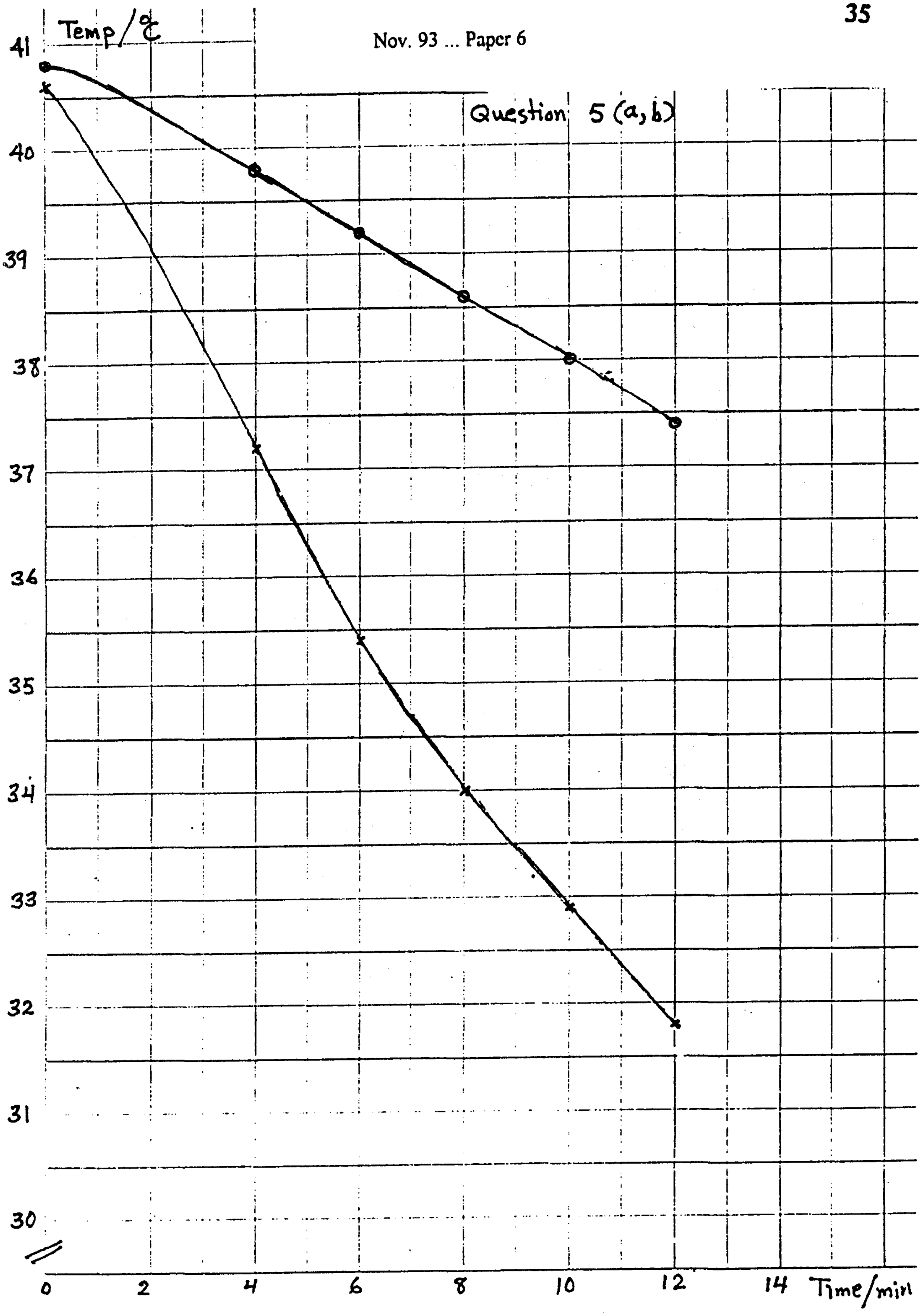
3.



4.



length illuminated = 15.5 cm


Temp/°C
Question 5 (a, b)
41
40
39
38
37
36
35
34
33
32
31
30
0
2
4
6
8
10
12
14
Time/min

c - Temp. drop of water in 10 mins. = 40.6 - 32.9 = 7.7 °C

" " " eggs " " " = 40.8 - 38.0 = 2.8 °C

The temperature drop of water in 10 mins. is much greater than that of the eggs.

d - (i) Eggs are living matter which can produce heat, but water is not.

(ii) Cups are open from the top which increases the heat loss, eggs are completely covered with their shells.

e - The white surface of the egg shell reflects heat radiations back and helps to reduce the heat losses.

f - 1) The drop in temperature of the eggs during the first ten minutes of cooling $\theta_E = 2.8$ °C

While the drop in water temp. during the same period, $\theta_w = 7.7$ °C

2) The ratio of temp. drops in the first ten minutes of cooling,

$$\theta_E / \theta_w = \frac{2.8}{7.7} = 0.36$$

This means that the temp. drop of eggs is about one third of the temperature drop for water over the same period.

3) There is no reason to worry that the eggs would get too cold during ten minutes, because their heat losses are much smaller than the heat loss of similar ordinary materials like water.

JUNE

1994

June 94

1	A	11	C	21	B	31	D
2	D	12	A	22	D	32	C
3	B	13	A	23	B	33	D
4	D	14	A	24	D	34	A
5	C	15	B	25	B	35	D
6	A	16	D	26	D	36	B
7	D	17	D	27	C	37	A
8	B	18	A	28	C	38	C
9	D	19	A	29	A	39	B
10	C	20	C	30	B	40	D

Paper 2

1. a- 10.8 s
   b- 10.8 / 40 = 0.27 s
   c - The drops are accelerated due to gravity, the velocity increases, and the distances travelled in equal time intervals are increasing.

---

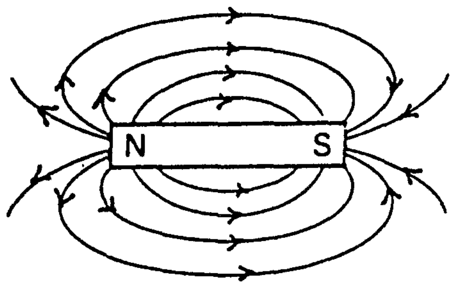
2. a- Kg is the unit of mass.
   b- $\rho = \frac{m}{V}$

$$= 5 / (6.4 \times 10^{-4}) = 7812.5 \ \ kg / m^3$$

---

3. a- Chemical energy
   b- Gravitational potential energy
   c - It is converted to internal energy (heat) in her body, also some heat energy and sound energy due to friction of her feet with the stairs.

4.



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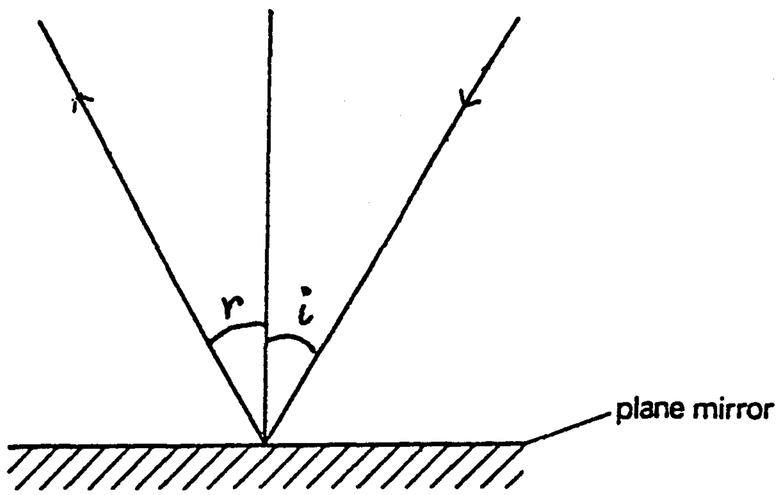
5. a - Rub the rod with the cloth several times
   b - Bring the rod near tiny pieces of paper, they will be attracted to the rod.

---

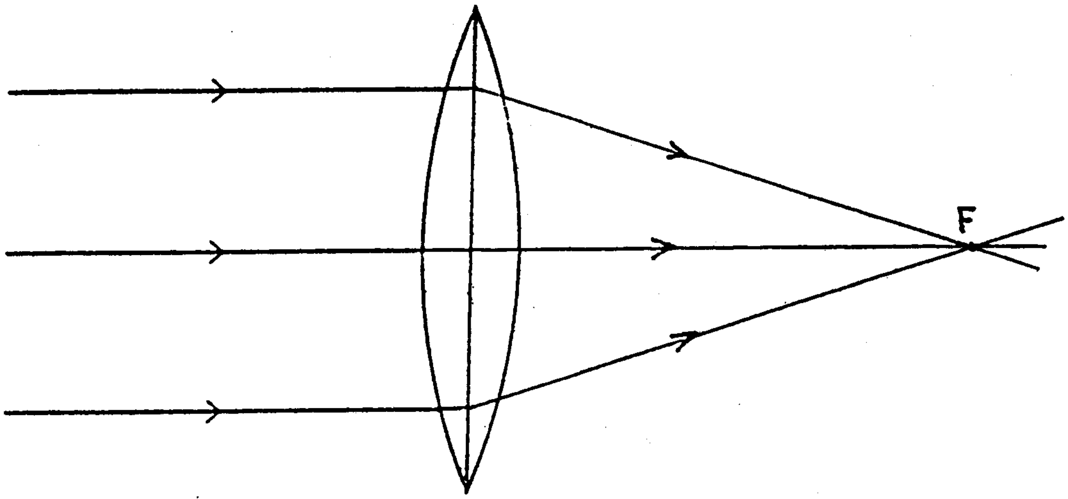
6. (a - , b -)



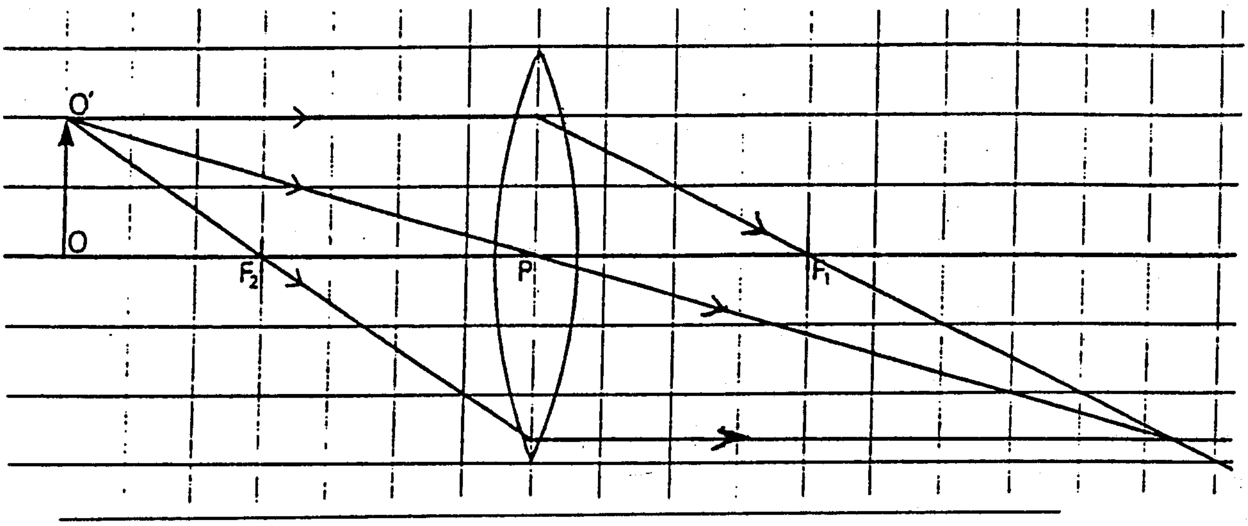
   c - The angle of reflection equals the angle of incidence.

---

7. a -



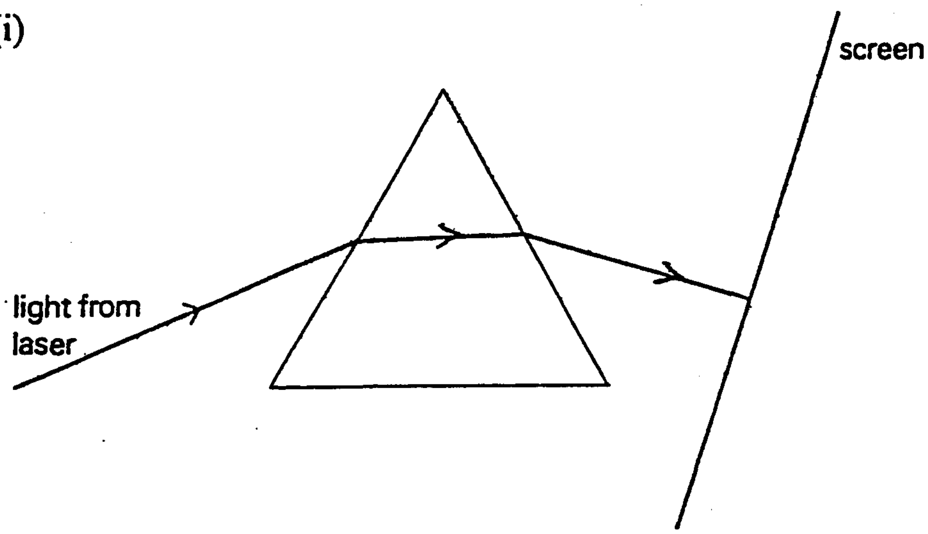
b -



8. a - 86
b - 222
c - (third box) $^{222}_{86}Ra$

---

9. a - (i)



(ii) A spectrum made of seven colours is seen on the screen, with the red at the top and violet at the bottom.
The colours are : red, orange, yellow, green, blue, indigo & violet.

b - (i) (left frame) infra-red
(right frame) X - rays

(ii) ... vacuum.

10\. a - (i) 7.0 mA = 0.007 A

(ii) 2.8 V

(iii) R = V / I

= 2.8 / 0.007 = 400 Ω

b - (i) It will be halved (= 3.5 mA)

(ii) It will be halved (= 1.4 V)

(iii) It remains the same. (no change)

11\. a - 108 / 3 = 36 count / min

b - (i) alpha rays

(ii) 864 / 3 = 288 count / min

288 - 36 = 252 count / min

(iii) After 5 hours the source gives half the count-rate.

New count-rate of source = 252 / 2 = 126 count / min

Count rate measured = 126 + 36 = 162 count / min

Total Counts in 3 minutes = 162 x 3 = 486 count / min

---

12. a - (i) time = 2d / v

= (2 x 385) / 350 = 2.2 s

(ii) The sound wave is reflected at A and returns back producing an echo, it is also reflected at C producing another echo.

Time of second echo = 2d / v

= (2 x 700) / 350 = 4 s

Interval between the echoes = 4 - 2.2 = 1.8 s

b - (i) wavelength = 0.5 m , frequency = 680 Hz

v = f x λ

= 680 x 0.5 = 340 m / s

(ii) λ = v / f = 340 / 100 = 3.4 m

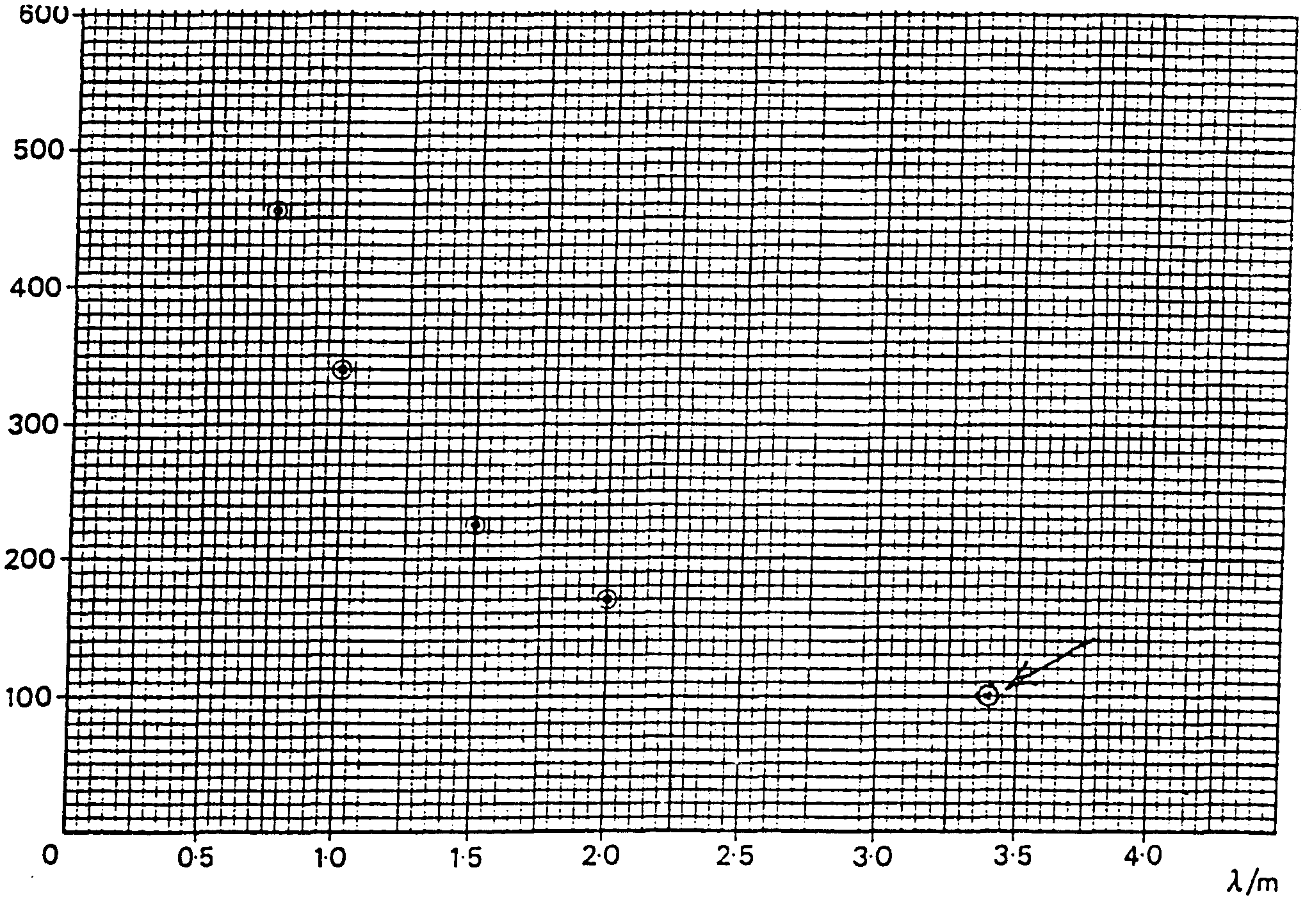
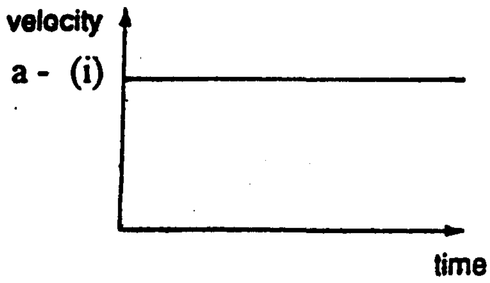


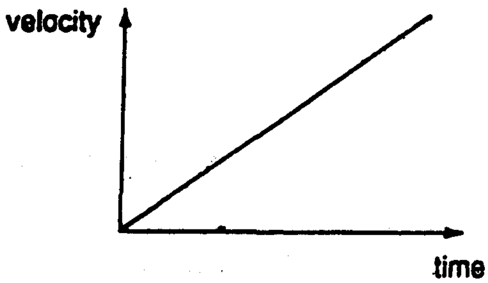
Fig. 12.2

Paper 3

1. a - (i)



shows uniform velocity



shows uniform acceleration

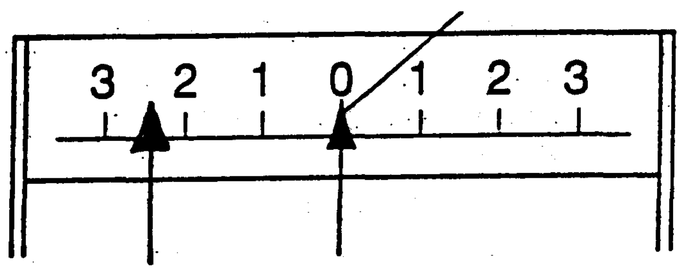
(ii) The velocity increases as a straight line which indicates that the acceleration is uniform.

b - (i) The force opposing the motion is the force of friction and it equals 0.10 N.

(ii) Accelerating force = m x a
= 0.64 x 0.25 = 0.16 N

Total force in the string = 0.16 + 0.10 = 0.26 N

c - (i)



(ii) When the truck accelerates in the forward direction, the block remains stationary due to its inertia, so the pointer appears as if it is moved backwards.

(iii) This decreases the displacement of the pointer on the scale.

* The two springs should be identical, and they should be extended (or compressed) in their elastic regions.

2. a - $\frac{V_1}{T_1} = \frac{V_2}{T_2}$, or , $\frac{6000}{293} = \frac{V_2}{343}$

$\therefore \; V_2 = \frac{6000 \times 343}{293} = 7024 \;\; cm^3$

b - Amount of escaping air = 7024 - 6000 = 1024 cm^3

The escaping fraction = $\frac{1024}{7024} = 0.146$

c - (i) Mass of cold air = $\rho \times V$ = 1.3 x 250 = 325 kg

(ii) Mass of hot air = 0.975 x 250 = 243.75 kg

(iii) Upward force = (325 - 243.75) x 10 = 812.5 N

d - (i) The number of molecules of less dense air is smaller, but because their temperature is higher, their average K.E. and average velocity are greater. The smaller number of molecules collides with the walls harder and more frequent so their pressure is equal to the pressure of the greater number of molecules but with smaller average K.E. and velocity.

(ii) Fast moving molecules of the hot air inside the balloon collide with the slower molecules of cool air, they lose some of their K.E. Their average K.E. decreases and their temperature falls so they cool down.

3. a - (i) 240 V is the maximum potential difference of the mains supply used for the heater.

The frequency of the a.c. supply is 50 Hz, or it is 50 cycles each second.

The power consumed by the heater is 2000 W, or 2000 J each second.

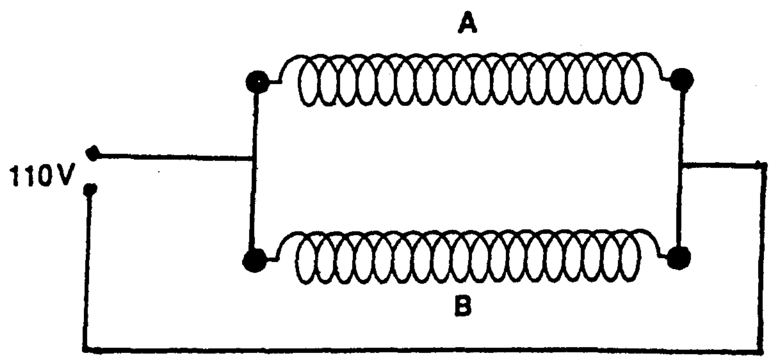
(ii) The metal case of the appliance should be connected to a thick copper wire going to the earthing cable.

(iii) It is a safeguard against accidental short circuits which may cause fire or electric shocks. The earthing wire takes the electric current to earth which blows the fuse and switches off the circuit.

b - (i) $I = P / V = 2000 / 240 = 8.33\ A$

(ii) $R = V^2 / P = (240)^2 / 2000 = 28.8\ \Omega$

c -



4. a - (i) A : The hot filament is used to heat the cathode.
B : The cathode emits electrons when it is heated.
C : The grid has a negative potential which controls the number of electrons reaching the screen, it controls the brightness of the screen.
D : The deflecting plates can deflect the electron beam in horizontal and vertical directions.

(ii) $Q = I \times t = (1.0 \times 10^{-4}) \times 1 = 1.0 \times 10^{-4}$ C

$$\text{No. of electrons} = \frac{\text{total charge}}{\text{charge of one electron}}$$

$$= (1.0 \times 10^{-4}) / (1.6 \times 10^{-19}) = 6.25 \times 10^{14}$$

(iii) The electron is accelerated by the anode, thus its kinetic energy increases. When it hits the screen, its kinetic energy is converted to internal energy and light.

b - 1. The time-base circuit connected to the X-plates moves electron beam rapidly with high frequency in the X-direction.
2. The changing voltage of the a.c. generator connected to the Y-plates causes the electron beam to move up when p.d. is positive and down when p.d. is negative.
3. The superposition of the two motions, in the X and Y directions, produce the trace displayed on the screen.

5. a - (i) alpha only : The area under the hole is blackened because it is affected by alpha particles, other areas are not affected.

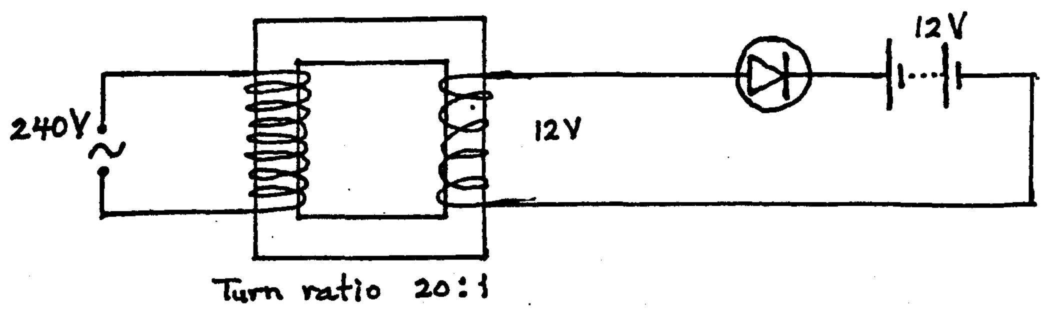
(ii) beta only : The areas under the hole and aluminium are blackened due to effect of beta rays. There is no blackening under the lead.

(iii) gamma only : All areas are blackened by different shades. It is darkest under the hole and least blackening under the lead because lead absorbs some of the gamma rays.

b - The badge shows the accumulated dose of radiations over a long period of time, it cannot show the intensity of radiations at a certain moment.

---

6. a -



b - (i) battery C

Power = V I, and for C the power = 192 W which is the greatest.

(ii) battery A

because it has the highest capacity
(capacity = current x time)

c - (i) $R = \frac{\text{product}}{\text{sum}} = \frac{12 \times 6}{12 + 6} = \frac{72}{18} = 4\ \Omega$

(ii) $R_{total} = 20 + 4 = 24\ \Omega$

$I = V / R = 3 / 24 = 0.125\ A$

(iii) $\rho = R\,a / L$

$$\therefore\ \rho = \frac{6 \times 16}{5} = \frac{12 \times 1}{L}$$

$L = (5 \times 12 \times 1) / (6 \times 16) = 0.625\ m$

<u>another solution</u> :

5 m of Q of area 16 units has $R = 6\ \Omega$

5 m of P " " 1 unit has $R = (6 \times 16)\ \Omega$

L m of P " " 1 unit has $R = 12\ \Omega$

now,

$$L = (5 \times 12) / (6 \times 16) = 0.625\ m$$

(iv) The resistance of the voltmeter is very large, so it reduces the parallel resistance by a very small amount, which will increase the current very little. This small effect is usually neglected.

Paper 6

1. a - The missing masses are :
   0 , 15 , 30 , X , 45 , 60

   b - X is greater than <u>30</u> g but less than <u>45</u> g .

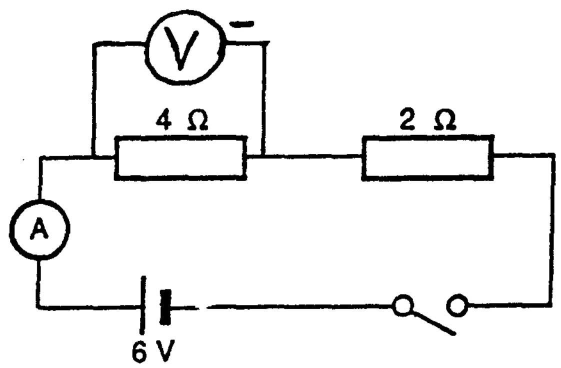
   c - 1. Draw a graph between the mass of object in grams (on the X-axis) and the time taken for 10 oscillations in seconds (on the y-axis) .
   2. At the value 7.3 on the y-axis draw a horizontal line which intersects the graph at a point P.
   3. From the point P draw a vertical line which intersects the x-axis at the value of the mass of bird .

---

2. a - 1.0 A

   b - (i) and (ii) are possible .
   (iii) is <u>not</u> possible .

   c - To increase the current in a circuit requires a decrease in the total resistance . Adding a switch (or any component) in series can <u>never</u> reduce the total resistance, so it cannot increase the current .



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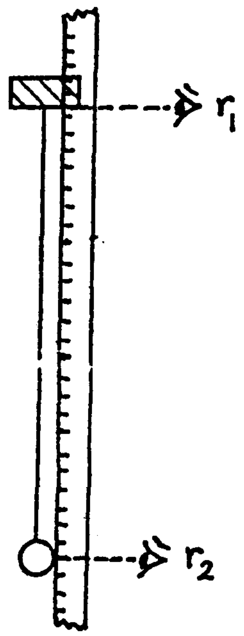
3. a - (i) The thermometer measures in Celsius degrees .
(ii) $-10\ ^\circ C$
(iii) one third the length of thermometer $\cong$ 9.2 cm
vertical depth of water = 8.8 cm
diagonal " " " $\cong$ 10 cm
One can immerse one third of the thermometer in the water if it is tilted in the diagonal direction .

b - 1. because the scale of the thermometer starts at $-10\ ^\circ C$ and cannot measure at $-20\ ^\circ C$
2. also, to avoid the change of state region when ice changes into water when it reaches $0\ ^\circ C$.

c - (i) The rate of heat absorption of the cup exposed to air is the greatest, while the rate of heat absorption of the "covered" cup is the least .
The cup wrapped with the cool bag is in between but closer to the exposed cup .
(ii) One should wrap the frozen food with the cool bag tightly such that no air remains inside the bag .

---

4. a - 1. Place the metre rule very close to the pendulum (away from the damaged parts).
   2. Take a reading r_1 at the upper end of the string .
   3. Take another reading r_2 at the point where the bob touches the rule .
   4. $\ell = (r_2 - r_1)$



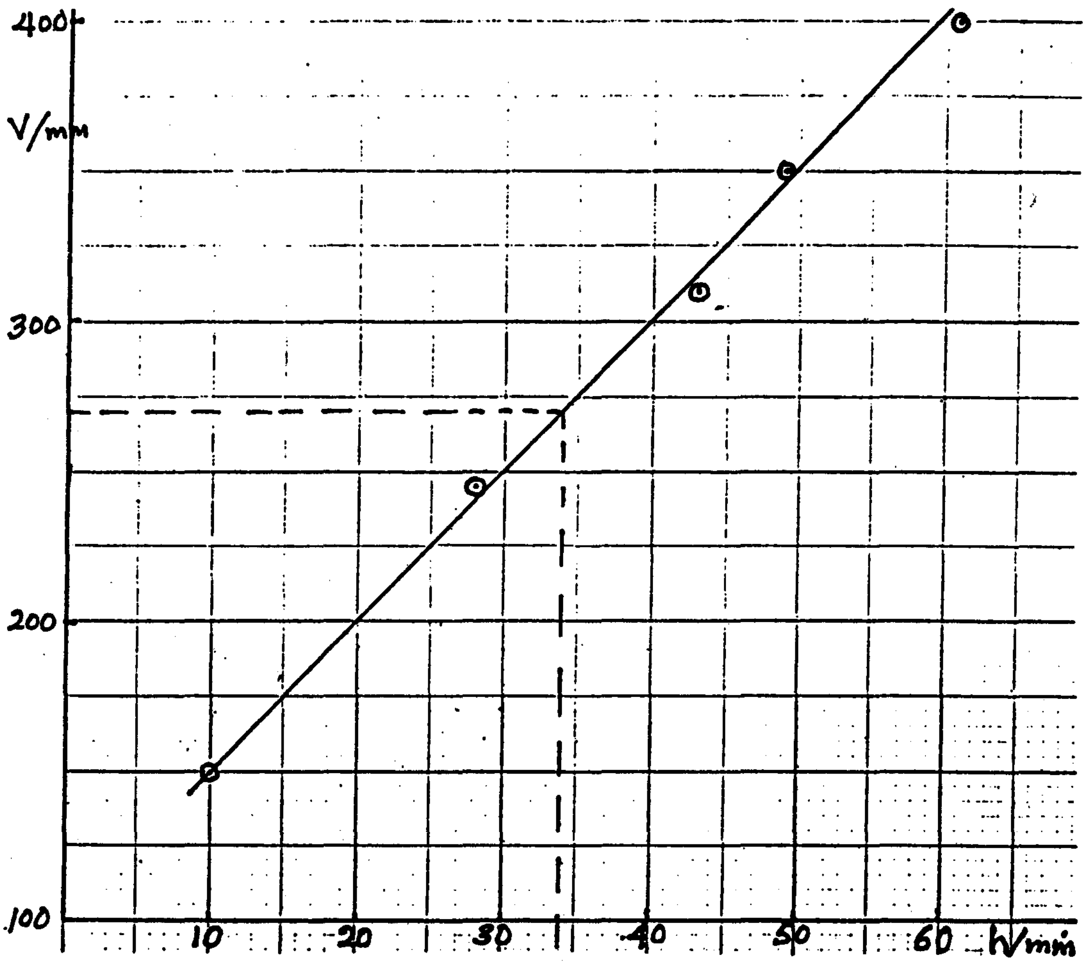
b - It measures the length to the nearest mm .

c - The length ℓ = 10 cm = 100 mm , and the error in measurement is about 1 mm . This means that the error does not exceed 1 % which is reasonably good .

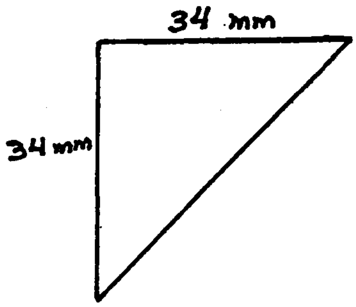
d - With a clamp and a stand the rule is held steady in its position during the measurement . Without a clamp and a stand the rule can move up or down during the measurement which introduces errors .

June 94 ... Paper 6

5.



b - When v = 270 mm , h = 34 mm



NOV.

1994

Nov. 94

1	C	11	A	21	D	31	C
2	D	12	C	22	B	32	B
3	A	13	B	23	C	33	D
4	D	14	C	24	D	34	C
5	C	15	A	25	D	35	D
6	B	16	C	26	C	36	A
7	A	17	C	27	B	37	B
8	D	18	A	28	B	38	C
9	D	19	A	29	B	39	C
10	B	20	D	30	D	40	A

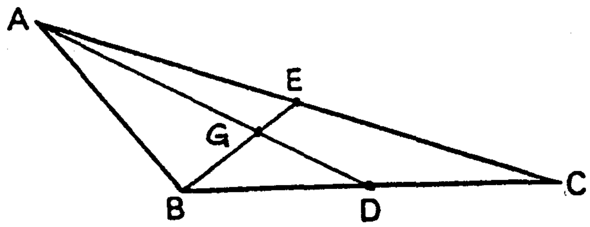
NOV. 1994

Paper 2

1. Choose : 3.0 m and 25 N

---

2. A plumbline is hung from the point A, if its thin thread passes by the point D, this indicates that D is vertically below A .



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3. (a) (i) The area of the surface of pond <u>decreases</u>.
   (ii) The air pressure on the surface stays the <u>same</u>.
   (iii) The force of the air on the surface <u>decreases</u>.
   (iv) The total pressure at the bottom <u>decreases</u>.
   (b) (i) 3 cm.
   (ii) greater than air pressure, by 6 cm of oil.

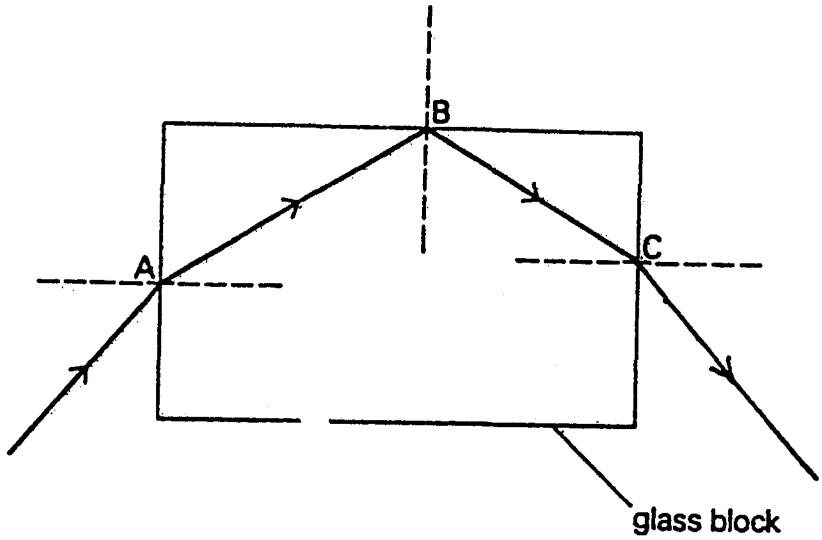
---

4. (a) Rod B is a better conductor of heat, therefore, heat is transmitted along B faster and melts the wax a longer distance.
   (b) The hot water expands, it becomes less dense and rises up. It is replaced by cooler water which produces circulation of water in a clockwise direction. This is called convection current.

---

5. (a) (i) Refraction occurs at A.
   (ii) Total internal reflection occurs at B.

(b)

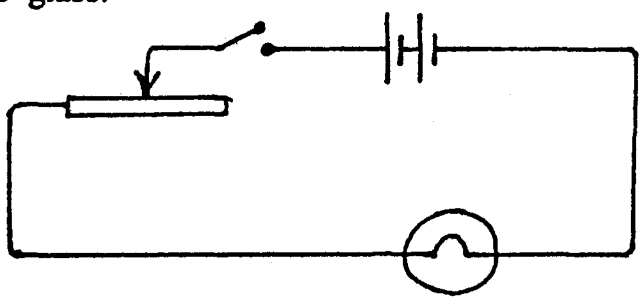


6. (a) (i) The dial micrometer reading increases.
   (ii) The thermometer reading increases.
   (b) (i) As the temperature rises, the brass rod expands to the left and presses on the dial micrometer so its reading increases.
   (ii) As the steam passes in the jacket, the temperature rises and the reading on the thermometer increases.

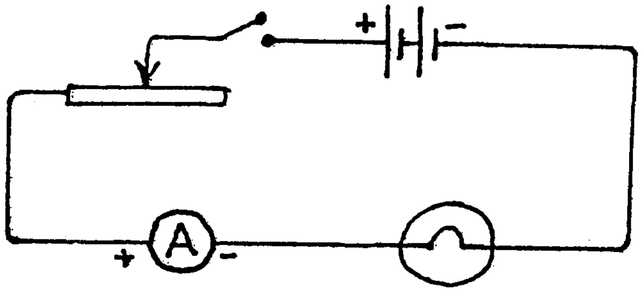
7. Anthea's body is wet and water evaporates from her body. Evaporation produces cooling of her body so she feels cold.

8. (a) Alpha particles.
   (b) Beta particles.

9. (a) An electric current consists of a flow of electric charges.
   (b) (i) Conductors , such as copper.
   (ii) Insulators , such as glass.
   (c) (i)



(ii) by increasing the resistance of the rheostat.
(iii) an ammeter.
(iv)



(v) The reading on the ammeter would <u>increase</u>, because the current in the circuit increases due to the decrease of the resistance in case of two lamps connected in parallel.
(vi) because the electric energy is dissipated in the resistance of the filament. This energy is converted to heat and light energies.

---

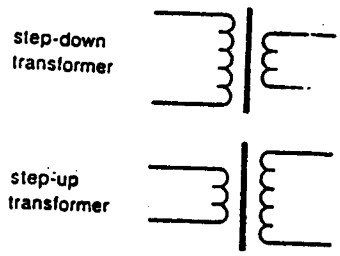
10. (a)

(b) (i) with alternating voltage of 10 V (YES)
with a steady voltage of 10 V (NO)

(ii) $\frac{V_1}{V_2} = \frac{N_1}{N_2}$, therefore $\frac{10}{50} = \frac{80}{N_2}$

$\therefore\ N_2 = 400$ turns

(iii) the core is made of soft iron,
the coils are made of copper wires.



(iv) For transmission of electric energy from a power station to homes and factories, the AC voltage is raised at the station to very high values by using step-up transformers. This reduces the current considerably and reduces the power lost in cables ($P = I^2 R$). Step-down transformers are used at the end of the cables (near the homes) to reduce the voltage to lower values suitable for domestic use.

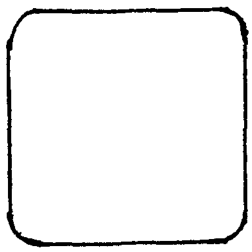
---

11. (a) (i) Close switch S_2 to heat the cathode.
(ii) Thermionic emission.

(iii) Close switch S_1 to apply the high positive potential to the anode.

(iv) Close switch S_3 to apply the positive voltage to the lower plate.

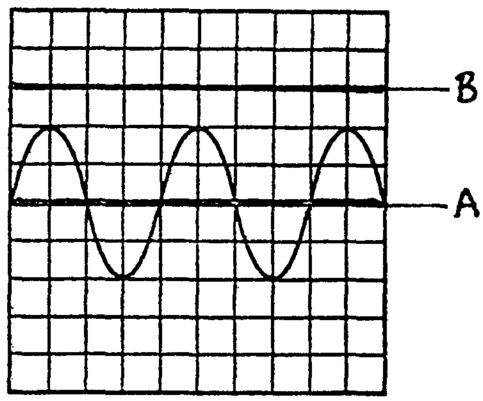
(v) A bright spot is seen on the screen deflected in the downward direction.



(b) (i) The volts/cm control

(ii) The time-base control (time/cm)

(iii), (iv)



---

12. (a) The average speed $= \dfrac{\text{distance moved}}{\text{time taken}}$

(b) average speed = 15/0.3 = 50 km/hour

(c) (i) from 20s to 100s

(ii) The distance travelled = ½ x 20 x 10 = 100 m

(iii) " " " = 80 x 10 = 800 m

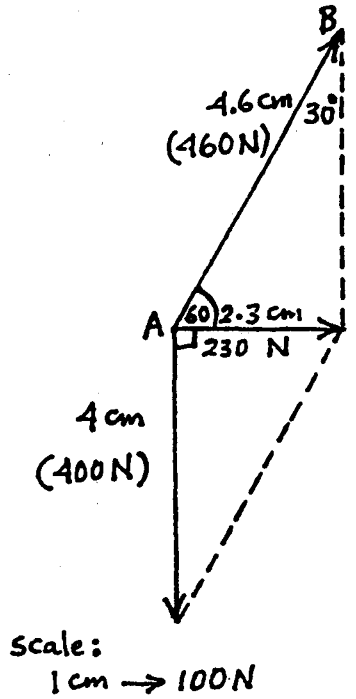
(iv) The total distance = 100 + 800 = 900 m

(v) The speed = distance/time

= 900/100 = 9 m/s

Nov. 1994

Paper 3

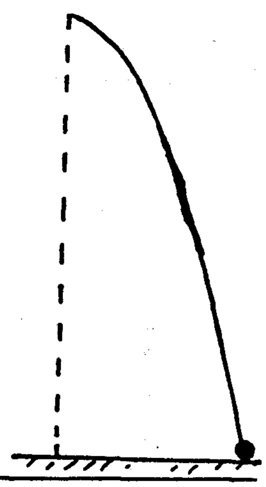


1. (a) The resultant = 230 N, its direction is horizontal (it makes an angle of 60° with the 460 N force and an angle of 90° with the 400 N force).

   (b) The speed is constant but its direction is always changing to move in a circular path. The acceleration does not change the magnitude of the velocity vector, but it changes its direction.

   (c) The resultant force is directed towards the centre of the circular path. It is a centripetal force which changes the direction of the velocity and produces the circular motion.

   (d) The ball moves in a horizontal direction with a constant speed ; and it falls down with a constant acceleration due to gravity. Its path takes the shape of a parabola.



2. (a) Water pressure $= h\ \rho\ g$

$= 18\,(1.05 \times 10^3)\,10$

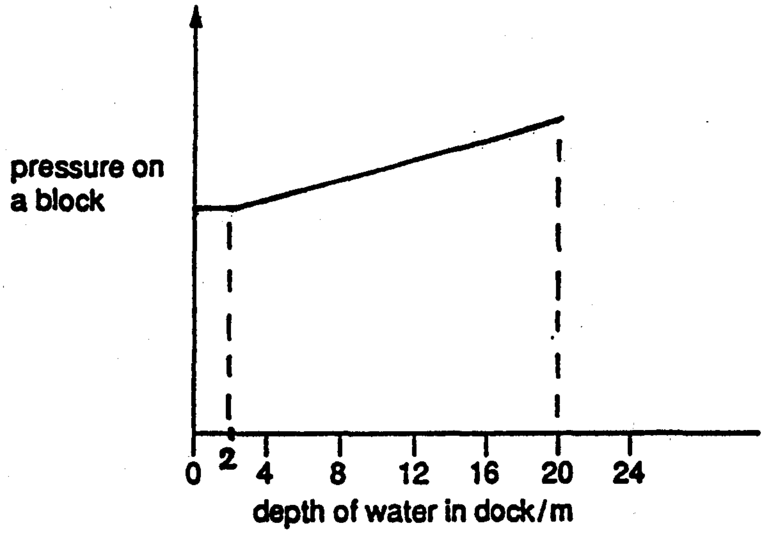
$= 1.89 \times 10^5 \quad N/m^2$

(b) Pressure of tanker $= F/A$

$= (60 \times 10^7)/1000$

$= 6 \times 10^5 \quad N/m^2$

(c)



(d) Power $=$ Force x Velocity

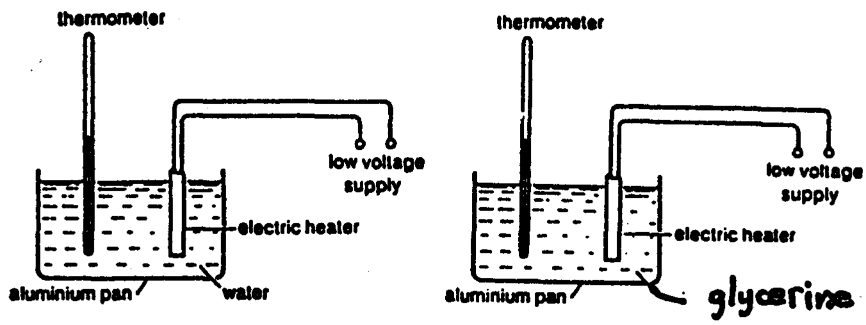
$(4.5 \times 10^7) =$ Force x 7

Force $= 6.43 \times 10^6$ N

---

3. (a) The specific heat capacity of a substance is the amount of heat energy required to raise the temperature of one kilogram of the substance by one Kelvin.

(b)



1. Use two identical beakers containing equal masses of water and glycerine, and having similar thermometers.
2. Use two identical immersion heaters of the same power to heat the water and glycerine for equal intervals of time. (use that $P x t = m c \theta$).
3. Notice that the rise in temperature in each liquid is different because the two liquids have different specific heat capacities.

(c) advantage 1 : It absorbs very little amount of heat energy when measuring the temperature of a substance.
advantage 2 : It can respond quickly to rapidly changing temperatures.

(d) (i) The temperature recorded with the silvery surface is less than that recorded with the matt black surface.
(ii) There is no heat transmission by convection current (heat is transmitted by radiation only).

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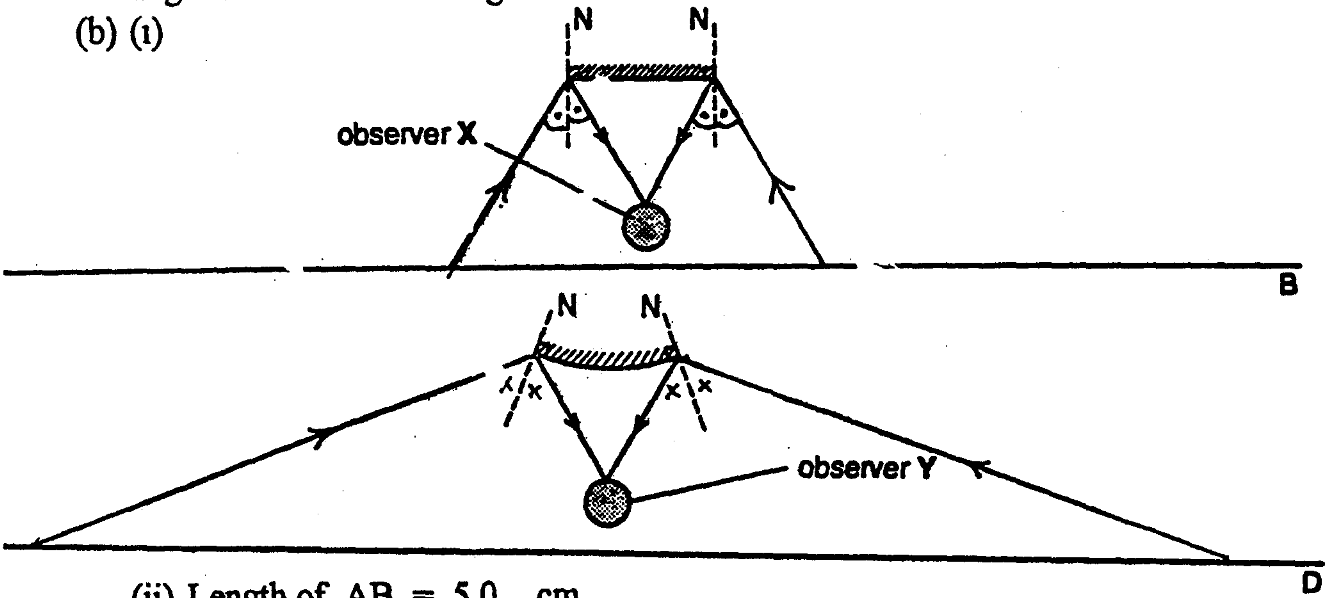
4 (a) The law of reflection :
angle of incidence = angle of reflection

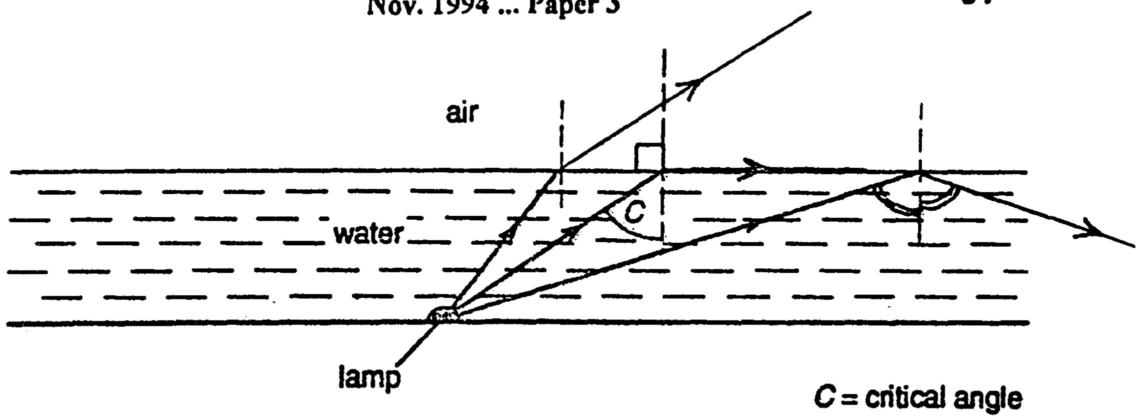
(b) (i)



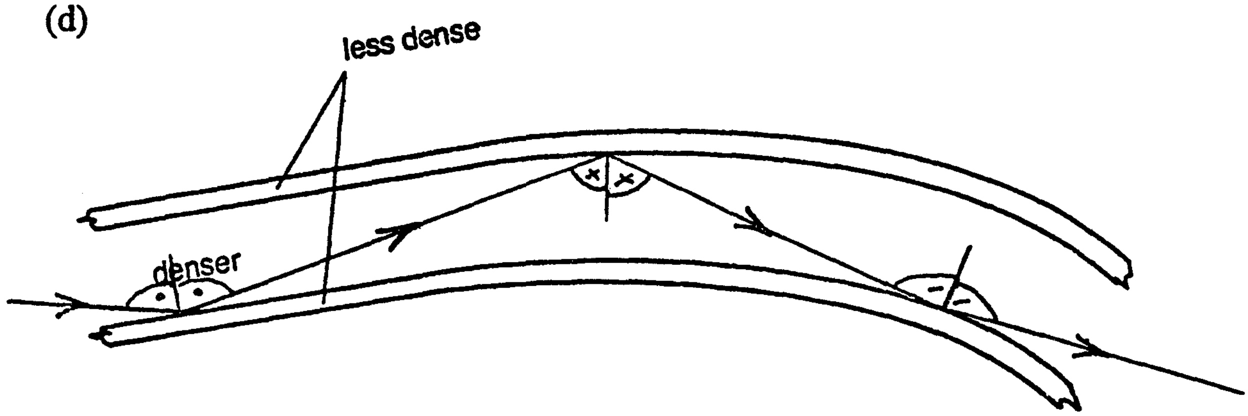
(ii) Length of AB = 5.0 cm
Length of CD = 16.1 cm

(iii) advantage of plane mirror :
It gives images of equal size as the object and at a distance equal to that of the object.
advantage of curved mirror :
It gives a wider angle of view so the field of view seen is wider than that of the plane mirror of the same size.

(c)



(d)

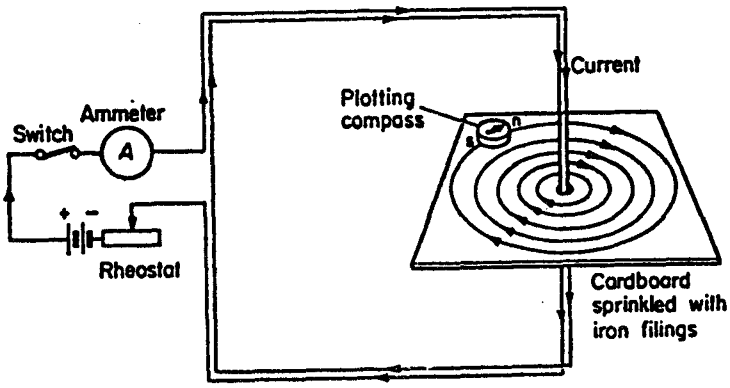


(i) A ray of light passes through a thin glass fibre by successive total internal reflections until it emerges from the far end of the fibre with very little loss of intensity. This occurs because the angles of incidence are always greater than the critical angle.

(ii) This is to convey a high intensity beam of light and keep the cable flexible so it can be curved.

---

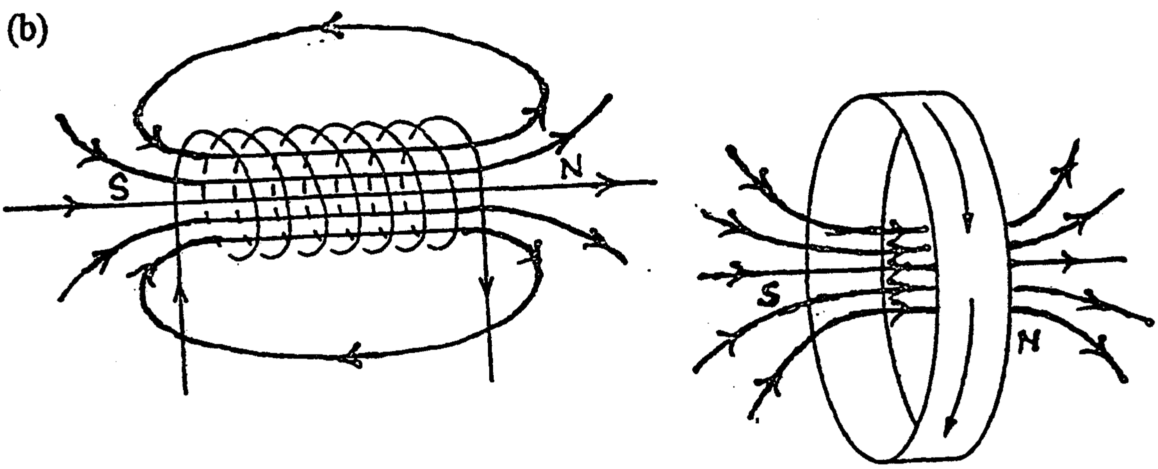
5. (a) (i)



1. Use the circuit shown in which a large current is passing in a thick straight wire.
2. Place several small plotting compasses around the wire to show that the field takes a circular shape centered about the wire.
3. Mark the two ends of each magnetic needle and connect the points to draw the field circle.
4. Repeat steps 2 and 3 at different distances from the wire to get several field circles.

(ii) If the current is reversed by changing over the battery connections the compass needles will swing round and point in the opposite direction, but the pattern of concentric circles remains unaltered.

(b)



(c) (i) When C_1 connected to C_2 by the key, the current flows through the solenoid producing a magnetic field which results in the attraction of the soft-iron plunger.

(ii) When P is attracted towards the solenoid, the contact plate touches the contacts of the starter motor circuit causing the current to flow and the motor to turn.

(iii) When K switches off the circuit, the solenoid loses its magnetic field and releases the plunger, so the spring S pulls the plunger out of the solenoid which switches off the motor circuit.

6. (a) (i) Isotopes are atoms of the same element having the same atomic numbers but having different mass numbers due to different numbers of neutrons.

(ii) 90 means that each nucleus contains 90 protons.

230 means that ^{230}Th nucleus contains 230 nucleons, (90 protons + 140 neutrons).

234 means that ^{234}Th nucleus contains 234 nucleons, (90 protons + 144 neutrons).

(b) (i) Particle A is a negative electron.

Because the loss of a negative charge from the nucleus increases the proton number by one (from 11 to 12) and keeps the mass number constant.

Particle B is an alpha particle.

Because the emission of an alpha particle decreases the mass no. by four units (from 226 to 222) and decreases the atomic number by two units (from 88 to 86).

(ii) Because the emission of gamma-radiation does not change the mass number or the atomic number.

(c) As the level of fuel rises in the tank, the floating radioactive source rises and comes nearer to the detector and increases the count rate which is linked to the level indicator and increases its reading. (When the fuel level falls, the opposite occurs.)

Nov. 1994

Paper 6

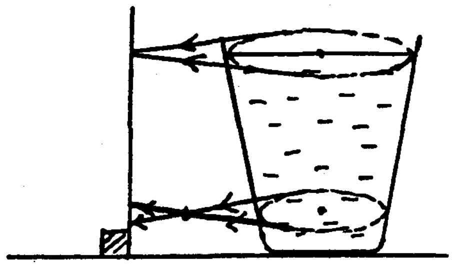
1. (a) (i) , (ii)

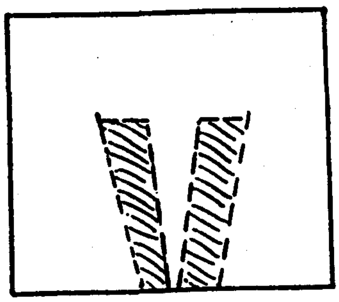
ℓ_1 /cm	ℓ_2 /cm	ℓ_3 /cm	ℓ_4 /cm	$x = (\ell_2 - \ell_1)$/cm	$y = (\ell_3 - \ell_1)$/cm	$v = \frac{1}{2}(x+y)$/cm
1.0	12.2	20.4	33.8	11.2	19.4	15.3

(b) (i) because the light is focused at a point so it appears sharp, narrow and bright

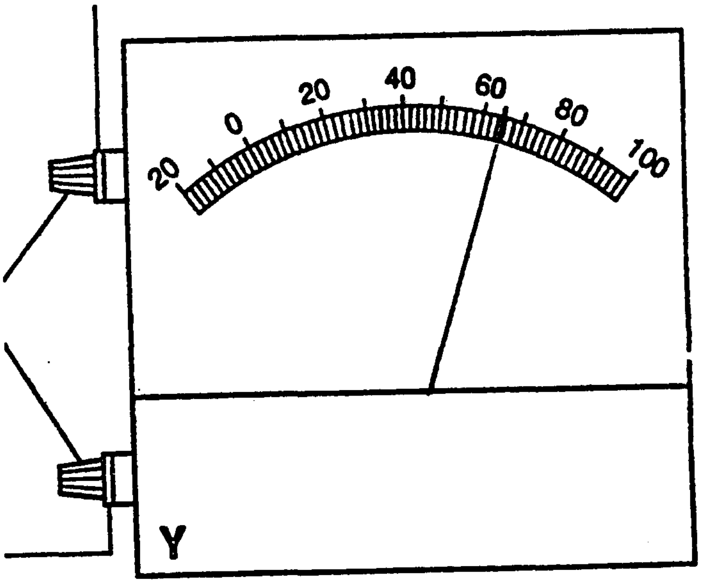
(ii) at the bottom, the screen is placed farther away from the focus, so the rays are not focused to a point and appears wide and not sharp.

If the screen is moved nearer to the glass vessel, the patch of light would appear reversed : it is sharp and bright at the bottom, while it is wide, and not sharp at the top.





2. (a) (i) 50 mA
(ii) I = 34.5 mA
(iii) Scale reading at 65 mark as shown

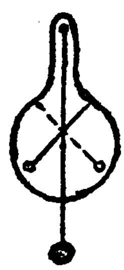


(b) (i) Good electrical connections should use clean wires, wrapped clockwise round the terminals and should be tightened thoroughly so that it would not introduce any resistance in the circuit

(ii) The poor electrical connections increases the resistance in the circuit, therefore, the current is decreased and the reading on X is reduced.

---

3. (a)



1. Three small holes are made at well-spaced intervals round the edge of card by using the sharp point.
2. Hang the card from one hole in the pivot of the stand and clamp so that the card can swing freely
3. Hang the plumb-line from the pin and the position of its thread is marked on the card by two small crosses. These crosses are joined by a straight line, using the metre rule and the marker pen.
4. Repeat steps 2 and 3 when hanging the card from other holes.
5. The intersection of the drawn lines is the position of the centre of mass of the card.

(b) Yes.

(c) When marking the position of the thread on the card, the line of sight of the eye should be perpendicular to the thread and card to avoid parallax error.

---

4. (a) (i) N = 41 - 20 = 21°C
W = 35.8 - 20 = 15.8°C
D = 21 - 15.8 = 5.2°

$$\frac{D \times 100}{N} = \frac{5.2 \times 100}{21} = 24.8\ \%$$

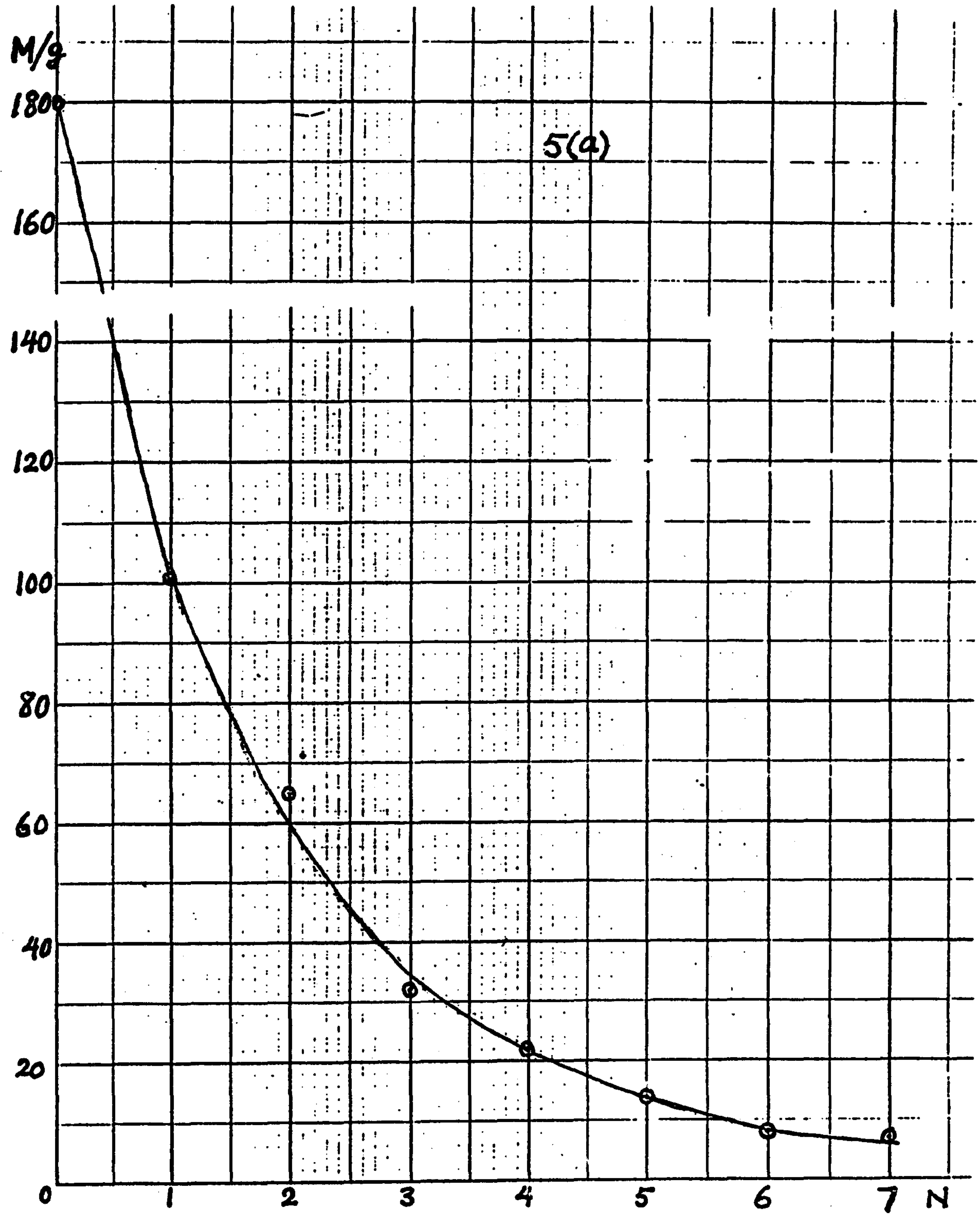
The fabric used can reduce the rise in temperature by about 25%.

(b) (i) The temperature may be read to the nearest degree and the position of the mercury meniscus may be estimated to half a degree.
(ii) 53°C.

---

5. (a) The graph

(b) The force between the magnet and the steel sheet decreases as the distance between the magnet and the steel sheet increases.



M/g
180
160
140
120
100
80
60
40
20
0
5(a)
1
2
3
4
5
6
7
N

JUNE

1995

June 95

1	B	11	B	21	A	31	A
2	B	12	C	22	D	32	B
3	D	13	C	23	D	33	B
4	B	14	B	24	B	34	D
5	D	15	D	25	C	35	D
6	C	16	B	26	B	36	B
7	B	17	C	27	A	37	B
8	D	18	A	28	B	38	D
9	B	19	D	29	C	39	C
10	D	20	A	30	A	40	C

June 1995

Paper 2

1. (a) 8.6 cm
   (b) Number of paper sheets = 400 ÷ 2 = 200
   Thickness of one sheet = 2.2 ÷ 200 = 0.011 cm

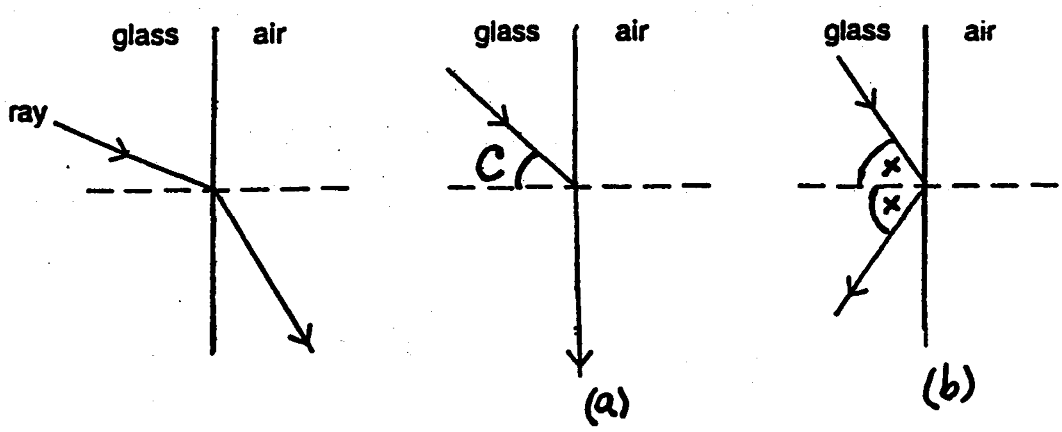
---

2. (a) (i) energy at B same as that at A (✓)
   (ii) No, it will rise up to a height of 0.4 m only which equals its potential energy at A .
   (b) only if friction is not too great (✓)

---

3. (a) fresh water.
   (b) Since the pressure is inversely proportional to the base area (P = F/A) ; the weight of the rescuer will be supported by a large area which produces smaller pressure on the roof, so he is less likely to fall through the roof.

4.



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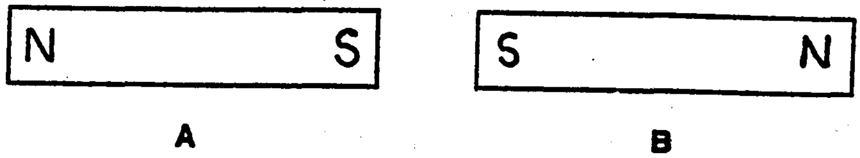
5. (a) It is the amount of heat energy required to raise the temperature of a body by one Kelvin.
   (b) The internal energy of the block is raised (✓)
   The block expands (✓)

(c) The heater is supplying the block with heat energy, while the block is loosing heat energy to the surroundings. When the rate of heat gained equals the rate of heat loss, the block remains at a steady temperature.

6.



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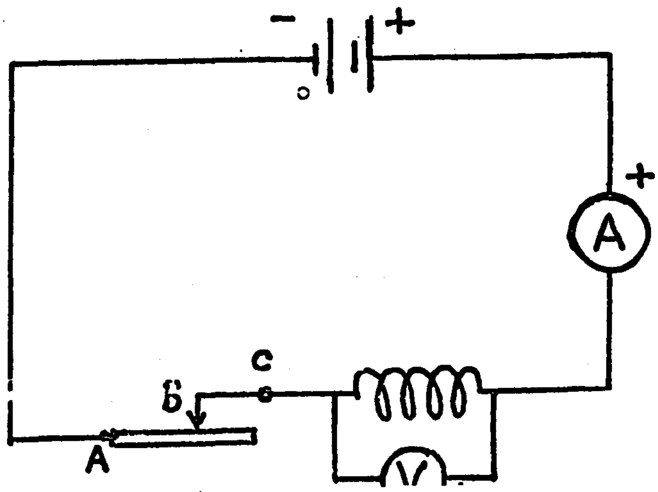
7. (a) (upper box) : a brush
   (lower box) : a commutator
   (b) Reverse the connections of the poles of the battery.

---

8. (a) (i) nearly 0 V
   (ii) nearly 12 V
   (b) In daylight, the p.d. of the relay coil is about 12 V, its magnetic field is strong enough to attract the reed relay and opens the circuit, thus the lamp is off.
   (c) This circuit could be used to switch off the street lamps during daylight, and switch them on when it is dark.

---

9. (a) (i)



(ii) $R = \frac{V}{I} = \frac{1.2}{0.16} = 7.5\ \Omega$

(iii) total $R = V(\text{total}) / I = \frac{2}{0.16} = 12.5\ \Omega$

Resistance of rheostat $= 12.5 - 7.5 = 5.0\ \Omega$

(iv) Move the slider B towards A to reduce the resistance. The voltmeter reading would increase [$V = I.R$].

(b) (i) element B is switched on.

(ii) both elements are switched off.

(iii) both elements are switched on.

(c) S_1 and S_2 both closed (✓)

---

10. (a) (i) Echo is hearing a reflected sound a short time after the original sound.

(ii) No. of claps used $= 121 - 21 = 100$

The time between two successive claps $= \frac{29.4}{100} = 0.294$ s

$V = \frac{2d}{t} = \frac{2 \times 50}{0.294} = 340$ m / s

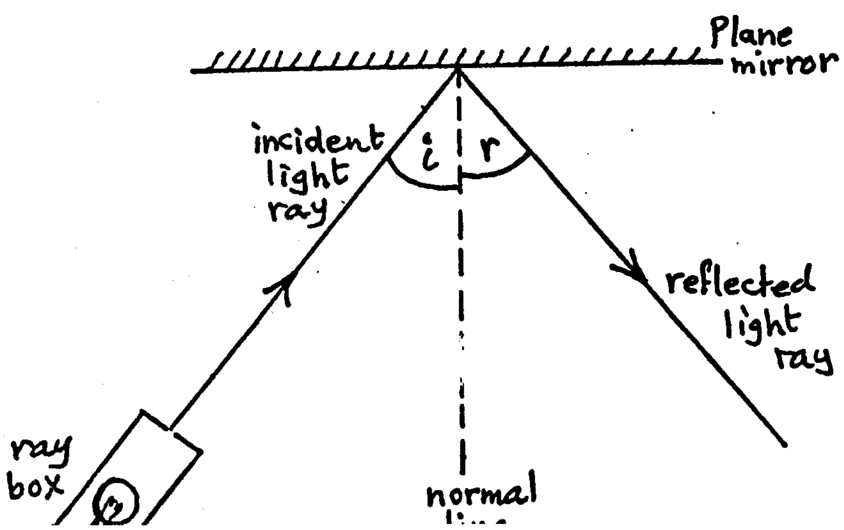
(b) (i) frequency = no. of revolutions per sec. x no. of teeth

$= \frac{500}{60} \times 90 = 750$ Hz

(ii) becomes lower (✓)

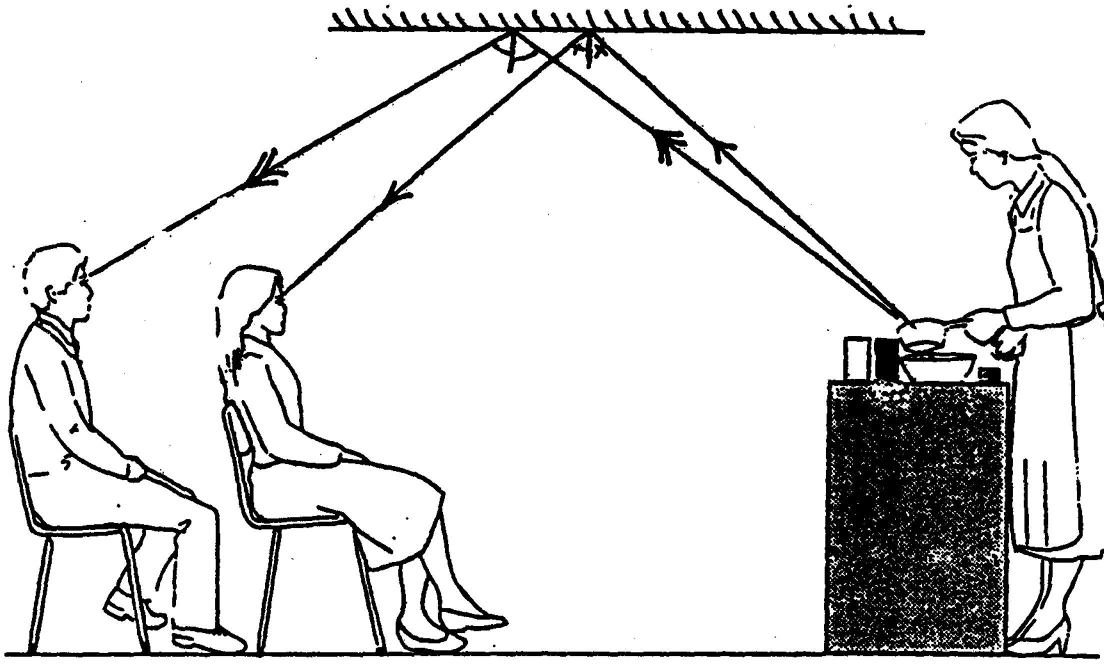
---

11. (a), (b)



(c) i equals r (√)

(d)



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12. (a) (i) a helium nucleus (two protons and two neutrons).

(ii) a negative electron.

(iii) an electromagnetic wave of very short wavelength.

(b) ... atomic number .... mass number ... protons ...
... nucleus .... nucleons ...

(c) $^{4}_{2}He$ or $^{4}_{2}\alpha$

(d) $^{218}_{84}Po \longrightarrow ^{214}_{82}Pb + ^{4}_{2}He$

(e) Polonium has 84 protons + 134 neutrons = 218 nucleons
Astatine has 85 protons + 133 neutrons = 218 nucleons
Radon has 86 protons + 132 neutrons = 218 nucleons
(The different elements have different proton numbers and also different neutron numbers ; but the sum of protons and neutrons for each element is the same and equals 218).

June 1995

Paper 3

1. (a) If the speed is constant but the train is changing its direction, this indicates that the velocity is varying.
   (Velocity is a vector which has both magnitude and direction)

   (b) The acceleration is a vector quantity, it should have a direction which cannot be completely specified from the speed-time graph.

   (c) (i) Rate of speed decrease $= \dfrac{\text{change in speed}}{\text{change in time}}$

   $$= \frac{(100-20)}{(4 \times 60)} = 0.33 \ \text{m/s}^2$$

   (ii) 1. Slowing down force $= m.\,a$

   $$= (4 \times 10^5) \times 0.33$$
   $$= 1.33 \times 10^5 \ \text{N}$$

   2. Distance travelled $=$ area under $(v - t)$ graph

   $$= (240 \times 20) + (\tfrac{1}{2} \times 240 \times 80)$$
   $$= 14400 \ \text{m}$$

   (d) Motion in a circle requires a centripetal force directed towards the centre of the circular motion. This force is supplied by the reaction of the tracks to the wheels of the train.
   The high speed increases the centripetal force required.
   The large radius decreases " " " " .
   These two effects balance each other to keep the centripetal force to a suitable value which can be supplied by the tracks.

---

2. (a) It is the amount of heat energy required to change one kilogram of boiling water to steam without change in temperature.

   (b) (i) 1. Use the balance to get the mass of an empty clean beaker.
   2. Start the clock and start to collect the condensed steam in the beaker at the same time.
   3. After 10 – 15 minutes, stop the clock and withdraw the beaker ; then find the mass of the beaker plus the condensed steam using the balance.

(ii) Mass of empty beaker $= m_1$ (kg)

" " beaker plus condensed steam $= m_2$ (kg)

" " condensed steam, $m = (m_2 - m_1)$ (kg)

The time taken for condensation $= t$ (sec.)

Voltmeter reading $= V$ (Volts)

Ammeter reading $= I$ (Amp)

Since, $VIt = mL$

$\therefore$ The latent heat of vaporisation, $L = \dfrac{VIt}{m}$ (J / kg)

(c) Heat energy lost by vapour = Heat energy gained by snow

$$mL\text{ (vapour)} = m'L'\text{ (snow)}$$
$$1 \times (25 \times 10^5) = m'(3.4 \times 10^5)$$
$$\text{mass of snow, } m' = 7.35 \text{ kg}$$

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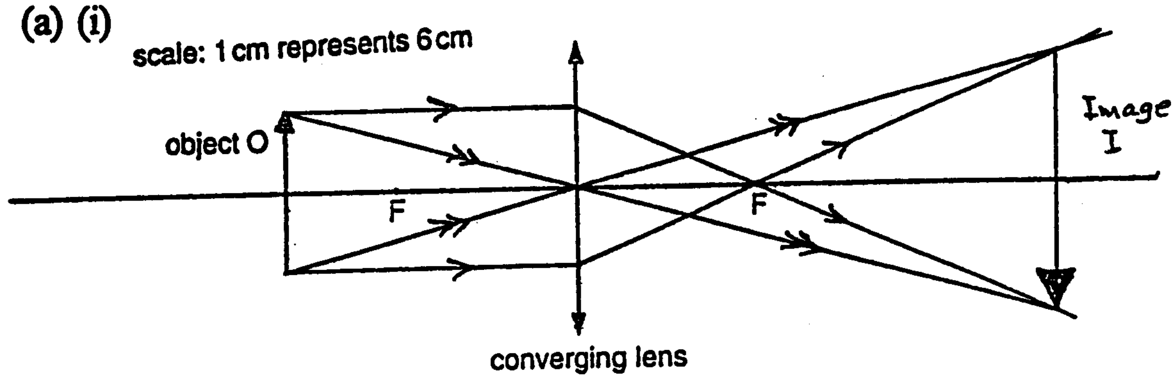
3. (a) (i)



(ii) An image is any picture or reproduction of an object by means of light rays.

(iii) The light rays falling on the white card are reflected to the eye lens which forms another image on the retina of the eye. (The brain feels the image on the retina due to electric pulses reaching it through the optical nerve).

(iv) 1. Distance of image from the lens $= 6.3 \times 6 = 37.8$ cm

2. Magnification $= 1.6$

(b) (i) The size of image gets <u>larger</u>.

(ii) Use the movable collar to move the whole enlarger upwards away from the photographic paper until the image becomes sharply focussed.

(iii) The new area = 2L x 2B = 4 LB
The area becomes four times greater, therefore the amount of light per unit area decreases, it becomes one fourth the original value.

---

4. (a) (i) * Bar A is an iron bar (magnetic material), because both sides 1 & 2 are attracted to the north and south poles of the magnetic needle of the compass
* Bar B is non-magnetic material, because the magnetic needle of the compass was not affected by bar B.
* Bar C is a magnet, because the effect of side 1 on the magnetic needle is opposite to the effect of side 2. This indicates that 1 and 2 are different poles of a magnet. (The figures show that side 1 is a north pole and side 2 is a south pole).

(ii) She should make her tests away from magnets or magnetic materials to avoid any effects on the compass needle.

(b) (i) When the window is opened, its magnet moves far up, so its force of attraction on the bar X is reduced and the spring can pull the bar X to close the circuit so the alarm rings.

(ii) ... soft iron ; so it could be attracted easily by the bar magnet.

---

5. (a) $I = \frac{P}{V} = \frac{150}{240} = 0.625\ A$

(b) current in wire n 0.625 A
" " " d 1.250 A
" " " e 1.875 A

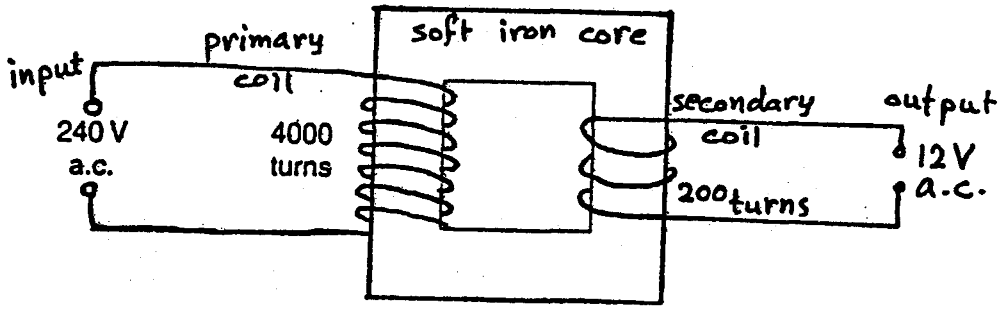
(c) $P = I^2R$ when using 120 V on the same lamp the current is reduced to almost one half its value. This reduces the power and the brightness to about ¼ the original value.

(d) current in wires a and b 1.25 A

(e) In each circuit drawn from the power supply, do <u>not</u> use more than two lamps in parallel so that the current in wires would not exceed 1.25 A.

---

6. (a) (i)



(ii) 1. Maximum output power $P_2 = P_1$

$= I_1 V_1$

$= 0.5 \times 240 = 120$ W

2. Maximum output current $I_2 = P_2 / V_2$

$= 120 / 12 = 10$ A

(iii) because a.c. input produces a constantly changing magnetic field, thus producing a continuously induced a.c. output power in the socondary coil.

(iv) 1. The induced currents in the soft iron core (called eddy currents) are dissipated in the iron as heat energy which causes the warming of the iron core.

2. Some heat is produced in the wires of the two coils due to their resistances (Power lost in coils equals $I^2 R$).

(b) Since I_1 is a changing short pulse, it produces a changing magnetic field in the detector coil which induces an electric current pulse in the buried metal object which in turn affect the detector coil producing an opposite pulse I_2.

According to Lenz law the induced pulse I_2 should be produced in a direction such that it opposes the change producing it, thus I_2 is produced in opposite direction to I_1.

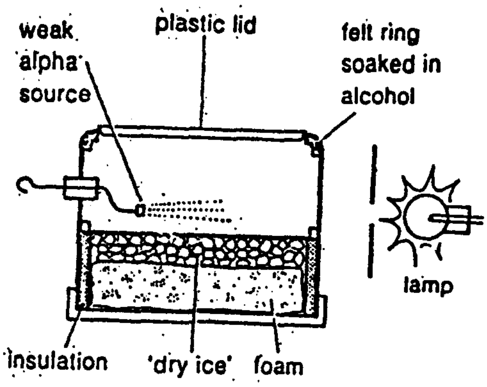
7. (a) (i) An ion is a particle, an atom, or group of atoms carrying a <u>net</u> electric charge.

(ii) The collisions of alpha particles with air molecules change the neutral molecules into positive ions carrying positive charges and negative ions carrying negative charges.

(iii) The positive ions are attracted towards the negative electrode, and negative " " " " " positve " , thus a current passes through the air in the detector.

(b) Alpha emitter source.
because it has a high ionising power.

(c) The cloud chamber shown enables the tracks of charged particles to be seen or photographed,
Alpha-particles tracks are thick and straight.
Beta-particles tracks are thin and curved.
Gamma-rays do not produce direct tracks, their tracks are due to indirect ionization.



(d) (i) It is the time taken for <u>half</u> the nuclei present in a given sample to decay.

or,

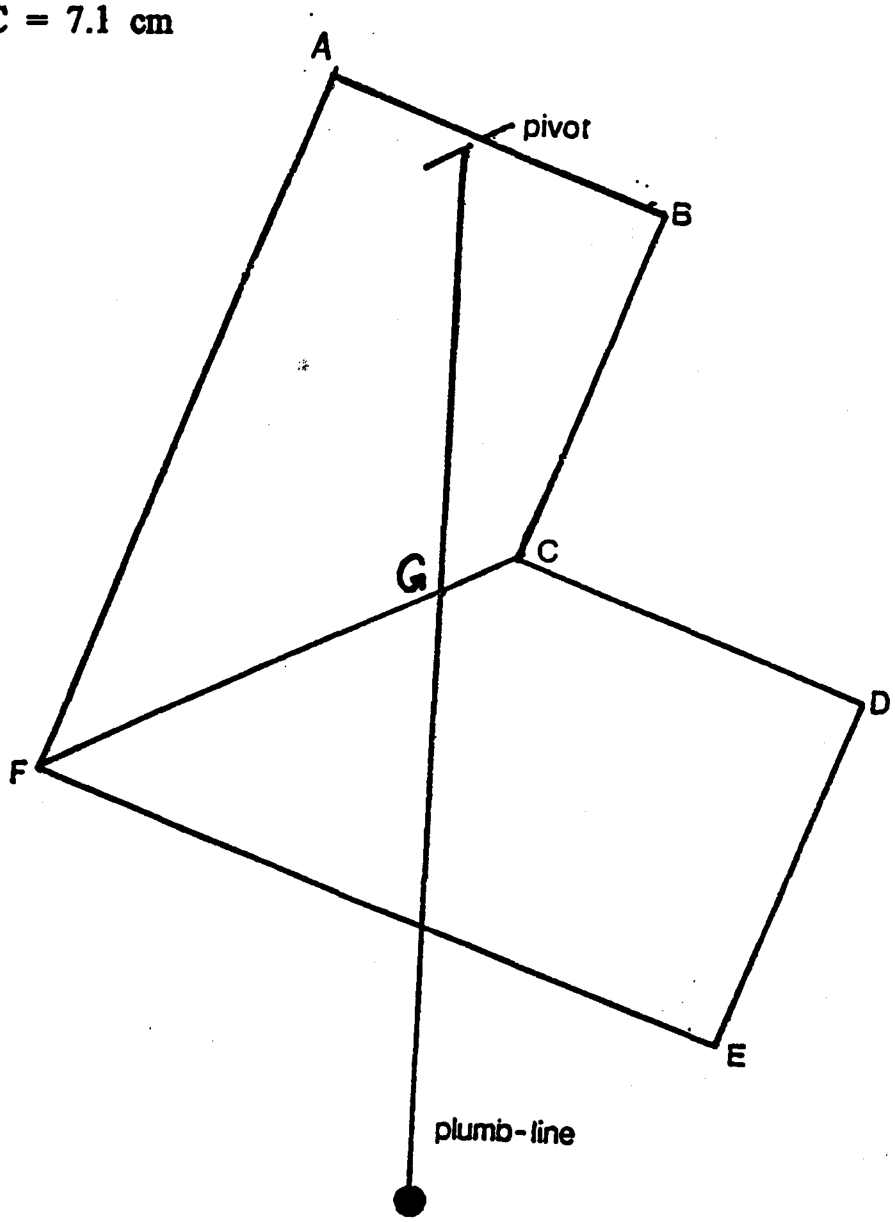
It is the time taken for the activity of a given sample to fall to half its original value.

(ii) Use a long half-life source, so that it can be used for many years without appreciable decrease in its activity.

June 1995

Paper 6

1. (a) FC = 7.1 cm
   (b)



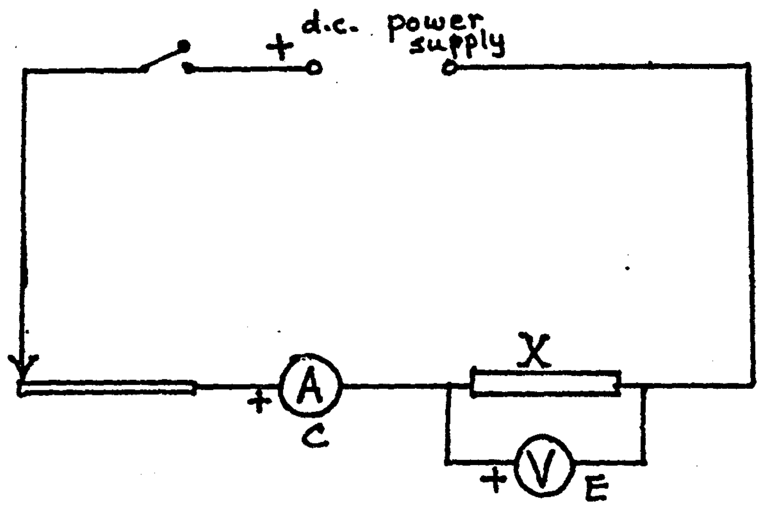
   (c) Push the card slightly and notice that it swings freely several times about the pivot
   (d) The card will turn a little in anticlockwise direction, so that F will move closer to the plumb-line.

2. (a) The anti-slip mat is effective in stopping the items from sliding around. Using this mat requires a sliding force which is about three time greater than the force required in case of regular surfaces.
   (b) In this way, the surface in contact with the bench remains the same under the effect of different loads.

   (c) Lubricate the pulley well to make sure that it is frictionless pulley.

---

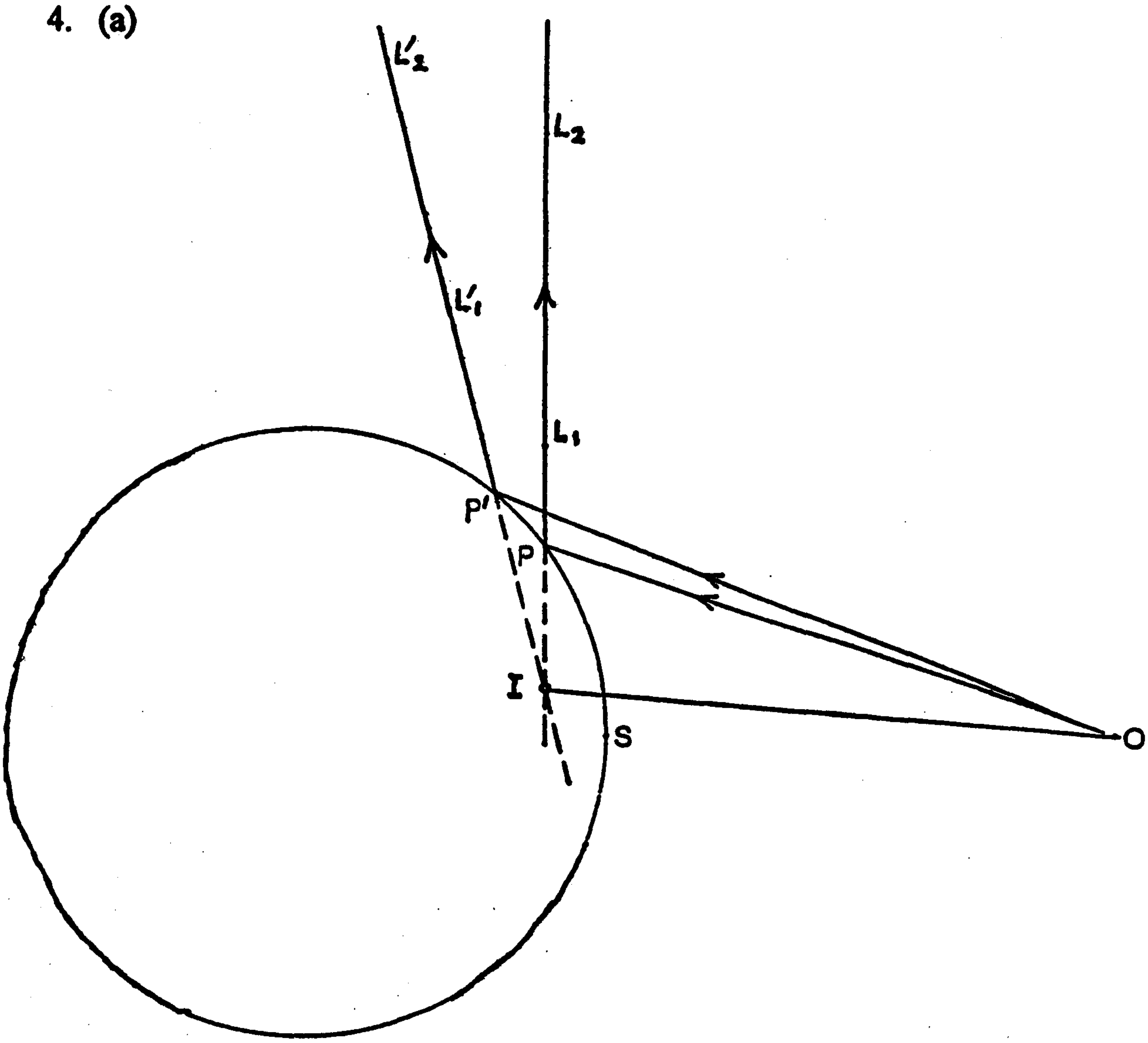
3. (a)



   (b) 1. Connect the circuit as shown and set the rheostat to its <u>maximum</u> resistance (to get the minimum current).
   2. Switch on the circuit and record the values of the ammeter reading (I) and the voltmeter reading (V) and get the value of the resistance (R = V/I).
   3. Reduce the resistance of the rheostat a little and record the new values of V and I to find another value of R.
   4. Repeat step 3 several times to get different values for V & I and calculate "R" in each case.
   5. When the current gets close to 1 A, replace the ammeter C by ammeter B so that we can go to higher values of current (up to 2A).
   6. The average value of the resistance R is obtained by summing up all the R's and dividing by their number

---

4. (a)



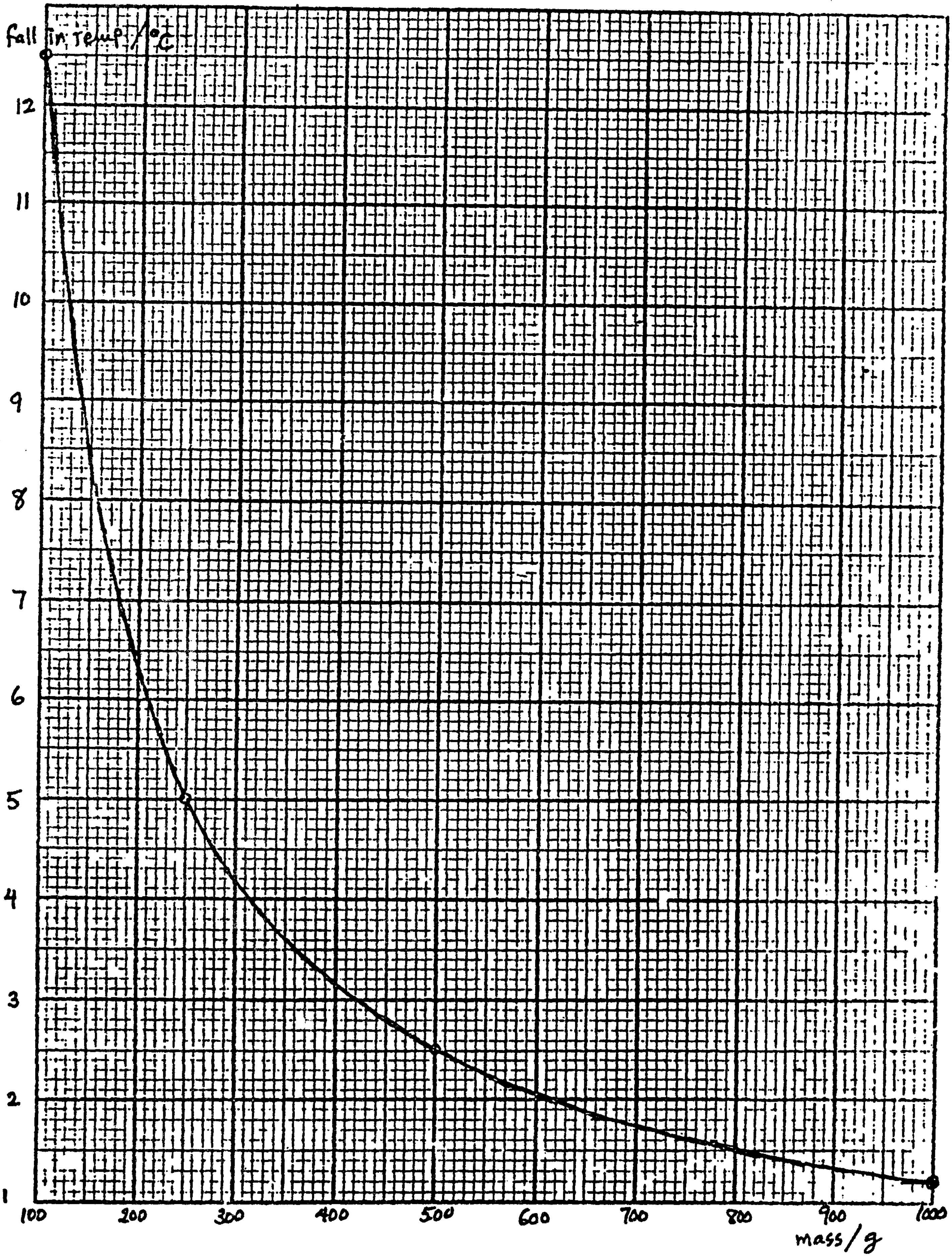
(b) The reflected rays are diverging.

(c) (ii) $OI = 8.3$ cm

(d) The manification M is less than 1, thus the image is diminished, i.e., the image is less wide than the object.

(e) The height of the beaker is straight, i.e., there is no curvature in its vertical direction, so there is no magnification in the height of the object - the image has the same height as the object.

5. (a) (i)


fall in temp /°C
12
11
10
9
8
7
6
5
4
3
2
1
100
200
300
400
500
600
700
800
900
1000
mass / g

(ii) The fall in temperature of the water decreases as the mass of water increases

(iii)

M/g	T/°C	(M/g) x (T/°C)
200	6.2	1240
400	3.1	1240
800	1.5	1200

(iv) The fall in temperature is inversely proportional to the mass of the body. Smaller mammals experience greater falls in temperatures of their bodies which make it harder for them to survive in cold weather.

(b) ... in order to conduct the experiment under the same conditions, and to study the effect of changing mass only on the fall in temperature.

NOV.

1995

Nov. 95

1	C	11	A	21	B	31	B
2	D	12	A	22	B	32	B
3	A	13	D	23	D	33	C
4	B	14	D	24	B	34	D
5	B	15	B	25	D	35	D
6	A	16	C	26	A	36	C
7	D	17	B	27	D	37	D
8	A	18	B	28	C	38	A
9	C	19	D	29	A	39	B
10	A	20	D	30	C	40	B

Nov. 1995

Paper 2

1. (a) There is no resultant force.
   (b) The spacecraft accelerates to the right.

---

2. (a) 17 seconds.
   (b) The working time = $95 \times 17 = 1615$ sec.
   The fraction of actual work = $1615 \div 3600 = 0.45$

---

3. (a)

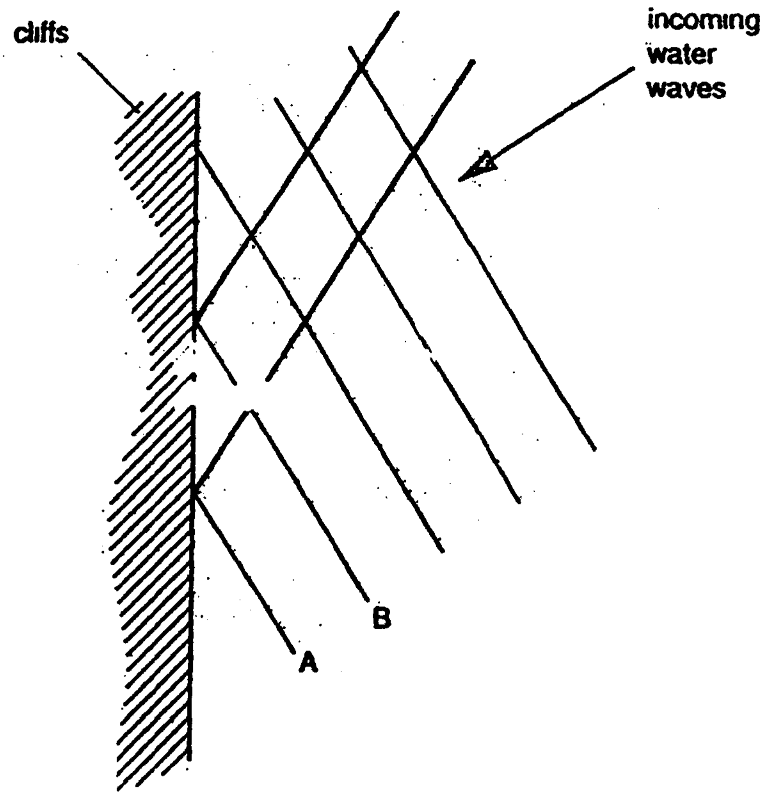
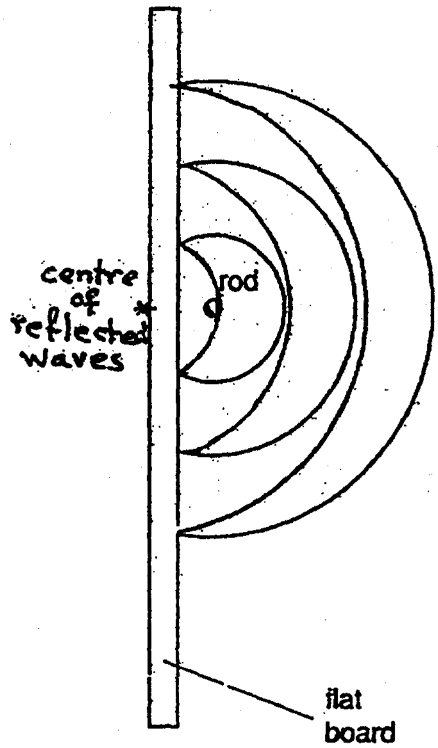


Fig. 3.1

(b) (i)



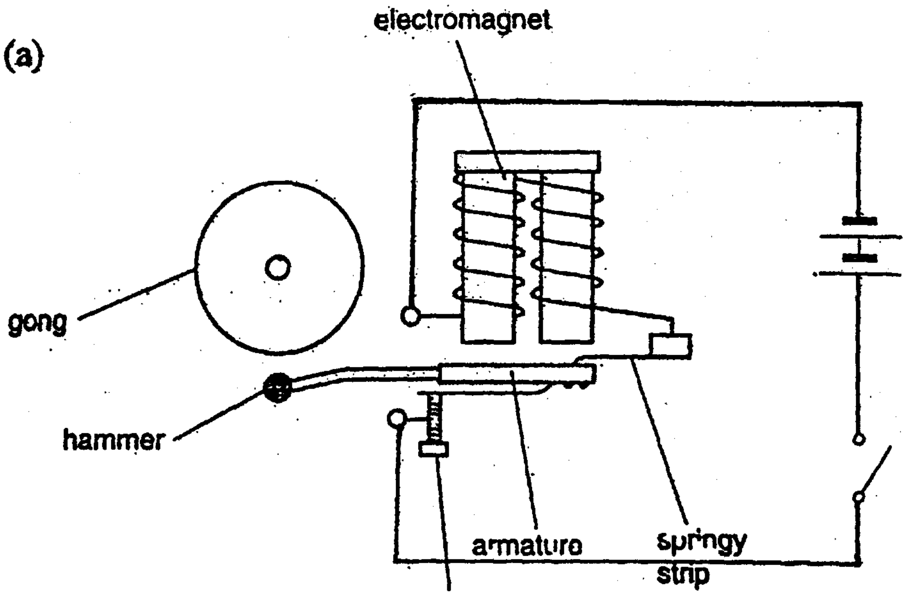
(ii) Using a vibrating long wooden bar produces plane waves.

---

4. When the can is left in the sun it warms up. The molecules of air gain more energy and move faster so they hit the walls of the can harder and more frequently. The pressure of air inside the can increases and it gets fatter.

---

5. (a)



(b) (i) The armature is made of soft iron.

(ii) It is a <u>soft</u> magnetic material : When the electromagnet is magnetised it attracts the armature ; and when the electromagnet is demagnetised, the armature is released and moves away from the electromagnet.

---

6. Filament lamp
Rheostat (or, variable resistance)
Transformer.

---

7. When the switch S_2 is closed, the electric current heats the filament of the cathode which emits a large number of electrons. When the switch S_1 is closed, a very high positive potential is applied to the anode (relative to the cathode). The anode accelerates the electrons and focuses them to produce a narrow beam so that they have enough energy to produce light when they hit the fluorescent screen.

---

8. Protons are located in the nucleus of the atom.
Neutrons " " " " nucleus " " "
Electrons are located in the shells around the nucleus (electronic orbits).

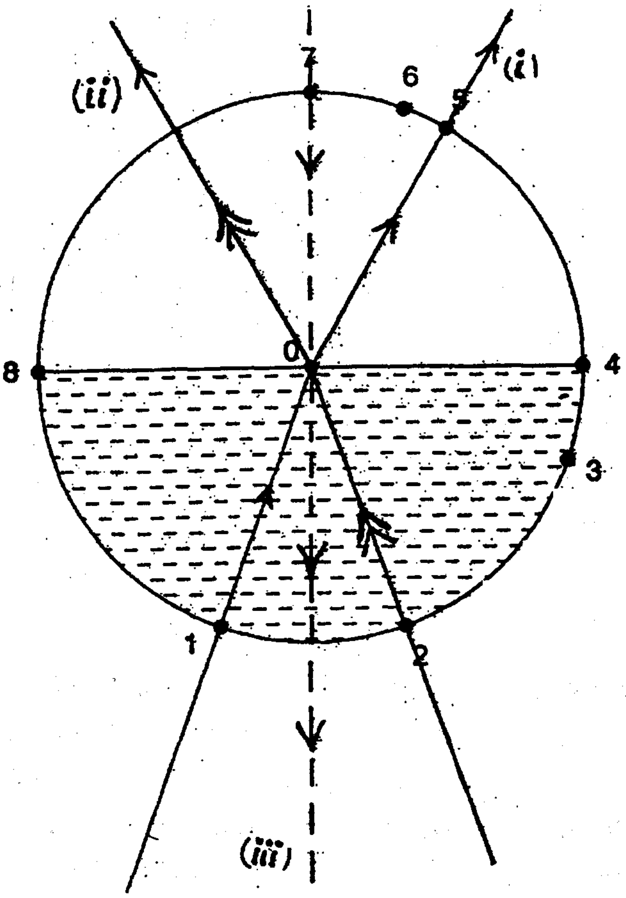
---

9. (a) (i) Refraction of a wave means the change in the direction of its wavefront as it goes into a different medium.

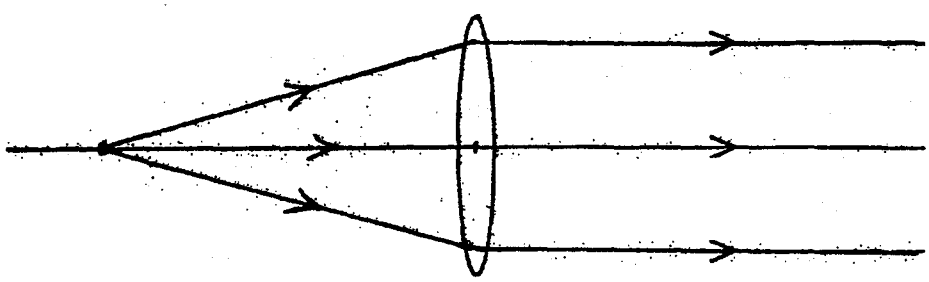
(ii) Refraction occurs due to the difference in wave velocity from one medium to another.

(b) (i) Through the point no. 5

(ii)
(iii)



(c)



10. (a) Volume $= 0.9 \times 0.3 \times 0.4 = 0.108 \ m^3$

(b) mass $= \rho \times V$

$= 1000 \times 0.108 = 108$ kg

(c) New volume $= 0.9 \times 0.3 \times 0.41 = 0.1107 \ m^3$

The volume of gravel $= 0.1107 - 0.1080 = 0.0027 \ m^3$

Density $= \frac{\text{mass}}{\text{volume}} = \frac{6.21}{0.0027} = 2300 \ kg/m^3$

11. (a) Extension is the difference between the extended lengtı and the original unloaded length.

(b) 1. Hang the rubber strip in a clamp and stand with a poiıteı at its end next to a vertical scale and get the reading R_1
2. Suspend the load from the lower end of strip and record the new reading R_2.
3. The extension $= R_2 - R_1$

(c) From the graph, 2N load produces 2.5 cm. extension.
The unloaded length $= 31.6 - 2.5 = 29.1$ cm

(d) The extension of the rubber strip is directly proportional to the applied load.

(e) Strain energy.

(f) The designer should know how much the rubber strips stretch when loaded and make sure that they stretch within the elastic limit. This ensures that the rubber strips return back to their original length when they are unloaded.

---

12. (a) Radioactive decay is the spontaneous disintegration of unstable nuclei of heavy elements, by the emission of particles or radiations - this results in forming new elements or products.

(b) (i) (1) The half life $= 165 - 106 = 59$ sec.
(2) $1200 \rightarrow 600 \rightarrow 300$
There are two half-lives $= 106$ sec.
One half-life $= 106 \div 2 = 53$ sec.
(3) $1200 \rightarrow 600 \rightarrow 300 \rightarrow 150$
There are three half-lives $= 165$ sec.
One half-life $= \frac{165}{3} = 55$ sec.

(ii) The value 55 seconds is most reliable, because it is an average value of largest number of half-lives.

Nov. 1995

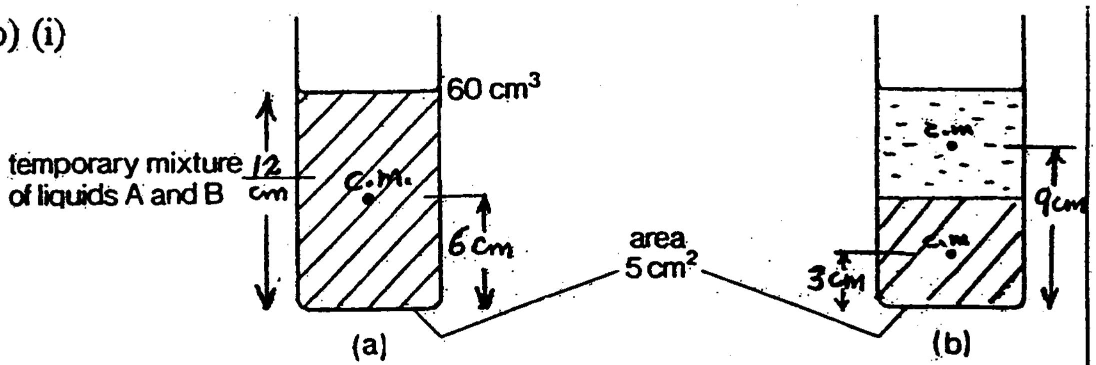
Paper 3

1. (a) (i) Volume of plastic $= 93 - 75 = 18\ \text{cm}^3$

Density $= \frac{\text{mass}}{\text{volume}} = \frac{3.5}{18} = 0.19\ \text{g/cm}^3$

(ii) Molecules of different substances have different masses and also the intermolecular distances between them are different leading to different volumes.

(b) (i)



(ii) 1. The height of the mixture $= \frac{60\text{cm}^3}{5\text{cm}^2} = 12\ \text{cm}$

2. The mass of the lighter liquid $= \rho V$

$= 0.65 \times 30 = 19.5$ g

" " " " heavier " $= 0.85 \times 30 = 25.5$ g

The total mass $= 19.5 + 25.5 = 45$ g

3. The gravitational potential energy for a liquid is calculated for its centre of mass.

G.P.E. for the mixture $= mgh$

$= 0.045 \times 10 \times 0.06 = 0.027$ J

4. G.P.E. for the heavier liquid $= 0.0255 \times 10 \times 0.03 = 0.00765$ J

" " " " " lighter " $= 0.0195 \times 10 \times 0.09 = 0.01755$ J

Total G.P.E. $- 0.00765 + 0.01755 - 0.0252$ J

5. Difference in G.P.E. $= 0.027 - 0.0252 = 0.0018$ J

(iii) This energy is converted to heat due to the friction of molecules while they are separating.

2. (a) (i) 1. When temperature rises the thermistor becomes hot and its resistance decreases thus increasing the electric current in the circuit.

2. The large current in the coil heats the bimetallic strip causing it to bend.

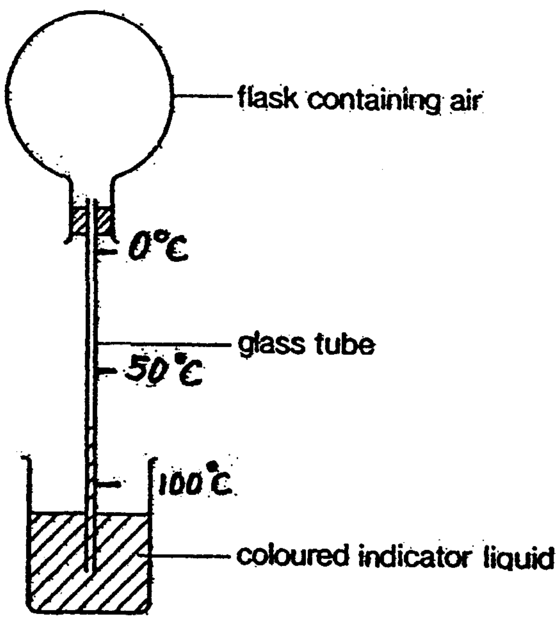
3. The bending bimetallic strip pulls the pointer causing it to turn about the pivot and give a different reading.

(ii) The greater is the temperature rise, the greater is the difference in expansion of the two metals of the bimetallic strip and the greater is its bending. This produces greater pulling of the pointer which causes it to move a greater distance.

(b) (i) 1. Place pure melting ice around the flask, the air inside it will contract and the coloured indicator liquid will rise. When the liquid reaches its maximum value mark the 0°C .

2. Let steam from boiling water pass around the flask for enough time to allow the air inside the flask to expand to its maximum pushing the indicator liquid down the tube to its lowest value then put the 100°C mark.

(ii)



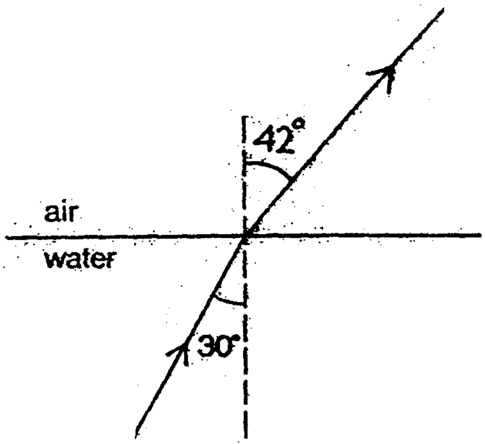
(iii) When the atmospheric pressure decreases, the liquid in the tube falls down a little, thus the temperature recorded will increase.

(a) The refractive index of glass is the ratio between the velocity of light in vacuum (or in air) to its velocity in glass.

(b) $n = \dfrac{\sin \hat{i}\,(\text{air})}{\sin \hat{r}\,(\text{subs})}$

$1.33 = \dfrac{\sin \hat{i}}{\sin 30}$

$\hat{i}\,(\text{air}) = 41.7°$



(c) $n = \dfrac{1}{\sin C}$

$\sin \hat{C} = \dfrac{1}{1.33}$

$\hat{C} = 48.75°$

(d) (i) Lamps 1,2 and 3

(ii) The rays from these lamps will reach the surface of the pool with smaller angles of incidence, so their refraction will be less than that of lamp 4. The refracted rays extend from above the observer's head to the surface of the pool these could be seen by the observer.

(iii) The rays from lamps 5 and 6 will have greater angles of incidence and will be refracted more towards water surface. These rays cannot reach the eyes of the observer, they cannot be seen.

---

4. (a) (i)

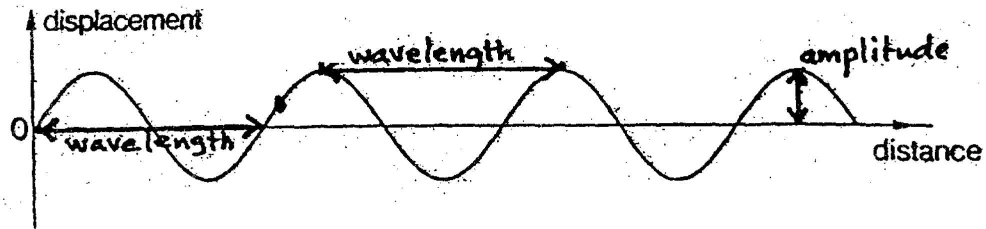
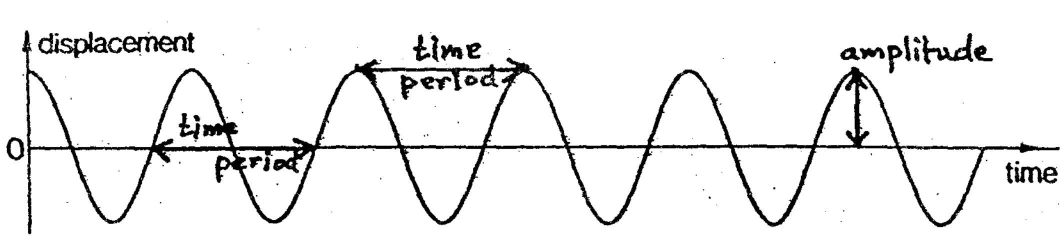
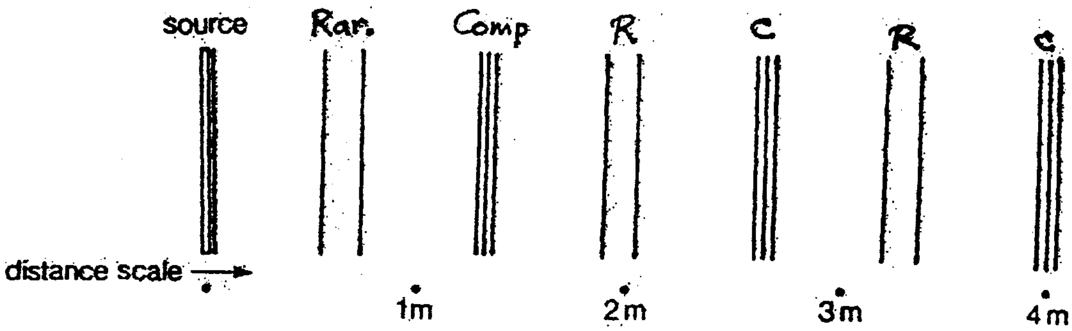


Fig. 4.1



(ii) Loudness : The louder sound causes the molecules of air to move with greater amplitudes.
Pitch : A sound with higher pitch causes the molecules of air to move with higher frequency.

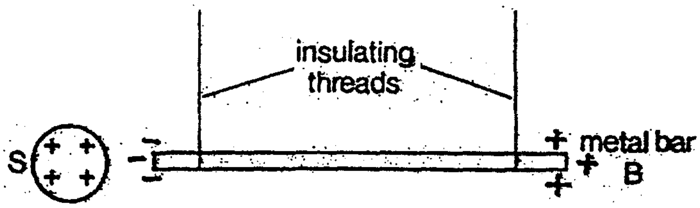
(b) $v = f \times \lambda$
$\lambda = 330 \div 250 = 1.32$ m



(c) $v = \frac{2d}{t} = \frac{2 \times 1500}{2} = 1500$ m/s
Short bursts waves are used to determine the time interval between the emission of a sonar wave and its return accurately.

---

5. (a) (i)



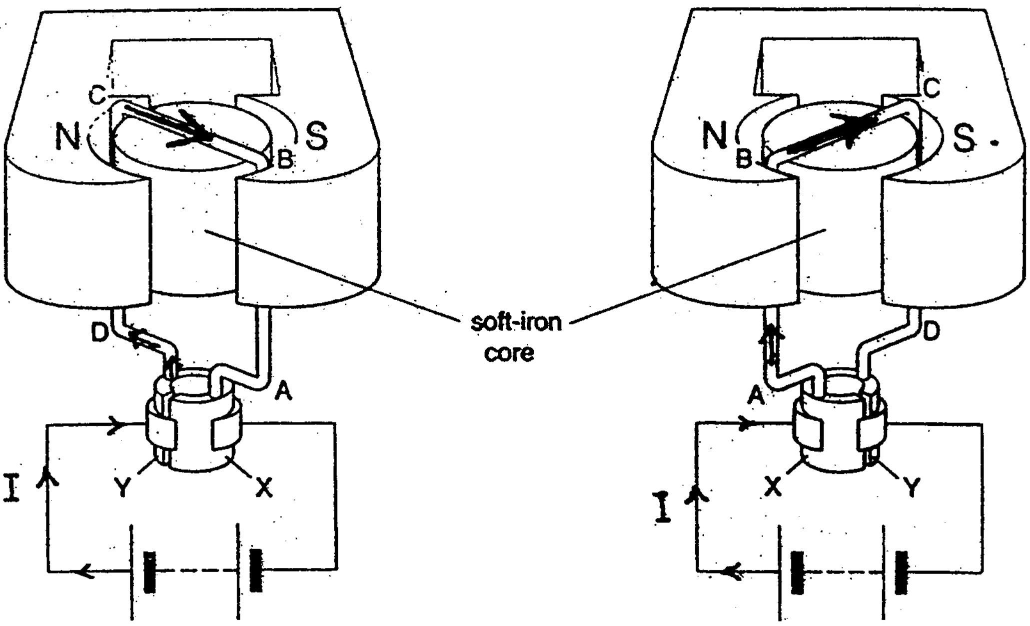
(ii) The electrons from earth flow to neutralize the positive charges on the right end of the metal bar ; but the negative charges on the left end remain in their place.

(b) (i) ★ The positively charged grid attracts the negatively charged smoke particles so they are removed from the air.
★ The negatively charged grid attracts the positively charged smoke particles so they removed from the air.
★ The fan directs the dirty smoky air to flow through the air cleaner.

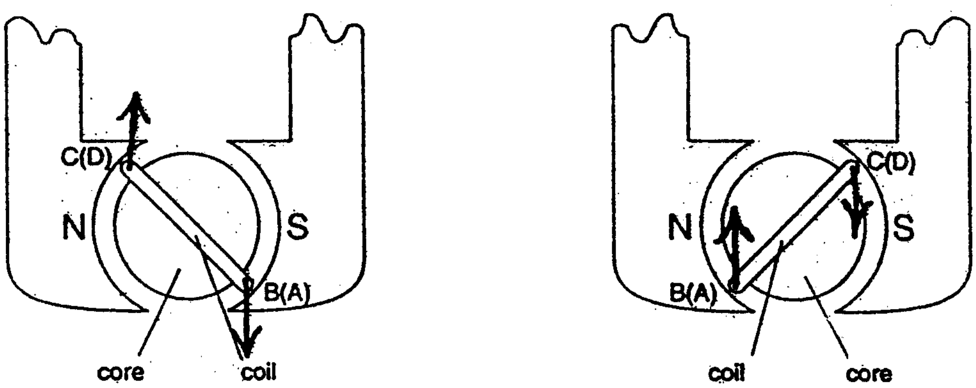
(ii) The battery helps to keep the positive grid always positive at the same potential (even after attracting the negative smoke particles). It also keeps the negative grid always negative in the same way.

---

6. (a) (i)



(ii)



(iii) The force on CD is upward, while the force on BA is downward and the coil turns in a clockwise direction. When the coil is vertical, the commutator segments are changing from one brush to the other. This reverses the currents in CD and BA. The force on CD is now downwards and on BA is upward and the coil continues to turn in a clockwise direction.

(iv) ★ The coil is made of very large number of turns.

★ Several coils are used. They are set at small angle to each other and several pairs of magnet poles are used to have smoother running and a constant turning force in all positions.

(b) (i) $P = I\ V$

$I = 12000 \div 480 = 25\ A$

(ii) $P = \frac{m\,g\,h}{t} = \frac{(20 \times 80)\ 10 \times 15}{45} = 5333\ \ W$

$= 5.33\ \ kW$

---

7 (a) 1. Tracks 1, 2, 3, 6, 7 and 9 passed through the foil with no deflection which indicates that the atom consists mainly of empty space.

2. Tracks 5 and 8 were deflected sideways which indicates that they were repelled by the positive nucleus.

3. Track no. 4 is almost back-scattered which indicates that it collided with very heavy central nucleus.

4. Because the atom should be neutral, the electrons revolving about the nucleus should carry negative charges equal to the positive charge of the nucleus.

(b) Emission R is a beta particle.

..... because the mass no. (24) remained constant, and the atomic no. increased from 11 to 12. This indicates that the emitted particle is a negative electron, i.e., a negative beta particle.

$$^{24}_{11}Na \longrightarrow\ ^{24}_{12}Mg + \ ^{0}_{-1}e$$

Nov. 1995

Paper 6

1. (a) $W_1 \times a = 0.201$
   $W_2 \times b = 0.200$

   (b) The unit of W_1 and W_2 is missing (thus the unit of $W_1 \times a$ and $W_2 \times b$ cannot be determined).

   (c) a is determined accurately to the nearest 1 mm
   b is not determined to the nearest 1 mm (it is given to the nearest 0.1 m or 100 mm).

   (d) b is larger than a because W_2 is smaller than W_1.

   (e) The thread should be very thin so that it would not increase the weight W

2. (a)

S_1	S_2	Slider of VR at	V_1/V	I/mA (I in mA) $I = \frac{V_1 \times 1000}{\text{total resistance between P and Q}}$	V_2/V
open	closed	Y	0	0	0
closed	closed	X	2	$\frac{2 \times 1000}{2000} = 1$	0
closed	open	Y	0	0	0
closed	open	X	2	0	2

(b) When an instrument is shorted this means that its two ends are connected to a thick wire having no resistance. The current passes through the shorting wire and no current passes in the instrument, the potential difference across the instrument is zero.

3. (i) The image is not bright because the lamp is not directly in front of the wire gauze, very little amount of light rays can pass through the openings in the wire gauze.

Correction : Move the lamp to be placed in the centre between A and B.

(ii) The distance from the lens to the screen is not the same, it is close at one end and far from the other end.

Correction : Turn the screen to be parallel to the lens.

(iii) The light rays near B cannot reach the lens (because the lens is not in front of the object) and they cannot produce an image of B.

Correction : Displace the object so that all BA is directly in front and parallel to the lens.

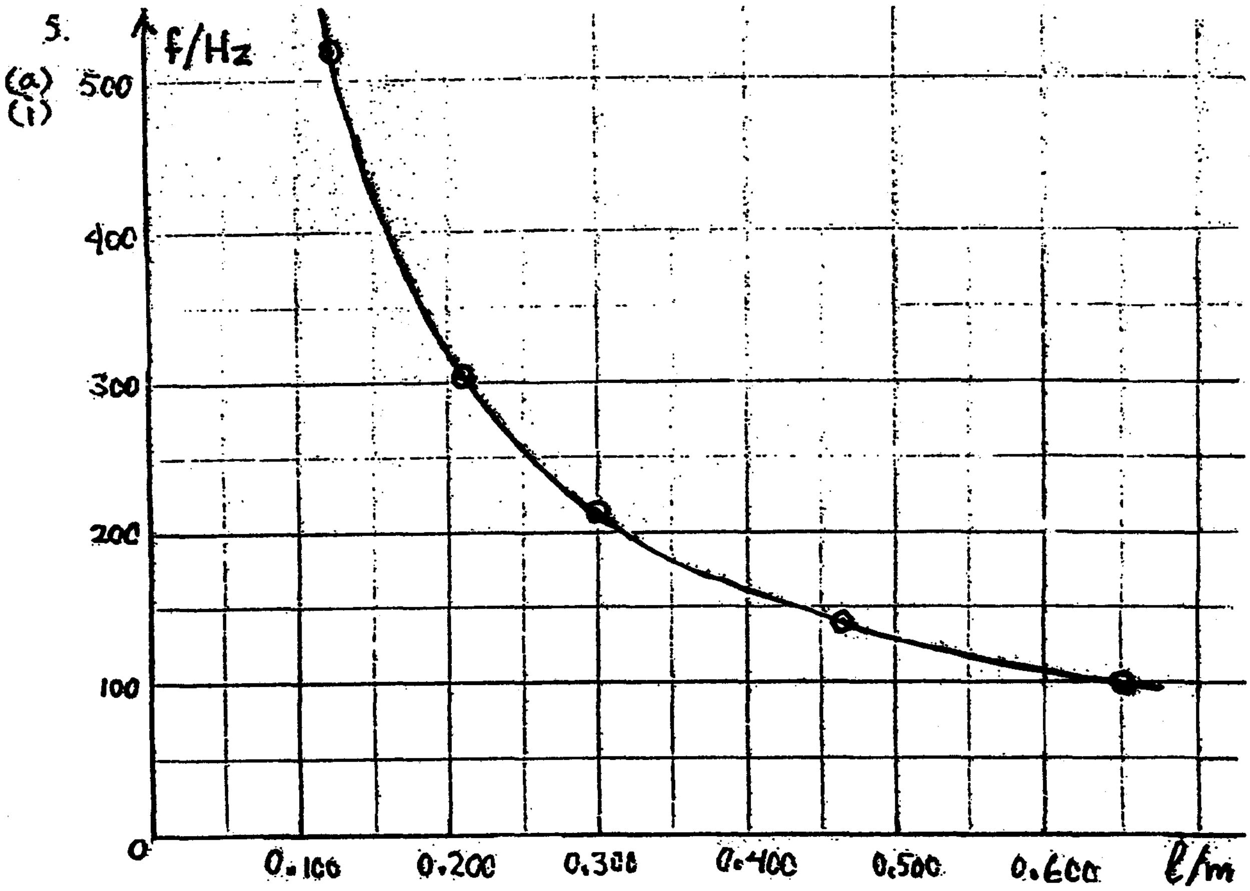
(The object BA, the lens and the screen should all have one common central axis).

---

4. (a)
1. Find the mass of the empty beaker (m_1) using a top pan balance.
2. Place the empty beaker under the condenser and start the stop-watch at the same time.
3. When the beaker is about half-full (collect at least about 100 g), remove the beaker from under the condenser and stop the stop-watch at the same time.
4. Compute the time taken (t) in seconds.
5. Find the mass of beaker plus the collected water (m_2) using the same balance.
6. The mass of condensed water, $M = m_2 - m_1$ (in grams).
7. $R = \frac{M}{t}$ (in g/s).

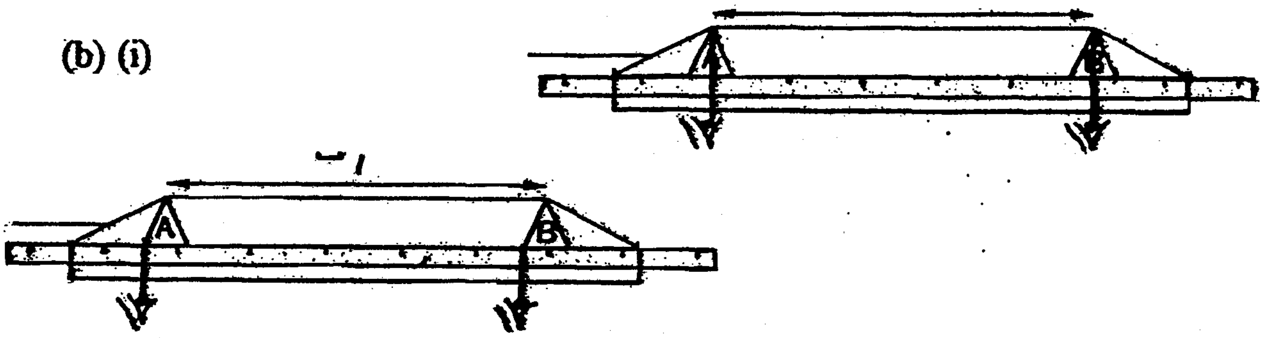
(b) The rate of producing the steam is constant because the mains voltage is constant and the supplied power is constant.

5.
(a) (i)



(ii) The frequency decreases when the length of string is increased

(b) (i)



(ii) The line of sight of the eye should be perpendicular to the scale to avoid the parallax error.

(c) ★ Atmospheric pressure in the lab is not a variable in this experiment.

JUNE

1996

June 96

1	B	11	C	21	A	31	D
2	D	12	C	22	A	32	B
3	C	13	C	23	D	33	A
4	B	14	A	24	A	34	D
5	B	15	B	25	B	35	B
6	A	16	B	26	C	36	D
7	B	17	A	27	C	37	D
8	C	18	C	28	C	38	B
9	B	19	D	29	D	39	C
10	D	20	D	30	D	40	C

June 1996

Paper 2

1. (a) The solid state.
   (b) The gas state.

---

2. (a) (i) Volume $= 42 - 34 = 8\ cm^2$.
   (ii) Density $= \frac{mass}{volume}$
   $= \frac{21.2}{8} = 2.65\ g/cm^2$
   (iii) Measuring the mass and the volume of the larger section gives more accurate values with smaller error. The density calculated from the values of the larger section is more accurate.

---

3. (a) The action of turning a body about a pivot by applying a force, is called the moment of the force.
   (b) Closing a door, where it turns about the hinges (the pivot).

---

4. (a) A
   (b) Sound waves.
   (c) (i) The frequency is the number of complete vibrations made in one second.
   (ii) ... stays the same (✓).

---

5. (a) Condensation.
   (b) Evaporation.

6.

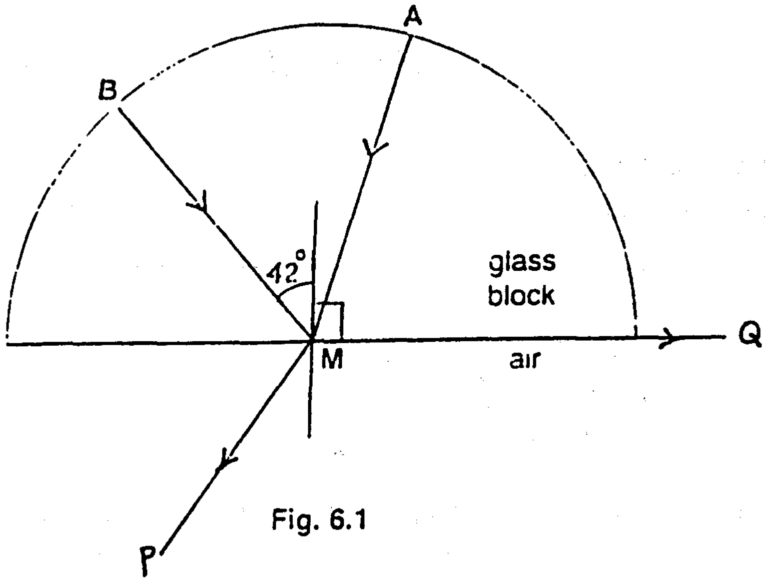


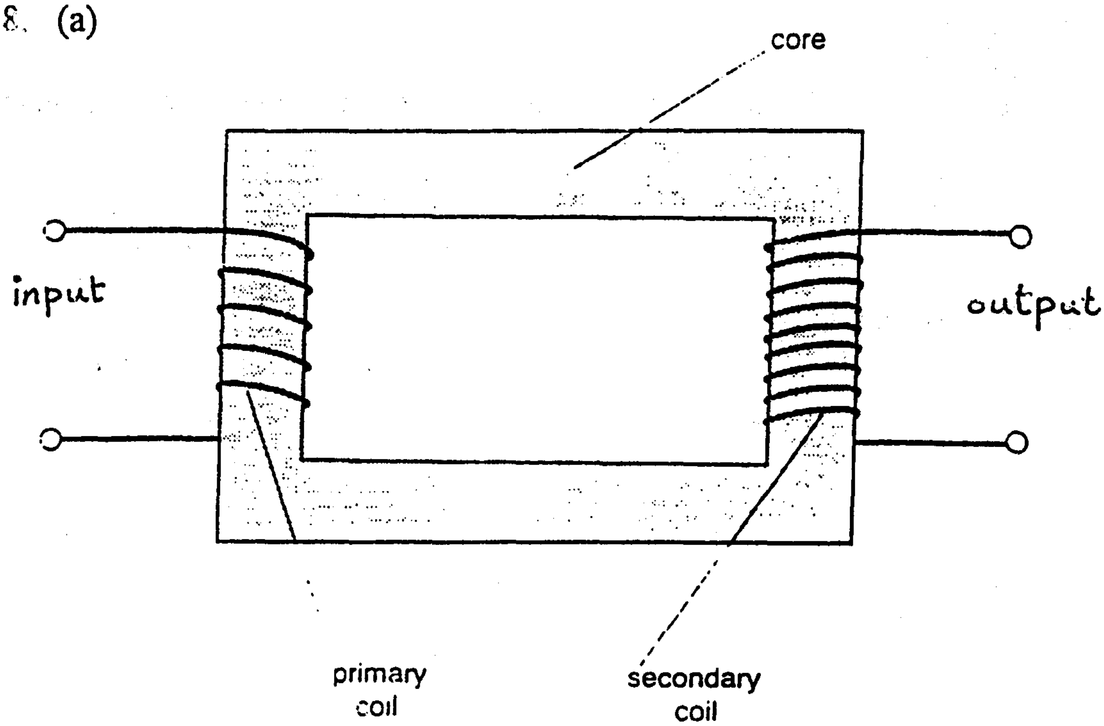
Fig. 6.1

---

7. (a) by rubbing the plastic rule by a piece of cloth.
(b) The plastic rod could be positively charged (x)
" " " " " negatively charged (✓)
" " " " " uncharged (✓)

---

8. (a)



(b) (i) a set-up transformer.

(ii) because the number of turns of the secondary coil is greater than the number of turns of the primary coil.

(c) $\frac{V_1}{V_2} = \frac{N_1}{N_2}$

$\frac{0.5}{V_2} = \frac{5}{9}$ $\therefore V_2 = 0.9\,V$

---

9. (a) (i) constant, from A to B (from 500 s to 1000 s)

(ii) changing, from B to C (from 1000 s to 2000 s) (or from 0 to A).

(b) (i) Distance travelled = area under (V, t) graph

$= \frac{1}{2}(500 \times 15)$

$= 3750$ m

(ii) Distance from A to B $= 500 \times 15$

$= 7500$ m

(iii) Distance in final part $= \frac{1}{2}(1000 \times 15)$

$= 7500$ m

(iv) Total distance $= 3750 + 7500 + 7500$

$= 18750$ m

(c) speed $= \dfrac{\text{distance}}{\text{time}}$

speed $= 18750 \div 2000 = 9.375$ m/s

$= 9.4$ m/s

---

10. (a)

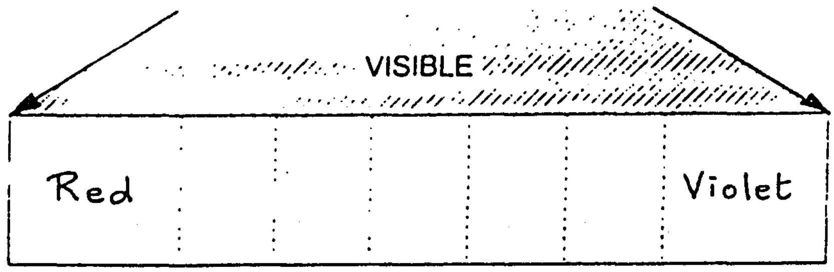
Radio Waves	INFRA-RED, RADAR AND MICROWAVE	VISIBLE	Ultra-violet	X-rays	gamma rays

(b) (i) They are all transverse waves.

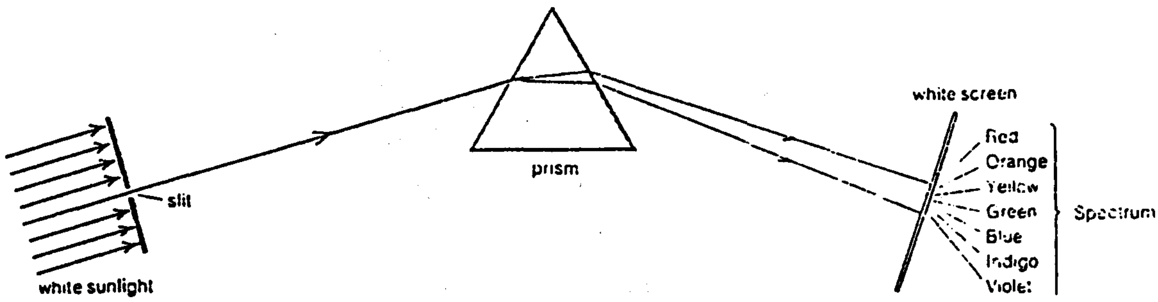
They travel with the same velocity in vacuum.

(ii) They have different frequencies and wavelengths

(c)



(d)

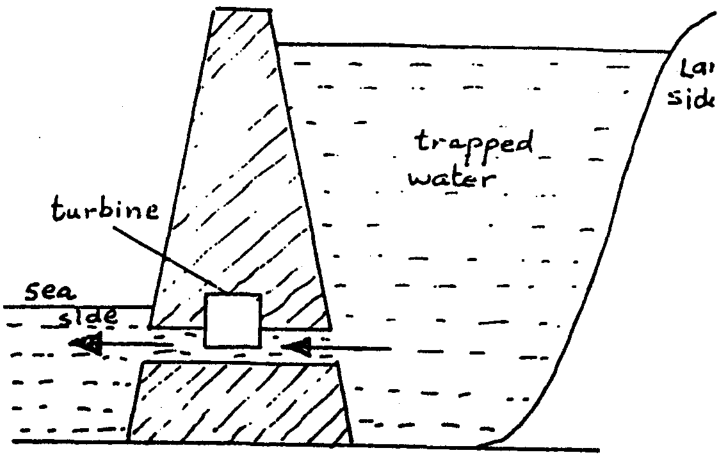


A narrow beam of white light is obtained from the ray box (or from the sun). When the beam passes through a glass prism, it is refracted and dispersed into a range of different colours which can be received on a white screen. The colours of the spectrum are : Red, orange, yellow, green, blue, indigo, and violet.

---

11. (a) (i) Gravitational potential energy.
(ii) Electrical energy.
(iii) Some energy is converted to internal energy (heat).
(iv) The flowing water turns a turbine which turns the coil of the generator through the magnetic field of a permanent magnet and induces an electric current through its wires and generates electricity.
(v) Sun rays heats the water which evaporates and rises producing clouds in the sky. The clouds eventually falls back as rain which comes down to fill the reservoir.

(b) Tidal Energy :



A dam is built across an estuary. When the tide rises (by the effect of motion of the moon) the gates of the dam are opened so that tide waters flow towards the land and fills the dam. When the tide begins to fall, the gates are closed and the trapped water is allowed to flow out again, driving a turbine and a generator to produce electricity. In this way, the generators could only be worked for certain periods each day.

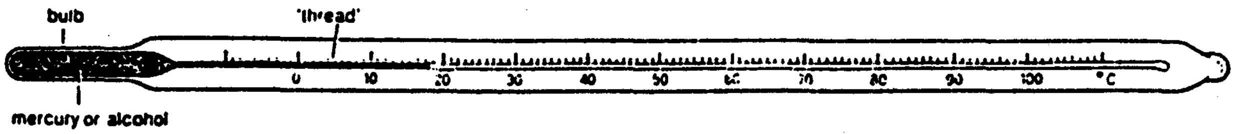
12. (a) The upper fixed point is the temperature of steam above pure boiling water under the standard atmospheric pressure.

Value = 100 °C

The lower fixed point is the temperature of pure melting ice.

Value = 0 °C

(b)



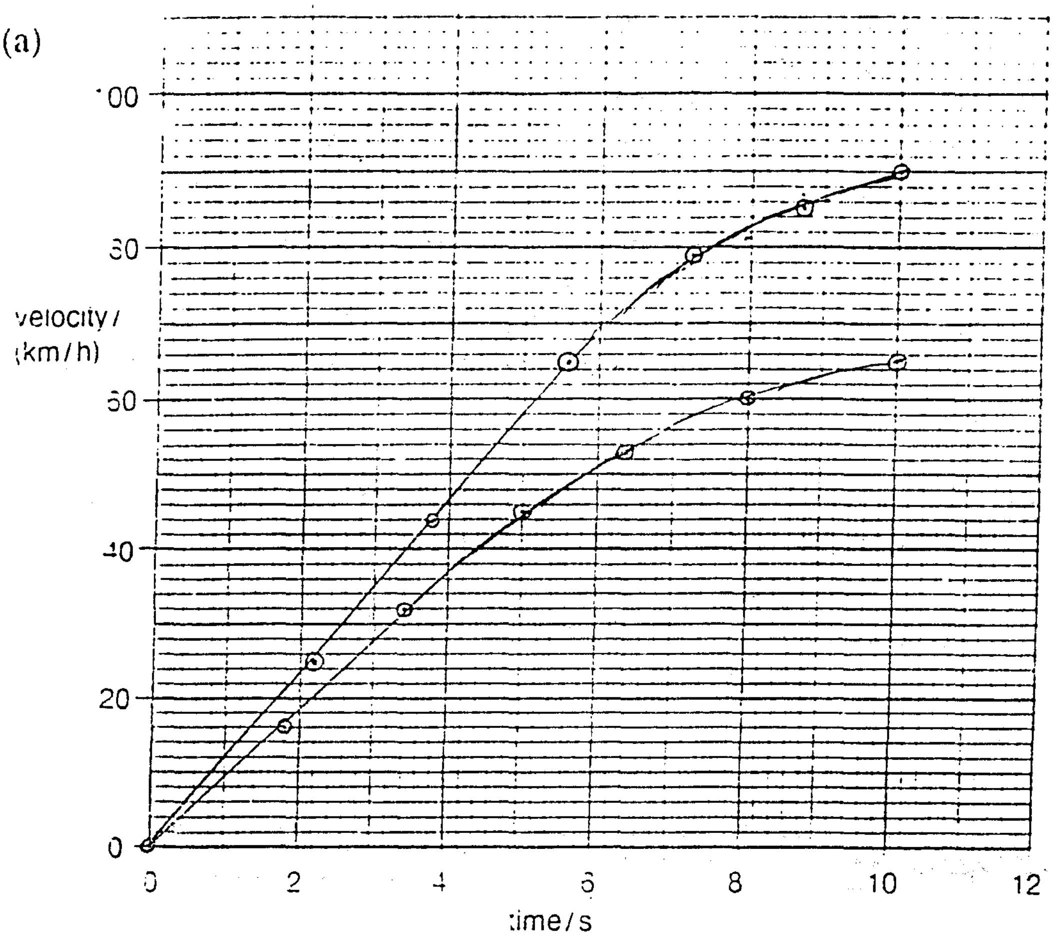
(c) * The change of resistance of a metal as the temperature changes.

* The e.m.f. produced in a thermocouple as the difference in temperature between its two junctions changes.

June 1996

Paper 3

1. (a)



(b) (i) so as to compare between their motions under the same conditions.

(ii) so that he can calculate the acceleration from the slope of each curve.

(iii) The computer measure the time between the pressure of the front wheel and that of the rear wheel on the same pad, then

$$\text{the velocity} = \frac{\text{length between front and rear wheels}}{\text{time measured}}$$

(c) (i) the car starts from rest with large constant acceleration. then the acceleration decreases gradually.

(ii) the motion on dry tyres has greater acceleration and greater terminal velocity than the motion on wet tyres.

(iii) As the speed of the car increases, the force of air resistance increases, thus the driving net force decreases and the acceleration decreases gradually. When the acceleration becomes zero, the car reaches its terminal velocity.

(iv) With wet tyres, the grip of the tyre on the road is less and the force of resistance to motion is large, so the net driving force is less giving smaller acceleration and smaller terminal velocity.

(d) (i) the change in velocity $= 90 - 85 = 5$ km/h

$$= \frac{5 \times 1000 \text{ m}}{3600 \text{ s}} = 1.39 \text{ m/s}$$

(ii) The change in momentum $= m \cdot v$

$$= 750 \times 1.39 = 1042.5 \text{ kg m/s}$$

(iii) average accelerating force $= \dfrac{\text{change in momentum}}{\text{time taken}}$

$$= \frac{1042.5}{10 - 8.7} = 802 \text{ N}$$

(e) (i) Average force of resistance on wet road = 2500 − 400 = 2100 N

(ii) " " " " " dry " = 2500 − 802 = 1698 N

(iii) The average force of resistance in the wet is greater because the wet conditions decreases the grip of the tyres of the road due to lubrication ; this increases the force of resistance to motion and decreases the net driving force.

---

(2) (a) (i) Infra-red radiations of the sun rays are absorbed by the copper tubes and raises their temperature.

* To increase the heat energy absorbed by the tubes :

1- the tubes are painted in matt black to increase absorption.

2- " " " made of copper because it is good heat conductor.

3- Very long continuous copper tubing is use to increase the surface exposed to the sun.

4- A glass plate covering the tubes helps to trap the heat radiations (green house effect).

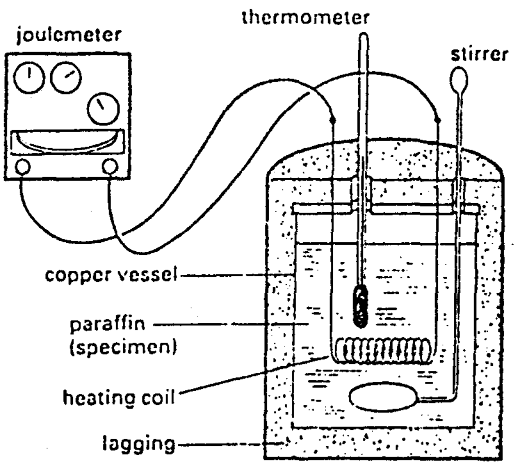
(ii) The heat absorbed by the outer surface of the tube is conducted through the copper to the inner side of the tube and then transferred to the water in the tube by conduction and radiation.

The hot water circulates so that it goes into the heating coil from the lower part up. This allows the water in the cylinder to be heated from the lower side producing convection currents.

(iii) If the heating coil is positioned nearer to the bottom the amount of hot water stored increases, but the rise in temperature would be less.

(b) (i) The specific heat capacity of a substance is the amount of heat energy needed to raise the temperature of <u>one kilogram</u> of the substance by <u>one degree</u> Celsius.

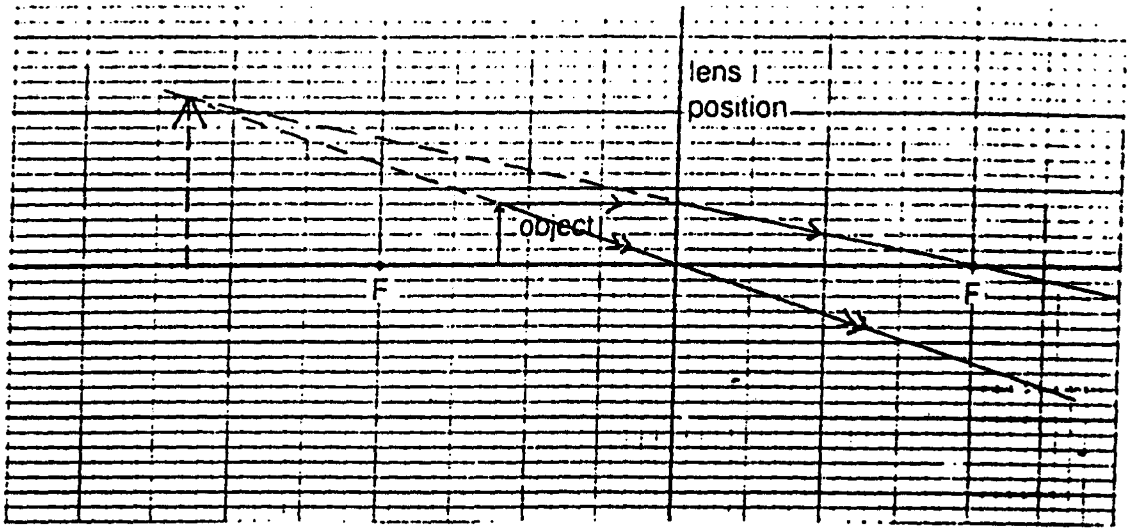
(ii)



The mass of empty beaker, m_1	=	kg
" " " beaker and liquid, m_2	=	kg
" " " the liquid, $m = (m_2 - m_1)$	=	kg
The initial temperature of liquid, θ_1	=	°C
" final " " " , θ_2	=	°C
The temperature rise, $\theta = \theta_2 - \theta_1$	=	°C
The time taken for heating the liquid, t	=	sec.
The power of the heater, P	=	Watt

$$c = \frac{P \cdot t}{m \cdot \theta} \qquad (\text{J/kg K})$$

3. (a)



(b) The lens is "convex" (converging lens).
The 2 cm lens (the 10 cm lens could also be used).

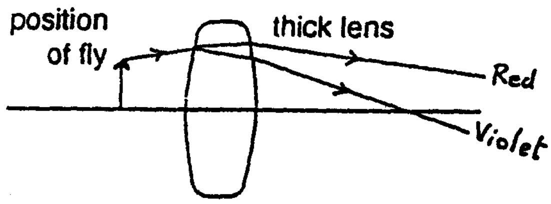
(c) Magnification = 2.75

(d) The image is "virtual".

(e) (i) Wavelength = 4×10^{-7} m

(ii) $f = \dfrac{v}{\lambda} = \dfrac{3 \times 10^{8}}{4 \times 10^{-7}} = 7.5 \times 10^{14}$ Hz

(f) As the white light passes through the glass lens, it is refracted and dispersed into the spectrum of different colours. The curvature of the lens acts like the sides of the glass prism.



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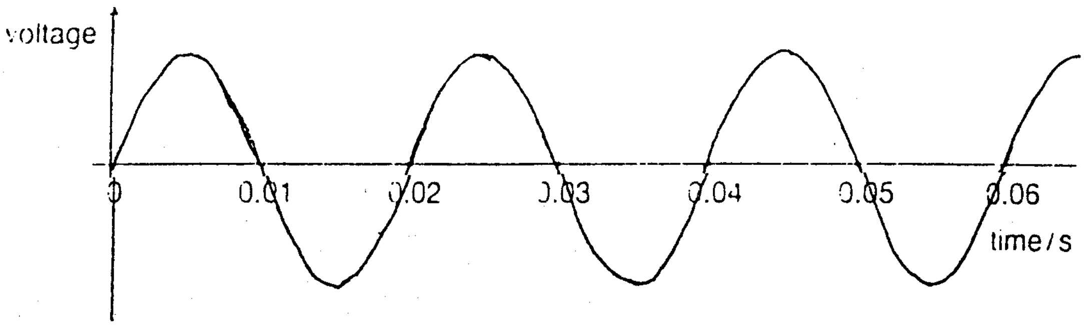
4. (a) It means that the generator supplies an energy of 300 000 joules every second.

(b) The kinetic energy of the wind is converted to rotational kinetic energy of the blades (or the sail) and the coil of the generator and this is converted to electrical energy. Some of the energy is lost as heat due to friction in the turbine and the generator - also, some energy is lost as sound.

(c)



(i) Voltage reverses its direction every 0.01 second (half a cycle).

(ii) because the ends of the coil are fixed to two copper slip rings which rub against two carbon brushes - also, because the rotating coil allows each side of the coil to reverse its direction of motion every half-cycle. This produces an alternating current.

(iii) The voltage produced increases by increasing the speed of rotation of the coil.
(can also be increased by increasing the number of turns of the coil or by using a stronger magnet).

(iv) When the rate of rotation increases, the voltage produced and its frequency both increase. In order to have an output power of constant voltage and frequency special arrangements are introduced to allow the generator to rotate at a fixed rate.

(d) (i) $$I = \frac{P}{V} = \frac{30\,000}{415} = 722.9 \text{ A}$$

(ii) The power cable should be thick, well insulated copper wire and should be kept as short as possible to keep its resistance at a minimum value.

(iii) The power loss $= I^2R$
$= (722.9)^2 \times 0.1$
$= 52258$ W
$= 52.3$ KW

The voltage drop $= IR$
$= 722.9 \times 0.1 = 72.3$ V

The transformer raises the voltage to reduce the current I and reduces the power loss and voltage drop through the cable.

5. (a) (i) The electric current through the filament heats the cathode. The hot cathode emits some of its free electrons from the metal surface (thermionic emission). The emitted electrons are accelerated and focussed into a narrow beam by the positive anode.

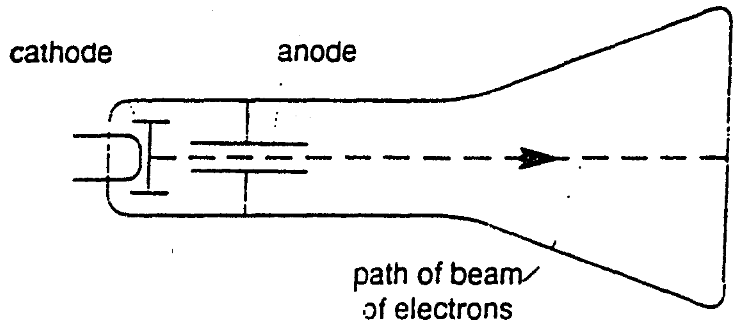
(ii) Nuclei of radioactive carbon experience some changes in their structure and emit electrons (beta particles) from the nuclei. An electron is emitted from the nucleus due to a decay of one of its neutrons changing to a proton and an electron (beta particle).

$$^{1}_{0}n \longrightarrow ^{1}_{1}p + ^{0}_{-1}e$$

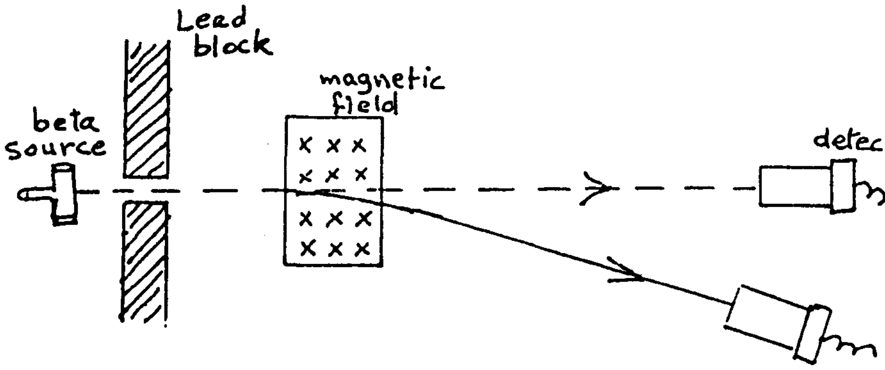
(b) (i) $^{14}_{6}C$ contains six positive protons and eight neutral neutrons.

(ii) $$^{14}_{6}C \longrightarrow ^{14}_{7}N + ^{0}_{-1}e$$

(c)



(1) When a magnetic field is applied perpendicular to the path of the cathode ray beam (directed into the paper) as shown ; the beam is deflected downwards and the bright spot on the screen is seen to move downwards.



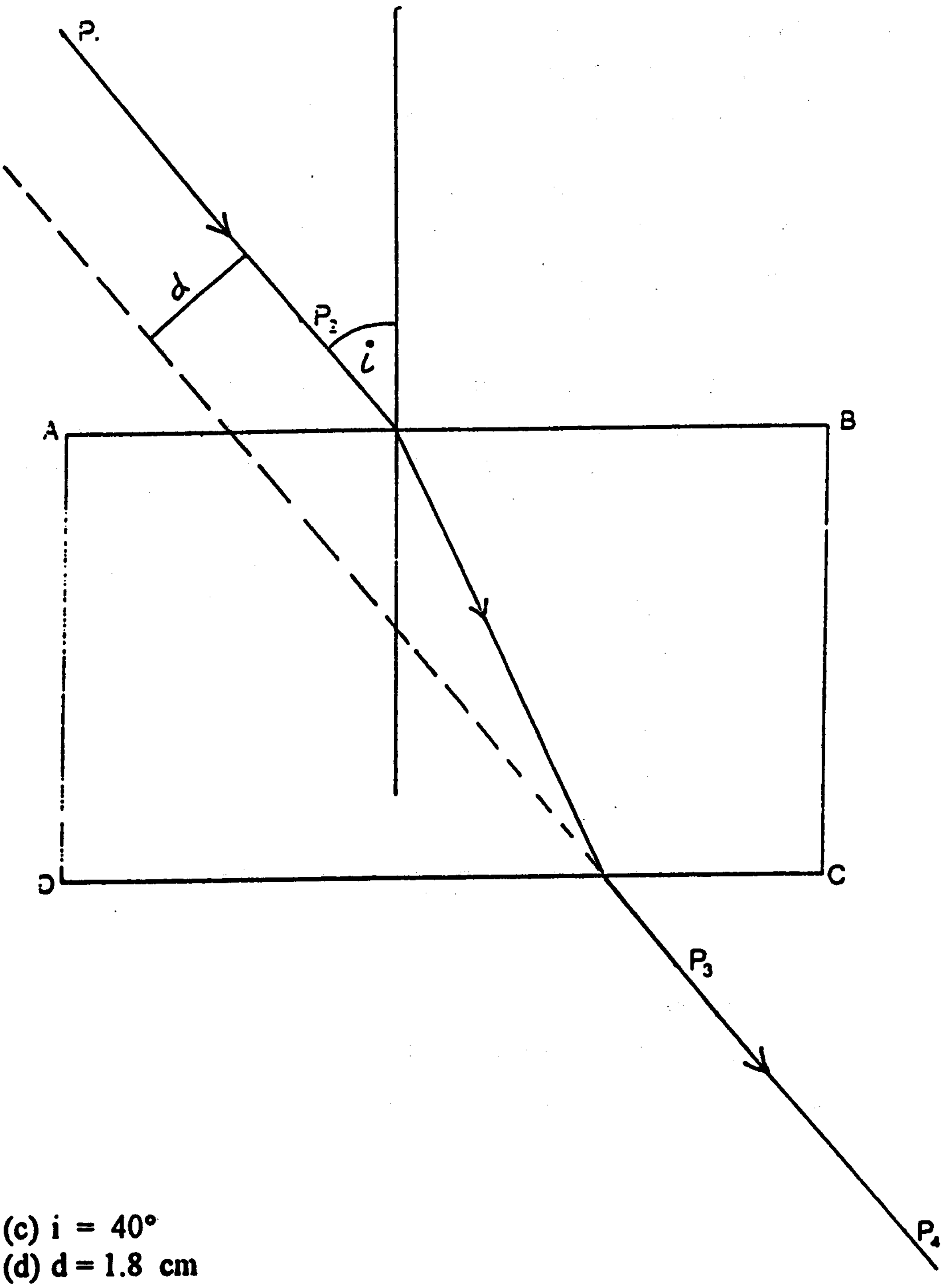
(2) A narrow collimated beam of beta particles can be detected in a straight-line direction by a G-M counter. When a magnetic field is applied perpendicular to the beam (into the paper), the count-rate detected decreases considerably. If the counter is moved gradually downwards, a position is found where the count-rate returns back to its original value, which proves that the beta-particles are deflected downwards by the magnetic field.

(3) Since the electrons and the beta-particles are deflected in the same direction by the same magnetic field, this indicates that they both carry similar electric charges (both are negatively charged).

June 1996

Paper 6

1. (a)



(c) i = 40°
(d) d = 1.8 cm

2. (a) 367 g.

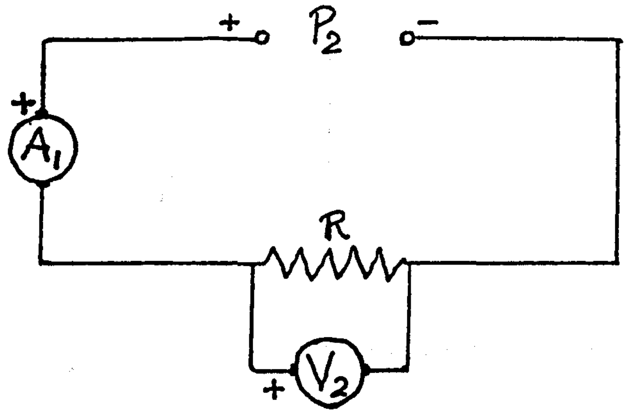
(b) (i) Largest mass : 380 g = average mass + 13 g
Smallest mass : 350 g = average mass − 17 g
(ii) (2nd box) (within 5 % of the average value).

(c) The thickness of the hook of hanger.
As the hook becomes thinner, the pressure produced by the weight becomes greater and it cuts easier through the paper (and vice versa).
(Of course, the change in the thickness of the paper and the change of the type of paper can change the outcome of the experiment).

---

3. (a) * Cut a length of one metre from the wire W_1 .
* Wind this wire on a plastic cylinder (note that the different turns should not touch each other, or use a plastic tubing as an insulator).

(b) (i)



(ii) Ammeter A_1 will give a larger deflection which allows the current to be measured accurately.

---

4. (a) The normal working potential difference is 12 V, and it consumes electrical energy equal to 50 Joules every second.

   (b) The heater is long and narrow to fit into the axial hole so it can distribute its heat evenly throughout the metal block.

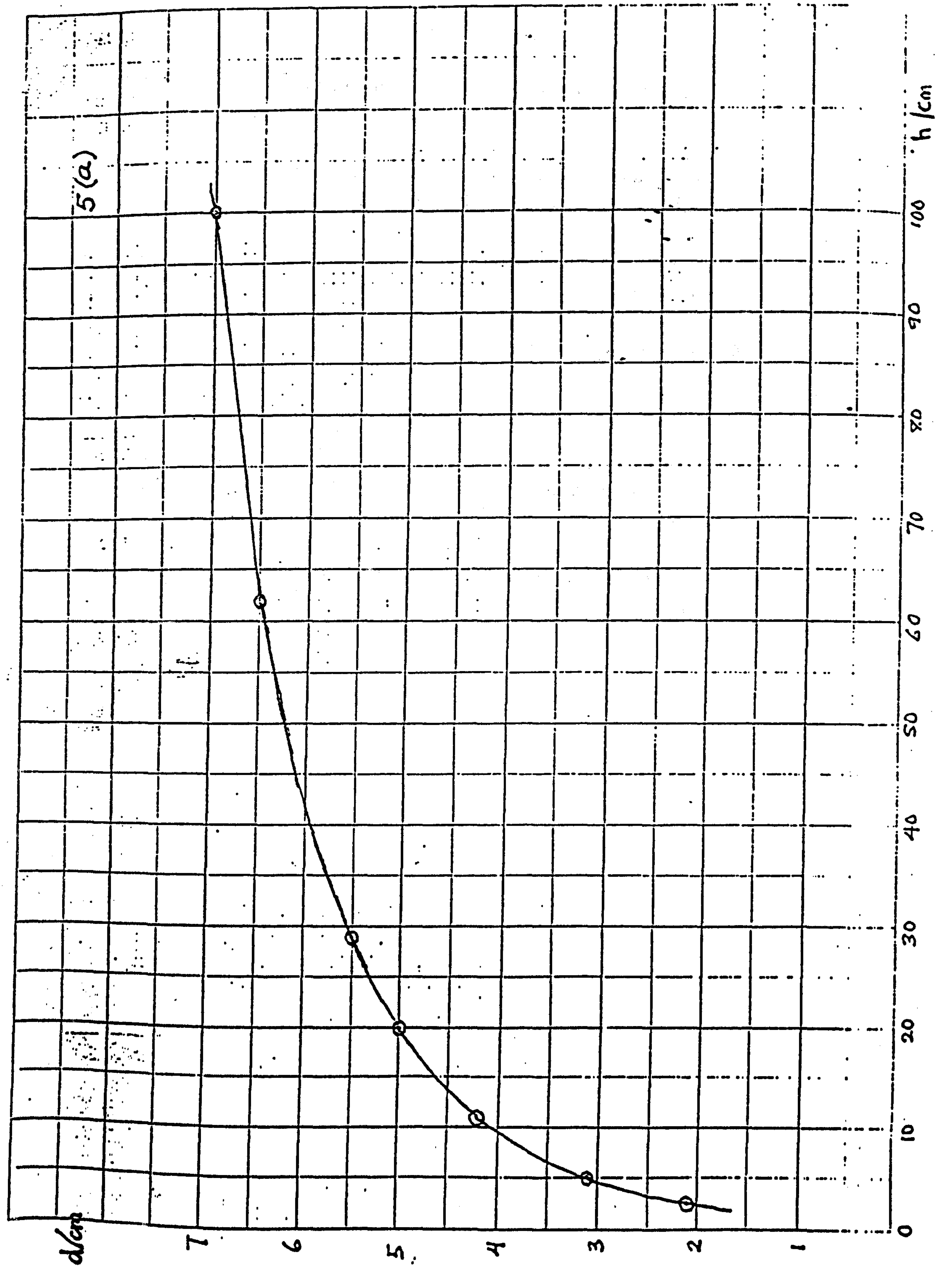
   (c) ... because the metal is good conductor of heat, and the temperature rapidly reaches the same value at all positions.

   (d) (i) one degree Celsius
   (ii) 48.5 °C.

---

5. (b) The diameter d increases as the height h increases.
   The rate of diameter increase is large at the beginning, but this rate decreases gradually until it tends to zero at great heights.

   (c) ... because the diameter of crater is not directly proportional to the height of the ball.


5(a)
h/cm
d/cm
0
10
20
30
40
50
60
70
80
90
100
1
2
3
4
5
6
7

NOV.

1996

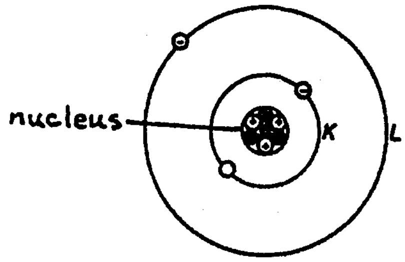
Nov. 96

1	D	11	A	21	B	31	A
2	A	12	C	22	D	32	C
3	C	13	A	23	C	33	C
4	B	14	D	24	C	34	A
5	D	15	D	25	C	35	B
6	D	16	A	26	B	36	A
7	A	17	B	27	B	37	C
8	B	18	B	28	A	38	D
9	B	19	A	29	B	39	A
10	B	20	B	30	D	40	D

NOV. 1996

Paper 2

1. The atom is made of :
   (a) a central nucleus which is positively charged. The nucleus consists of positive protons and neutral neutrons.
   (b) negative electrons which revolve around the nucleus in different orbits or shells.
   (c) The number of negative electrons equals the number of positive protons, thus the atom is neutral.

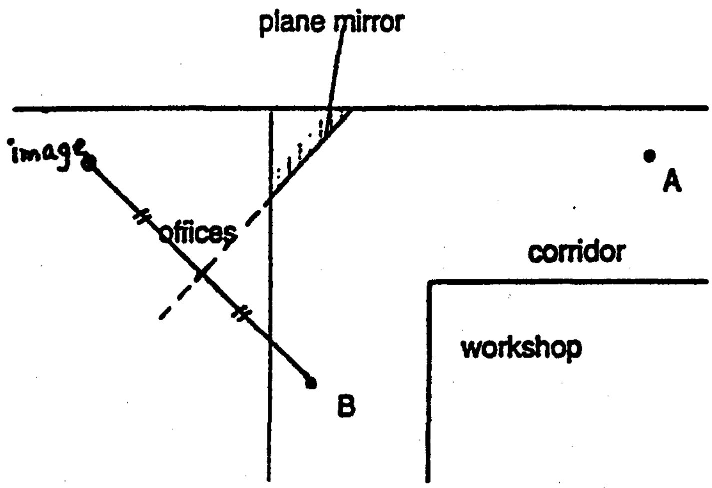


Lithium

---

2. (a) Vacuum.
   (b) (shade the mercury to the <u>same</u> height as Fig. 2.1).
   (c) level in the left-hand tube rises
   level in the right-hand tube rises.

3.



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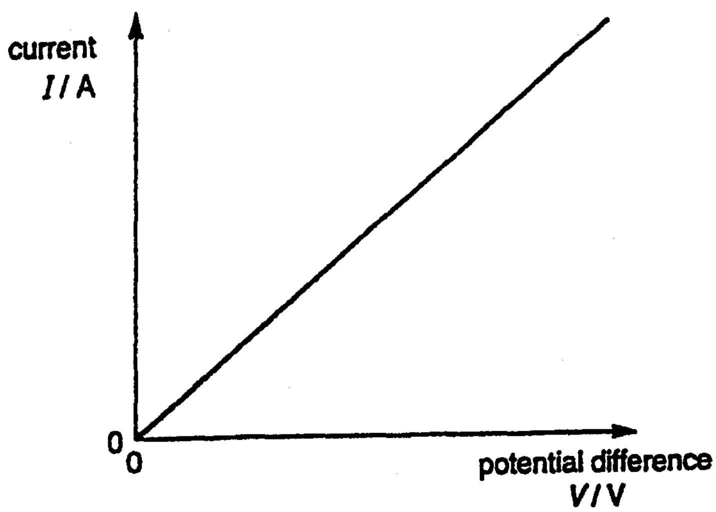
4. (a) The sound wave through the steel fence has a greater speed.
   (b) speed $= \dfrac{\text{distance}}{\text{time}} = \dfrac{100}{0.02} = 5000$ m/s

---

5. (a) $1.5 \div 2 = 0.75$ V
   (b) the reading decreases.
   (c) 1.5 V
   (d) No . The maximum voltage which could be supplied to the bulb is 1.5 V which is less than its voltage - it cannot give its full brightness.

---

6. (a) (i) It is used to change the current in the circuit.
   (ii) It is a "variable resistor" (rheostat).
   (b)



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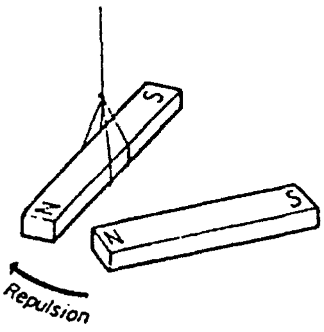
7. (a) The steel bar is stroked by a strong magnetic pole many times in the same direction.

   OR

   Place the steel bar inside a long solenoid connected to a circuit containing a battery. When the direct current flows in the solenoid for some time, the steel bar becomes magnetized.

(b)

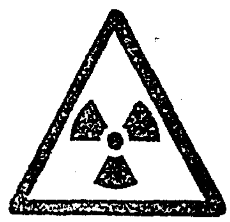


Like poles repel

Hang a magnet freely so that it can swing freely. Bring one end of the steel bar near each pole of the magnet. Notice that the steel bar will be attracted to one pole and will be repelled with the other pole which proves that it is magnetized.

---

8. (a) the correct sign.



(b) 1. Radioactive sources should be stored in special boxes lined with lead to absorb most of its radiations.
2. Store these boxes in a remote area (out-of-the-way place).

---

9. (a) (i) Chemical potential energy.
(ii) gravitational potential energy.
(b) because he has to raise the brick load together with the weight of his body.
(c) (i) The amount of work increases because the height is increased (work = F × d = mg × h).
(ii) The amount of stored energy used increases because the work needed has increased.
(d) 1. because he lifts the bricks only without lifting the weight of his body.
2. because this reduces the amount of heat energy produced and lost to the surroundings.

---

10. (a) (i) the energy of the vibrations increases,
(ii) the average distance increases.
(b) When the temperature rises in hot days, the bridge sections expand through the gaps. If there are no gaps the expanding sections may bend or may destroy the bridge.

(c) The thermal capacity of a body is the amount of heat energy required to raise the temperature of the body by one degree Celsius.

(d) (i) conduction.

(ii) copper is a better conductor of heat than iron.

(iii) 1. heat can be lost from the hot surface by radiation.

2. the hot surface can heat the air around which expands and becomes less dense and rises up then it is replaced by cool air, this produces convection currents.

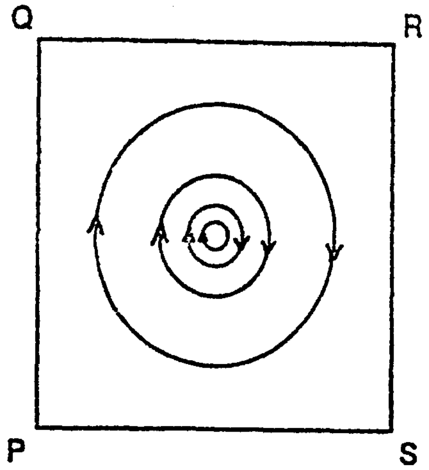
---

11. (a) (i) It is a safeguard against excessive currents which produce excessive heating and may cause fire. If a fault occurs in the circuit and the current exceeds 10A, the circuit-breaker switches off the circuit.

(ii) $I = \frac{V}{R} = \frac{20}{4} = 5A$

(iii) No, because the value of the current (5A) is less than the value of the circuit breaker.

(b)



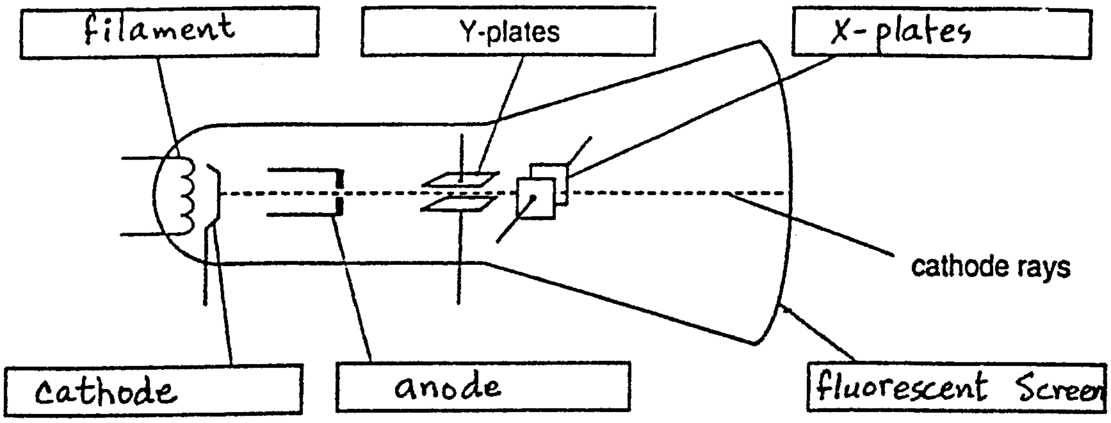
(c) (i) R (combined) $= R_1 + R_2$

$= 4 + 4 = 8\ \Omega$

(ii) Current becomes <u>half</u> its previous value (second box).

---

12. (a) (i)



(ii) a vacuum
(iii) heating to very high temperatures
(iv) cathode rays consist of a beam of fast-moving electrons.

(b) interchange the two wires connected to the Y-input.
(<u>or</u>, interchange " " " " " " d.c. supply).

(c) (i) the length of the line will <u>increase</u>
(ii) the time-base circuit should be switched on.

Nov. 1996

Paper 3

1. (a) (i) The lift starts from rest and accelerates - its acceleration decreases until it moves at a uniform speed.

(ii) The lift decelerates with a large deceleration, then the deceleration decreases until the lift stops.

(b) The distance travelled equals the area under the (v, t) graph. The area can be treated as two trapeziums (the lower one has a height of 0.6 m/s, and the upper one has a height of 1.34 m/s).

The area $= [\frac{1}{2}(10+8.8)\times 0.6]+[\frac{1}{2}(8.8+6.8)\times 1.34]$

$\therefore$ Total distance = 16.1 m

Average distance between the floors = 16.1 ÷ 3 = 5.4 m

(c) (i) Total mass = 350 + (65 × 6) = 740 kg.

Total mass = m g = 740 × 10 = 7400 N

(ii) Increase in potential energy $= (mg)\,h$
$= 7400 \times 16.1$
$= 129140$ J

(iii) Power $= \frac{E}{t} = \frac{129140}{10} = 12914$ W

(d) 1. Some energy is lost due to friction with the walls, it appears as heat and sound.

2. The efficiency of the motor is never 100 %.

3. More passengers may use the lift (the load becomes greater).

(e) 1. As the lift starts to move upwards with an acceleration, the passenger feels the <u>upward force</u> (F = ma).

2. When the lift moves uniformly, there is no acceleration (F = 0) and the passenger feels no force.

3. On approaching the third floor, the lift decelerates and there is a decelerating force (F = ma) in the downward direction. The passenger feels a though her feet were coming off the floor.

(f) $a = \frac{v-u}{t} = \frac{0-1.9}{2.2} = -0.86 \ m/s^2$

average deceleration = 0.86 m/s^2

2. (a) (i) Total pressure in old tyre $= (1.0 + 0.9) \times 10^5$
$= 1.9 \times 10^5$ Pa
Total pressure in new tyre $= (1.0 + 1.1) \times 10^5$
$= 2.1 \times 10^5$ Pa

$$V_1 P_1 = V_2 P_2$$
$$V_1(1.9 \times 10^5) = 0.015(2.1 \times 10^5)$$
$$\therefore \; V_1 = 0.017 \;\; m^3$$

(ii) Volume change $= 0.017 - 0.015 = 0.002 \; m^3$

(b) As the temperature of the air rises, the molecules of air gain more energy ; they move faster thus they collide with the tyre walls harder and more frequently which increases the air pressure.

(c) When the temperature rises, the water evaporates and water vapour produces a pressure which is added to the air pressure. P_2 is the sum of air pressure plus the water pressure, but P_1 is the air pressure alone - therefore, P_2 becomes greater than P_1.

---

3. (a) (i) f = 45 vibrations / min.
In deep waters : $\lambda = 1.5$ cm
$V = f \times \lambda$
$= 45 \times 1.5 = 67.5$ cm/min.
In shallow waters : $\lambda = 0.8$ cm
$V = f \times \lambda$
$= 45 \times 0.8 = 36$ cm/min.
* The frequency remains constant.

(ii) 1. Reduce the height of water in the shallow section (make it shallower).
2. Increase the angle of incidence of the incident ray of the wave.

(b) (i) Refractive index of glass $= \dfrac{\text{speed of light in air}}{\text{'' '' '' '' glass}}$
$$= \frac{3 \times 10^8}{2 \times 10^8} = 1.5$$

(ii) The ray of light bends towards the normal to the air glass boundary (the angle of refraction is smaller than the angle of incidence).

(iii) The angle of refraction = 55 − 22 = 33°

$$\text{Refractive index of glass} = \frac{\sin \hat{i}}{\sin \hat{r}} = \frac{\sin 55}{\sin 33} = \frac{0.819}{0.545} = 1.50$$

---

4. (a) * D is a general switch. Its purpose is to switch the whole circuit on or off.
   * E is a fuse. Its purpose is to switch off the circuit if an excessive current flows due to a short circuit.
   * F is a local switch. Its purpose is to switch lamp A on or off.

(b) (i) The total power $= VI$

$= 240 \times 1.46 = 350.4$ W

The power of A and B $= 2 \times 100 = 200$ W

The power of C $= 350.4 - 200 = 150.4$ W

(ii) $R\,(\text{of } A) = \dfrac{V^2}{P} = \dfrac{(240)^2}{100} = 576\ \Omega$

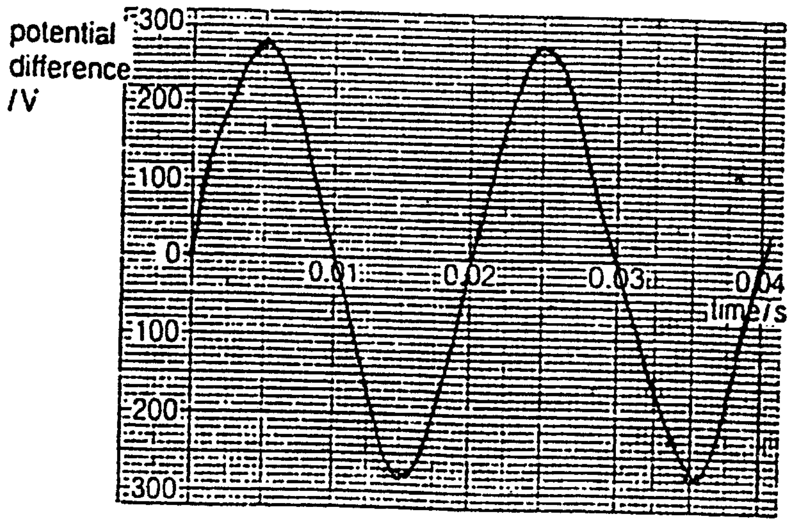
(c) When the lamps are connected in series :

1. The combined resistance of the lamps increases,
2. The current through the lamps decreases,
3. The p.d. across each lamp decreases,
4. The lamps do not light up unless all the switches are closed simultaneously. If one switch is opened all the lamps are off.

(d) 1. When using half the cross-sectional area, the resistance of the wire is doubled ($R \propto 1/a$).

2. When using half the length, the resistance is halved ($R \propto \ell$).
3. When making the two changes, the resistance of the wire is not affected (its value remains the same).

(e)



(f) $P = \frac{V^2}{R} = \frac{(200)^2}{576} = 69.4 \text{ W}$

The power of the lamp is reduced and its brightness is decreased (it lights up dimly).

---

5. (a) (i) The α - particles are completely absorbed by the aluminium foil and cannot be detected by the GM tube.

(ii) All γ - rays can penetrate the aluminium foil. A small change in foil thickness does not affect the gamma absorption, i.e., the GM tube cannot detect small changes in foil thickness.

(b) When the foil is thin most of the beta particles can reach the ratemeter, thus the count rate is high. When the thickness of foil increases, the absorption of beta particles increases and the count rate is decreased.

(c) (i) $^{90}_{38}Sr \longrightarrow ^{90}_{39}Y + ^{0}_{-1}e$

(ii) The half-life is the time taken to reduce the activity of a radioactive source to half its original value.

(*) If the isotope has a long half-life helps to keep its activity (or the count rate) almost constant during the time of the measurement.

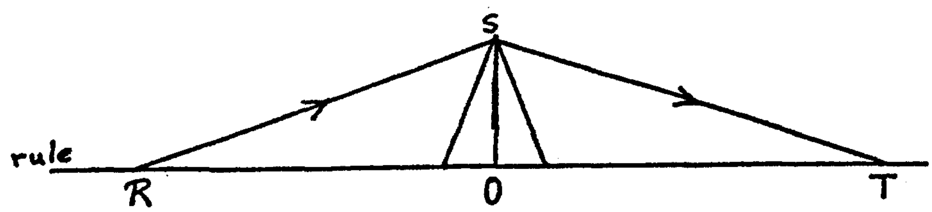
Nov. 1996

Paper 6

1. (a) h_o = 89.2 cm
   h_1 = 74.2 cm
   d = 89.2 − 74.2 = 15.0 cm
   (b) This is important to avoid the confusion which might occur due to the thickness of the rule. One has to take all the readings from the same reference line.
   (c) (i) $y = \frac{x}{d} = \frac{1}{150} = 0.007$
   (ii) The measurements taken are very reliable because the fractional error y is very small.

---

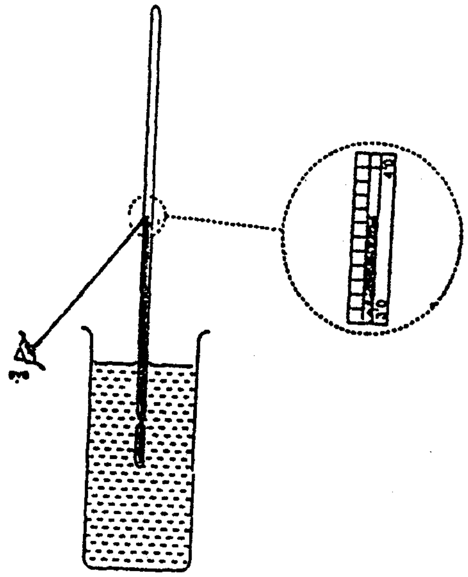
2. (a) ... so that the eye can see the light passing only through the upper tip of the prism.
   (b) The white light can be dispersed by the prism to its seven component colours ; but the red light is not dispersed, it remains red only.
   (c) ... so that he can choose one single direction for the incident ray.
   (d)



One should measure :
1. The height of the prism (SO in diagram)
2. The distance from R to O.
3. " " " O to T.

---

3. (a)



The line of sight from the eye to the mercury meniscus passes through a mark lower than 36.5 °C. This error is due to parallax.

(b) (i) thermometer no. 2

(ii) thermometer no. 2 and 3

(iii) thermometer no. 3

(c) 1. Immerse one third of the thermometer (100 mm) into the liquid.

2. The line of sight of the eye should be perpendicular to the scale to avoid the error due to parallax.

---

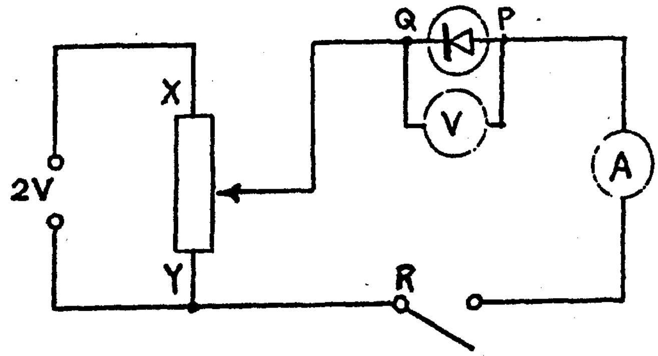
4. (a) (i) Zero.

(ii) 2 V.

(b) Before the switch is closed, the slider should be at Y so that the voltage applied to the diode would be zero and the current is also zero.

(c) With the slider at Y, the switch is closed noticing that V = 0 and I = 0. Increase the voltage gradually by moving the slider slowly towards X and notice the increasing value of the current. When I = o.5 A, stop moving the slider and record the value of the voltmeter reading.

(d)

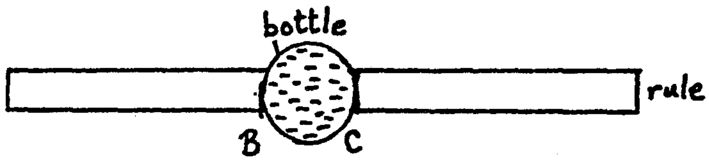


Reverse the direction of current in the diode, by interchanging the pints P & Q .

---

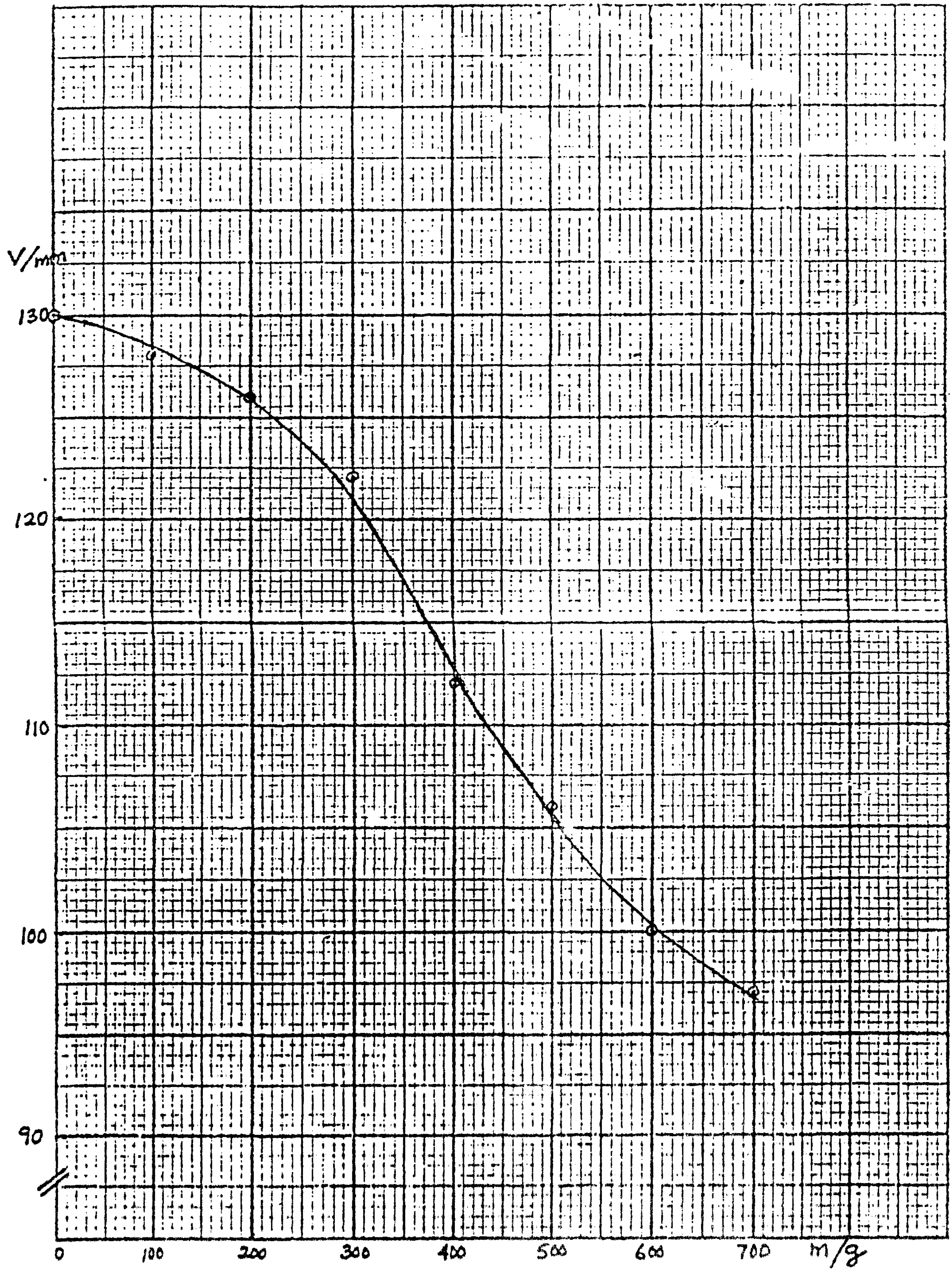
5. (a) (i) See the graph on page 279.
(ii) The image distance, v, decreases as the mass of sugar dissolved, m, increases.
(iii) The power of the converging lens increases as the mass of sugar dissolved increases.

(b)



The bottle is placed on the rule such that its diameter exactly touches the marks B and C as shown in the diagram.

Nov. 1996 Paper 6



JUNE

1997

June 1997

Paper 1

1	C	11	D	21	A	31	A
2	A	12	B	22	D	32	C
3	B	13	D	23	B	33	C
4	B	14	A	24	D	34	A
5	D	15	A	25	A	35	A
6	B	16	A	26	A	36	C
7	A	17	D	27	B	37	A
8	C	18	A	28	A	38	A
9	B	19	D	29	D	39	B
10	B	20	C	30	A	40	C

June 1997

Paper 2

1. The time of 20 oscillations = $20 \times 0.5 = 10$ s
   The reading of stop-watch = $10 + 0.4 = 10.4$ s

---

2. (a) (i) The mass (m) of the load,
   the height (h) which it has been lifted, and
   the acceleration due to gravity (g).
   (ii) The time (t) taken to lift the load.

   (b) Some energy is lost as heat and sound due to friction in the crane.

---

3. (a) Electrical energy.
   (b) The pointer of the voltmeter deflects and its reading increases gradually then it stops at a constant value.
   (c) One can use a time delay circuit to switch off a radio after a certain period of time (after one has gone to sleep).

---

4. (a) Good conductor of heat : aluminium, copper, iron.
   (b) " " " electricity : aluminium, copper, iron.
   (c) "Good conductors of heat are also good conductors of electricity" (because they contain free electrons).
   (d) (i) Cooking pans.
   (ii) Conducting cables (lamp filament).

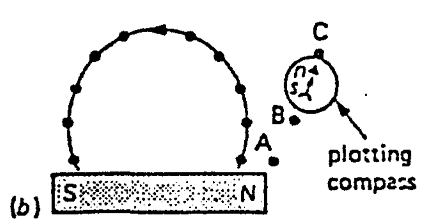
---

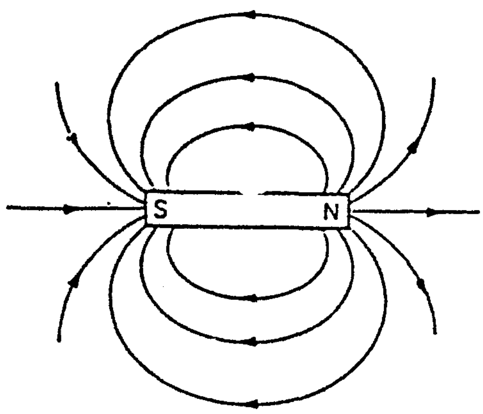
5. (a) Alcohol,
   ... because its freezing point is very low (– 112° C) and it remains in the liquid state at very low temperatures.
   (b) Mercury,
   ... because its boiling point is very high (360° C) and it remains liquid at 200° C (away from boiling).

---

6. (a) Virtual.
   (b) Erect (upright).
   (c) Same size.

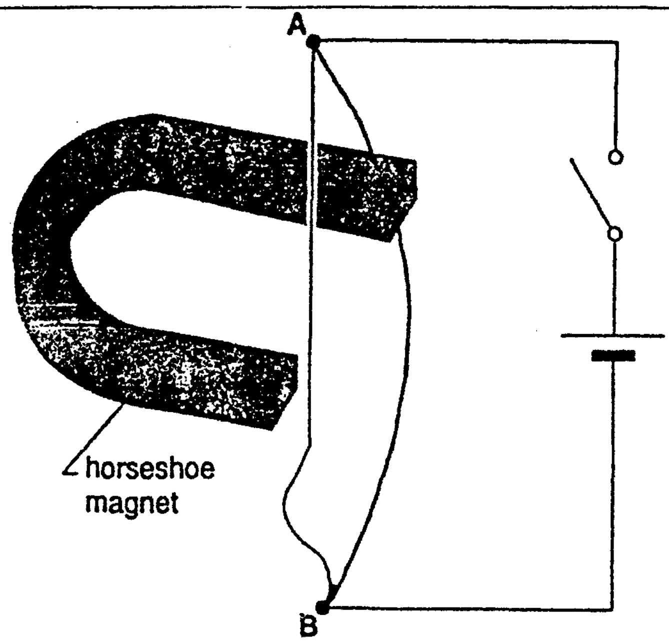
7.





1. Place the magnet on a sheet of paper and trace around it.
2. Starting near one end of the magnet, the positions of the ends of the compass needle are marked by pencil dots.
3. The compass is then moved a little and the ends of its needle are marked again by pencil dots.
4. This process is repeated many times until the compass reaches the other end of the magnet.
5. Other lines of magnetic field are drawn in the same way.
6. Mark the lines with arrows indicating the direction of the north pole of the compass.

8.



9. (a) The molecules in a gas travel in random directions and may also rotate. They move with different velocities, but their average kinetic energy is proportional to the temperature. They collide with each other and with the walls of the container.

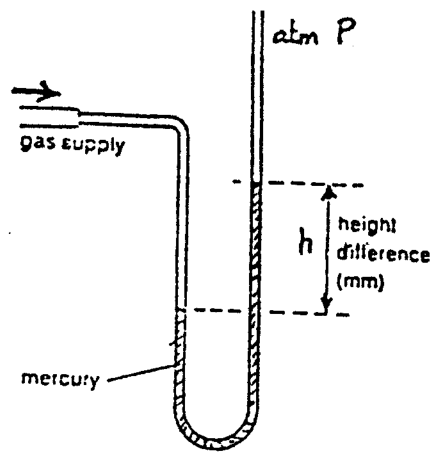
(b) (i) Smoke particles reflect the light falling on them, and are seen as bright specks against a dark background moving in random directions.
(ii) The relatively large smoke particles are surrounded by much smaller and much faster air molecules. Air molecules bombard the smoke particles randomly from all directions causing the smoke particles to move randomly.

---

10. (a) (i) The heavy weight of the camel is applied on large flat area of the feet, so the pressure produced is small and the feet do not penetrate into sand.
(ii) The heavy weight of the parcel is applied on the small area of the string producing very high pressure on the hand so it becomes painful.

(b) If the hole is near the bottom of the boat, it is deeper in the water where the pressure is higher and the flow of water into the boat is greater thus it sinks more quickly.
(If the hole is higher up, the contrary occurs).

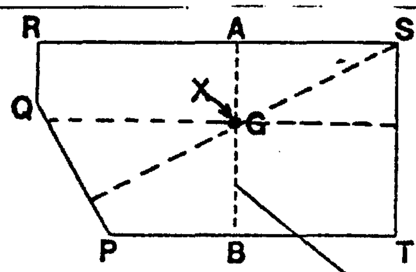
(c)



2. The other end is connected to the gas tap through a rubber tube.
3. The pressure difference pushes the mercury round the U-tube, and the height difference between the levels is measured by a meter rule.
4. The pressure of the gas = atoms. p ± height diff. (Using the same units).

---

11. (a)



(b) (i) the bottle on the right is more stable.
1. It has a larger base area, and
2. its center of mass is lower.

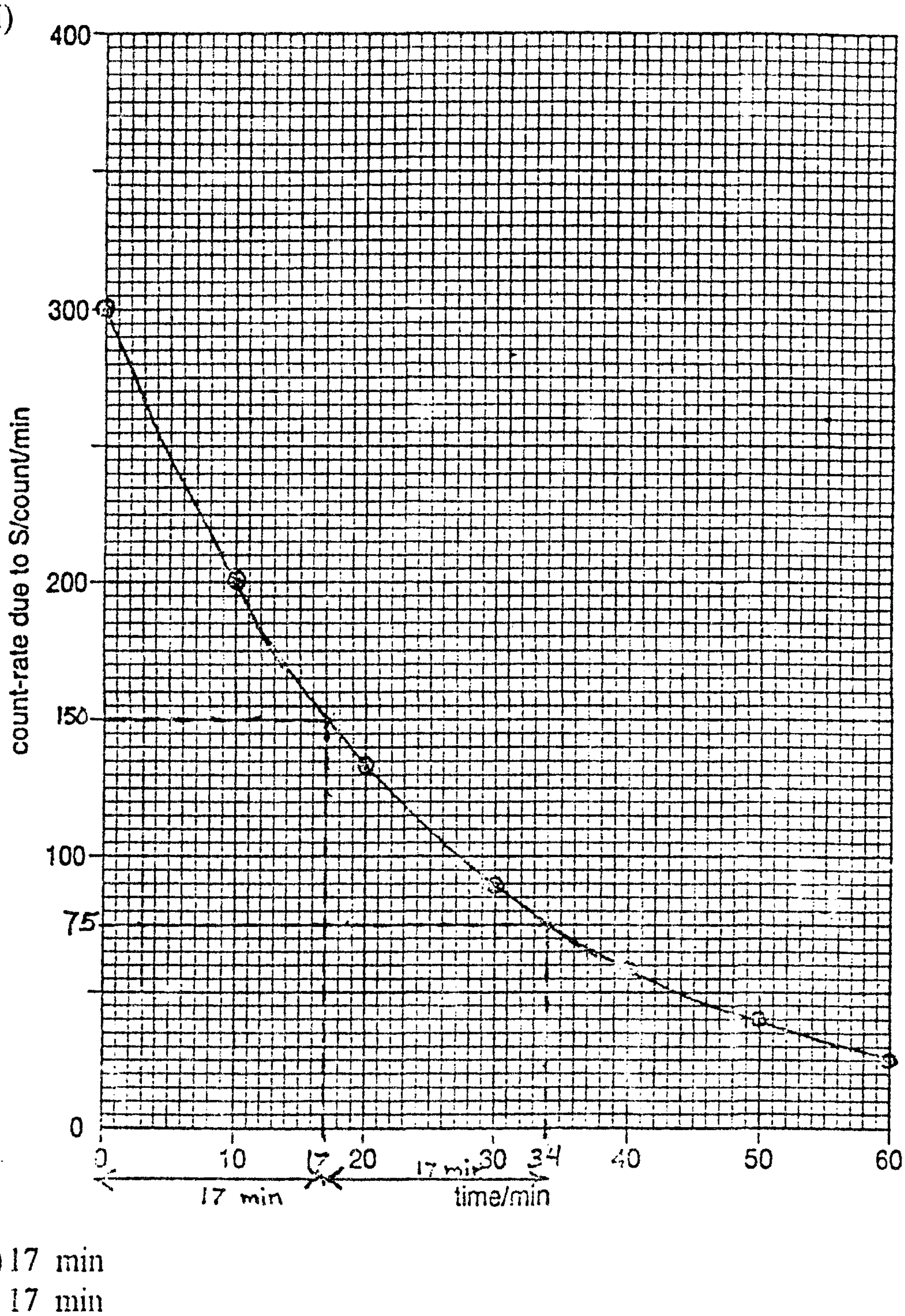
(ii) the glass on the left is more stable, because its center of mass is lower.

(c) the block on the left,
because its base area is smaller.

12. (a) (i) the background radiations.

(ii) 300, 200, 133, 89, 58, 40, 25.

(iii)



(iv) 17 min

17 min

17 min

(v) 300 c/min, one half-life before, it was 600 c/min

two half-lives before, it was 1200 c/m

three " " " , it was 2400 c/min

(or 2430 c/min including the background).

The time of three half-lives = $3 \times 17 = 51$ min

time before experiment began = 51 min.

(b) (i) * a β-particle is a fast moving negative electron

* an α-particle is a helium <u>nucleus</u> ^4_2He (consists of two protons and two neutrons).

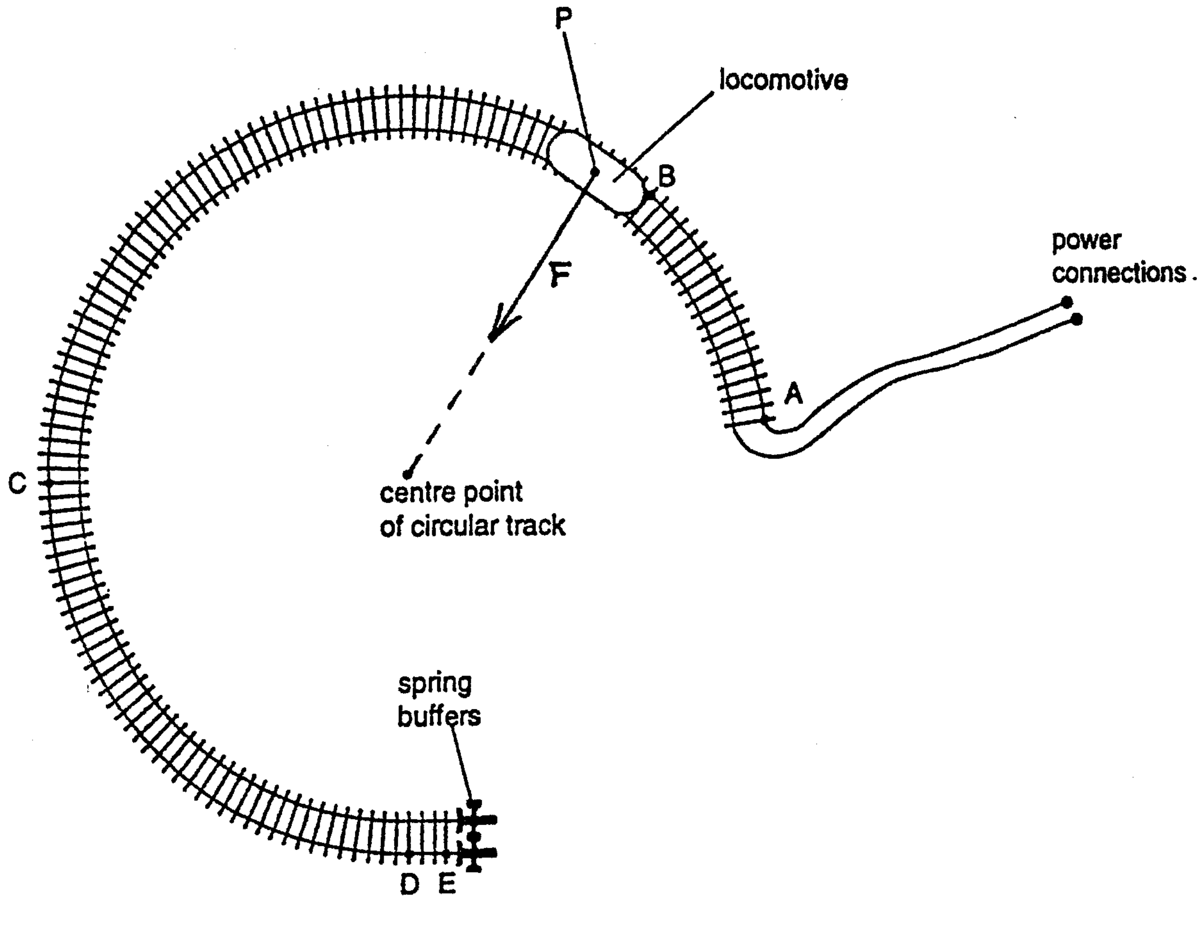
(ii) because the smoke does not absorb (or stop) the beta particles.

(iii) Source S is not suitable because it has a short half-life (17 min) and its radiations will decay (die down) after few hours.

June 1997

Paper 3

1. (a) (i)



(ii) The centripetal force is applied to the wheels of the locomotive due to sideways friction between the wheels and the railway track.

(iii) Since, F = m a

$\therefore \quad a = \frac{F}{m} = \frac{0.032}{0.40} = 0.08 \ m/s^2$

(iv) Although the speed is constant, yet the direction of the locomotive is changing during its circular motion; thus the velocity is changing and the locomotive is accelerating. The acceleration changes the direction constantly while keeping the speed constant.

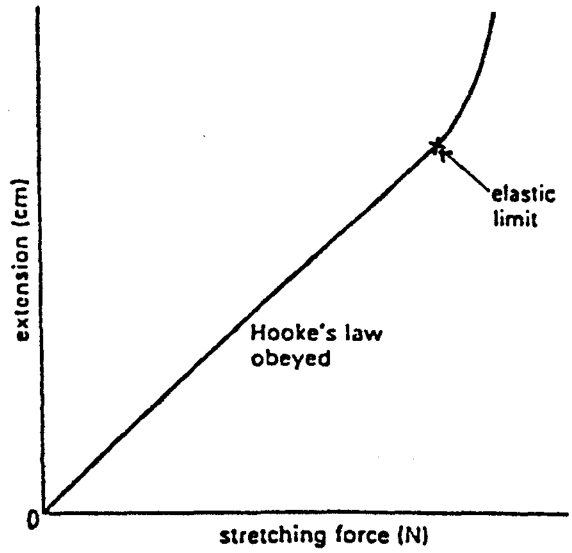
(b) (i) 1. change in momentum $= \text{mass} \times \text{change in speed}$
$= 0.40\,(0.20 - 0.15)$
$= 0.02\ \ \text{kg m/s}$

2. Average force $= \text{change in momentum} \div \text{time}$
$= 0.02 \div 0.30 = 0.07\ \text{N}$

3. Average power loss $= \text{average force} \times \text{average velocity}$
$= 0.07 \times 0.175$
$= 0.012\ \ \text{Watt}$

(ii) The locomotive collides with the spring buffers applying a force on them, and the spring buffers produce a reaction force which is equal in value and opposite in direction - this reaction force causes the locomotive to rebound.

(c) (i) The limit of proportionality is the point at the end of the straight line region. It gives the maximum force which could be applied to the spring so that the spring returns to its original length when this force is removed. If a greater force is used, the spring becomes permanently stretched or deformed.



(ii) 1. The spring is hanged from one end and then stretched by hanging a standard mass (m) from the other end.
The force applied (in N) = m (in kg) × (10 m/s^2)
2. Add standard masses several times and record the extension produced each time. Plot the relation between the load and the extension on a graph paper. Determine the point at the end of the straight line region to find the limit of proportionality.

2. (a) (i) The sun rays heated the petrol vapour and air in the can. The molecules gained kinetic energy so they moved faster and collided with the walls of the container harder and more frequently. This increased the pressure in the can until it burst open.

(ii) The plastic is a bad conductor of heat, so the heating of the vapour would be less and the increase in pressure will be less. Also, the plastic is flexible, a small rise in pressure can cause the can to get fatter and may not burst.

(b) (i) The relatively large smoke particles have relatively large masses. They are surrounded by much lighter and much faster air molecules. Air molecules bombard the smoke particles randomly from all directions causing the smoke particles to move randomly in zig-zag paths.

(ii) 1. Air molecules are constantly in motion, so they possess kinetic energy due to their velocities.

2. The motion of air molecules is random, i.e., they move in all directions randomly.

(c) 30 % of the gas remains in the same volume, so the pressure drops to 30 % of its original value.

$$P = (5.0 \times 10^5) \times \frac{30}{100}$$
$$= 1.5 \times 10^5 \text{ Pa}$$

---

3. (a) (i) The speed of light is much much greater than the speed of sound, therefore, the lighting is seen before hearing the thunder sound.

(ii) Distance = speed × time

$= 340 \times 3.1 = 1054$ m

(iii) The distance when the time is 8 min

$D = 340 \times 1.9 = 646$ m

The distance the storm moved in 2 min = 1054 − 646 = 408 m

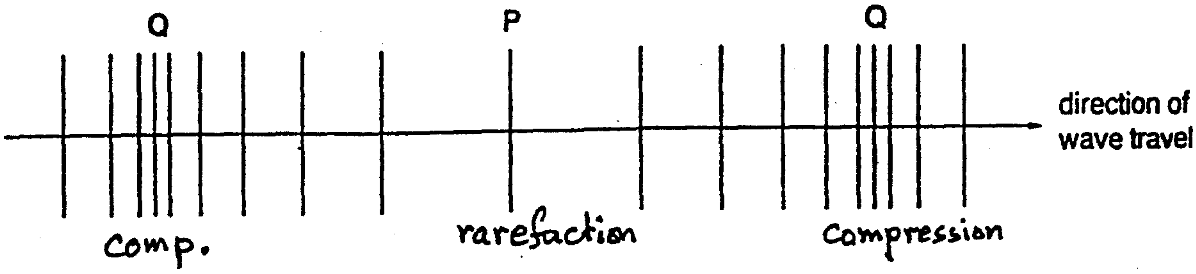
The speed of storm $= \frac{\text{distance}}{\text{time}} = \frac{408}{2} = 204$ m/min

$= 204 \times \frac{60}{1000} = 12.24$ km/h

(iv) At the begining, the storm was moving towards the observer ; then it moved away from the observer.

(b) (i) The light wave is an electromagnetic wave. The trace shows how the amplitude of the wave change with the distance from the source of light.

(ii)



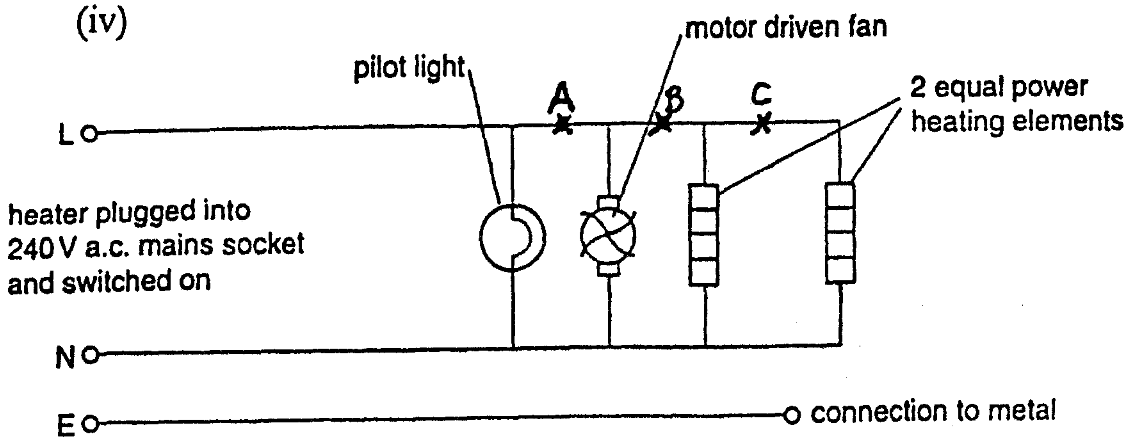
* P is a region of rarefaction where the molecules of air are farther away from each other and the pressure is lower than normal atmospheric pressure.
* Q is a region of compression where the molecules of air are very close to each other and the pressure is higher than normal pressure.

(c) * at M the light is bent (refracted) and is disperesed into its different colours.
* at N the light is totally internally reflected. (because the angle of incidence is greater than the critical angle).
* at O the light is refracted out into the air.

---

4. (a) (i) ... because they are all connected in parallel and are plugged into the mains socket.

(ii),(iii), (iv)



(v) A resistor (with a parallel switch across it) can be connected in series with the motor of fan.

(b) (i) The total power = 15 + 75 + 850 + 850 = 1790 W

The greatest current = $\frac{P}{V} = \frac{1790}{240} = 7.46$ A

(ii) 1. 10 A fuse.

2. The fuse rating should be a little higher than the maximum current required for normal use. If the current drawn becomes excessive the fuse melts and breaks the circuit.

3. This is the case of a short-circuit where the current becomes very high which causes the fuse to melt and break the circuit.

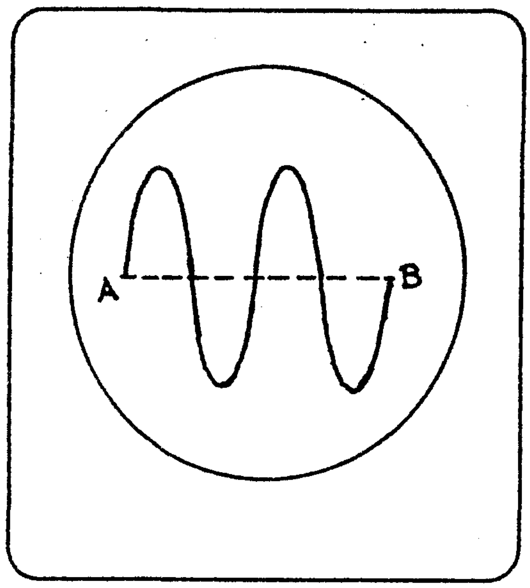
(iii) The power of fan and pilot light = 75 + 15 = 90 W

$$R = \frac{V^2}{P} = \frac{(240)^2}{90} = 640 \text{ ohm}$$

(iv) Electric energy purchased = $\frac{100}{6.2}$ = 16.13 kwh.

$$E = P \times t$$
$$16.13 = 1.79 \times t$$
$$t = 9 \text{ hrs.}$$

(c) (i)



(ii) In a faulty supply, the negative half of each cycle has a very small amplitude, so the average energy supplied to the lamp and heaters is less than normal and gives dimmer light and less heat.

(iii) From the graph, the periodic time of one complete cycle (T) is 0.02 sec.

$$\text{frequency} = \frac{1}{T} = \frac{1}{0.02} = 50 \text{ Hz.}$$

---

5. (a) (i) An α-particle is made up of two positive protons and two neutral neutrons.

(ii) ... because the atoms of the metal sheet consist mainly of empty space.

(iii) ... because those particles passed very close to the positive central nucleus and were repelled by it.

(iv) 1. Most of the atom is empty space.

2. The central nucleus is very small compared to the atom.

3. The nucleus is positively charged.

4. Because each atom is neutral, the electrons revolving about the nucleus should carry a negative charge equal to the positive charge of the nucleus.

(b) (i) The radiation <u>ionizes</u> the low-pressure gas producing positive ions and negative ions.

(ii) The potential difference between X and Y accelerates, multiplies, and collects the ions.

(iii) When a radiation enters the tube, ionization occurs and the ions are accelerated and collected by X and Y. An electric current passes in the outside circuit for a very short time, this is called a "pulse" of current.

(iv) Since each particle entering the G-M tube produces an electric pulse ; then counting the number of pulses per unit time by a scaler gives the value of the activity of the radioactive source.

June 1997

Paper 6

1. (a) $t = 3$ mm
   $d = 1.5$ mm

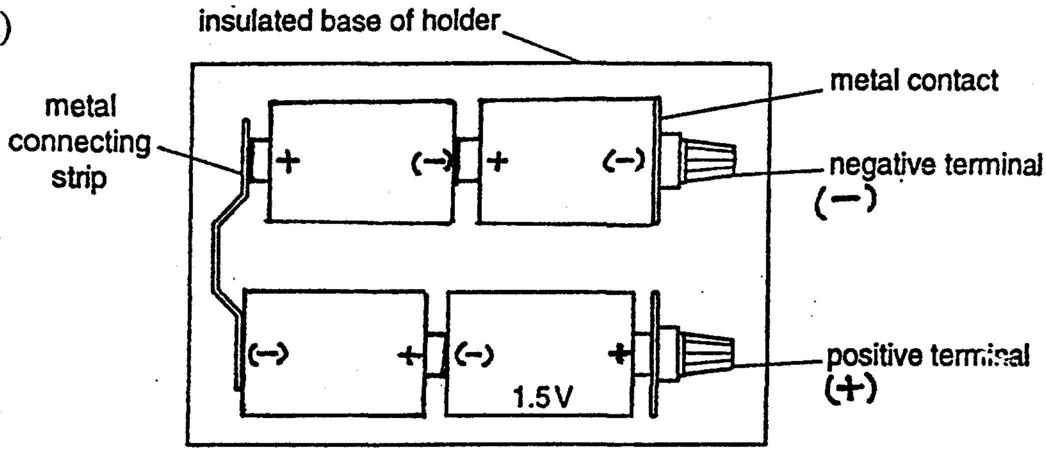
   (b) $\ell = 115.5$ mm
   $d_{av} = \frac{115.5}{91} = 1.3$ mm

   (c) ... better than 1 %.
   The error in measuring ℓ (115 mm) is less than 1 mm, which is less than 1 % of the 115 mm.

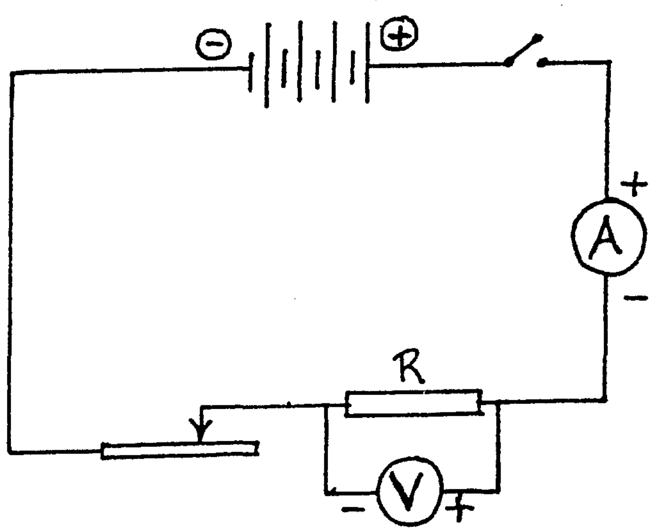
   (d) The value of d_{av} is an average value of a very large number of wires, so its accuracy is greater than that of d.

---

2. (a)



   (b)



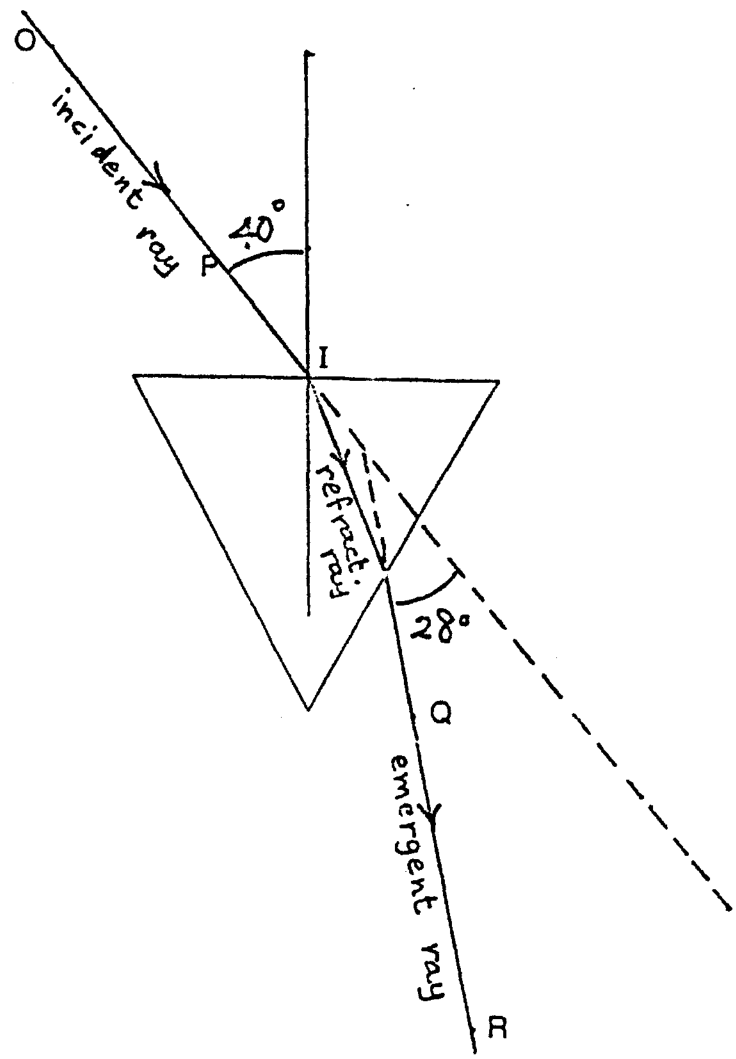
(c) (i) Zero V
(ii) 0 – 7.5 V
(iii) I would increase the resistance of the variable resistor.

---

3. (a) Time taken for A = 20 min
Time taken for B = 4.5 min
(b) (i) ... because the bottle in B is in direct contact with the frozen jacket and is cooled by conduction which is faster.
(ii) ... because the water in the bottle and the liquid in the jacket have reached the same temperature.
(iii) 1. The mass of the frozen liquid in the jacket.
2. The type of material of the frozen liquid (specific heat capacity of material).
(iv) ... because the silver colour is a good reflector of heat radiations coming from the environment. This reduces the heat gained from the environment.

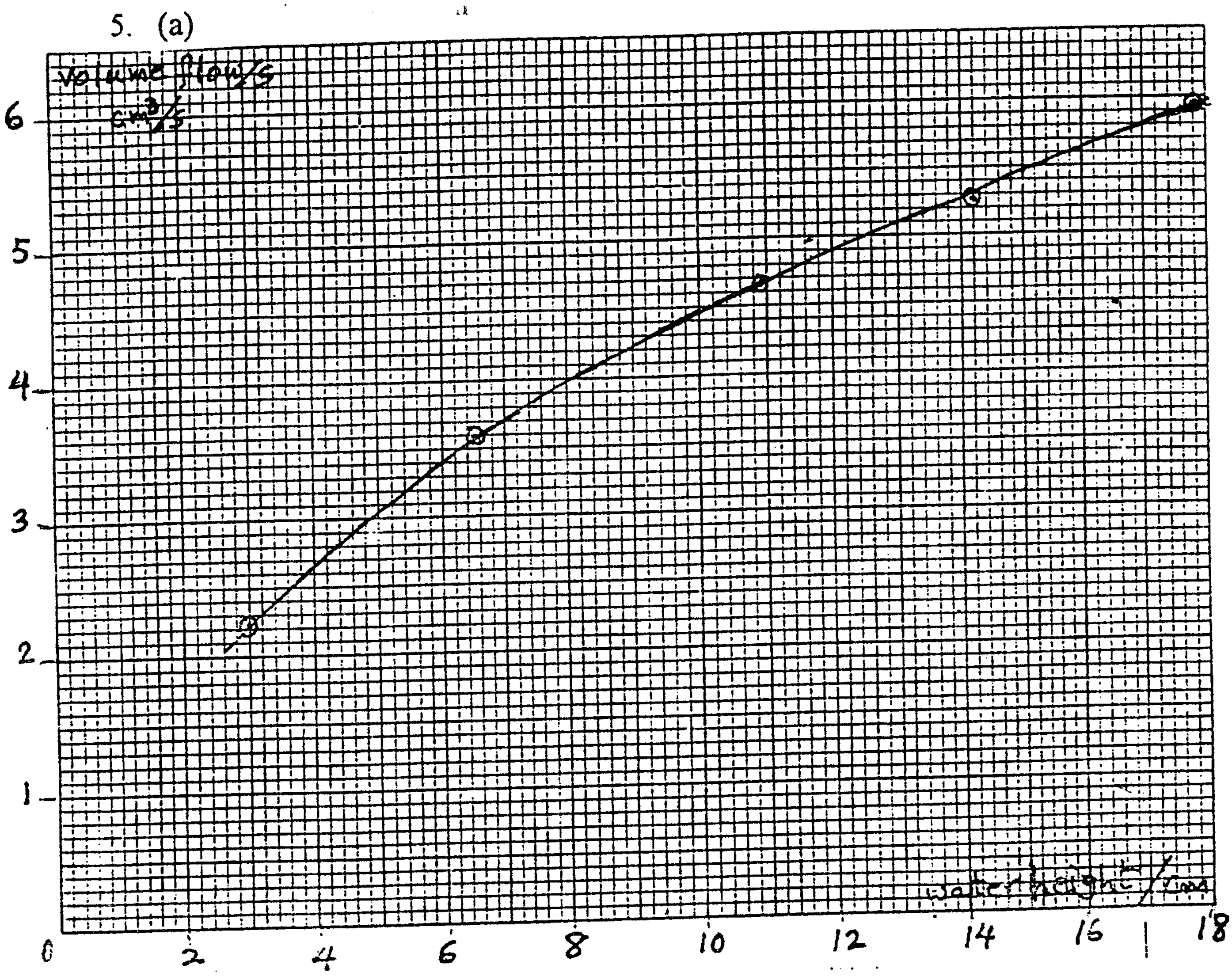
---

4. (a)



(b) Angle of incidence = 40°
(c) Angle of deviation = 28 °

5. (a)



(b) ... because the relation is **not** a straight line passing through the origin.

NOV.

1997

NOV. 1997

Paper 1

1	C	11	C	21	C	31	D
2	C	12	A	22	A	32	A
3	D	13	D	23	A	33	C
4	A	14	B	24	B	34	D
5	A	15	A	25	C	35	B
6	C	16	D	26	B	36	C
7	D	17	A	27	D	37	B
8	C	18	C	28	B	38	C
9	B	19	C	29	B	39	C
10	A	20	C	30	B	40	B

Nov. 1997

Paper 2

1. $\text{time} = \dfrac{\text{Distance}}{\text{Velocity}}$

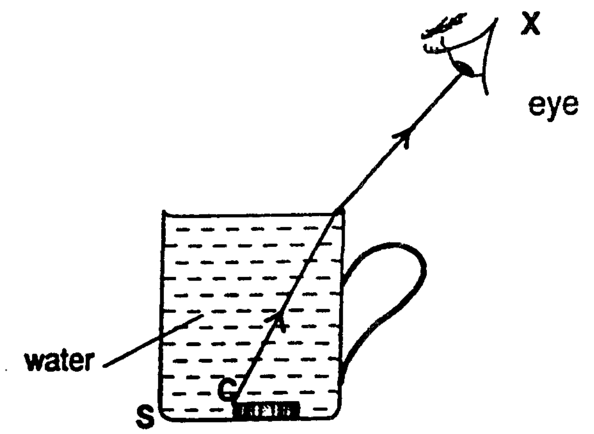
$= \dfrac{14}{20} = 0.7$ sec.

---

2. (a) The moment of a force is the turning effect of the force.
   (b) The moment = force × perpendicular distance.
   Choosing a long spanner (long distance) reduces the force required to undo the nut.

---

3. (a)



(b) The light ray from the coin C is refracted at the surface of the water to reach the eye at X.

---

4. (a) (i) The average speed of molecules increases.
   (ii) The number of hits increases.
   (iii) The pressure increases.

(b) Some of the air escapes out of the can through the hole until the inside pressure equals outside pressure.

(c) (i) The air pressure decreases when it cools down.
(ii) The can might be crushed to the inside because the outside air pressure is greater.

---

5. (a) reflection.
(b) refraction.
(c) diffraction.
(d) refraction and dispersion.

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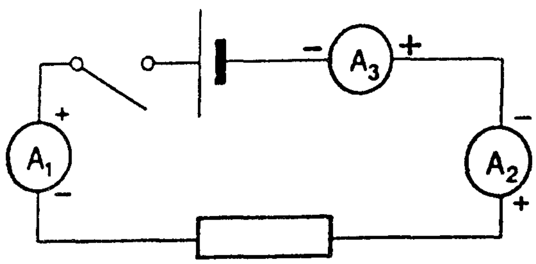
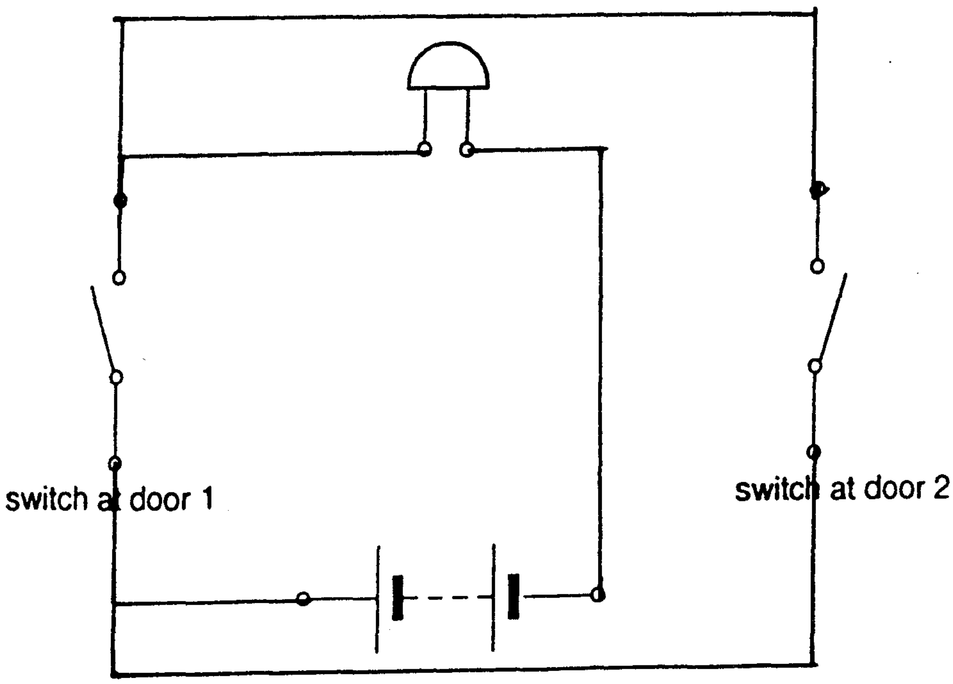
6. (a) electric charges (usually electrons).

(b) (i) Ammeters measure electric currents.
(ii)



(iii) $A_2 = 3$ A
$A_3 = 3$ A

7.



8. * The two nuclei contain the same number of protons (each has 8 protons).
   * ^{16}O contains 8 neutrons , but
     ^{17}O " 9 neutrons.

---

9. (a) (i) It is a step-down transformer.
   (ii) because it decreases the a.c. voltage from 230 V to 12 V.

   (b) because the input is a d.c. voltage from a bâttery, (the transformer to operate, the input voltage <u>must</u> be alternating).

   (c) Output A : secondary turns = 2500
   Output B : secondary turns = 5000

   (d) (i) Power transmitted at a high voltage would have a smaller current, which results in a smaller power loss (because lost power = I^2R).
   (ii) A step-up transformer is used at the beginning of the transmission line.
   It increases the voltage to a very high value, thus decreasing the current.
   (iii) A step-down transformer is used at the end of the transmission line.
   It reduces the a.c. voltage to a lower value suitable for use in houses and factories.

---

10. (a) * The match heats the air which expands and becomes less dense and rises up to the hand which feels the heat due to convection currents.
   * The hand underneath the match does not feel the heat because the air is a bad conductor of heat, and the amount of radiation is small.

   (b) The carpet material is a bad conductor of heat. Also, the carpet contains a large amount of still air which is a very bad conductor of heat. This reduces the heat lost from the room and keeps it warm.

(c) Heat from the sun can reach us because it is transmitted as electromagnetic waves (infra-red radiations) which can travel through vacuum.

(d) The snow is a bad conductor of heat, it acts as a heat insulator which keeps the body away from cold air currents of the snow storm. This helps to keep the body warm.

---

11. (a) 1. The molecules move farther away from each other.
2. The molecules move exchanging places with one another.
3. The binding forces between molecules decrease.

(b) (i) $I = \frac{V}{R} = \frac{34}{6.8} = 5\ A$

(ii) $V \cdot I \cdot t = m \cdot L$

$34 \times 5 \times t = 1 \times 340\,000$

$t = 2000$ seconds.

(iii) Time would be smaller ;

... because some heat is gained from the environment which reduces the melting time.

(iv) ice is a bad conductor of heat.

(v) The specific latent heat of fusion of ice has a very large value (340 000 J/kg) and the icebergs have very large masses ; therefore the time needed for melting the icebergs should be very long.

---

12. (a) (i) The iron rod A is magnetized.

(ii) The two rods are magnetized in the same direction producing like poles at the neighbouring ends which produces <u>repulsion</u> between the two rods.

When the current is off, the iron rod A loses its magnetization, but the steel rod B keeps its magnetization and is <u>attracted</u> towards rod A.

(b) (i) When an electric current flows in the motor coil placed in the magnetic field of a permanent magnet ; an upward force acts on one side of the coil, and a downward force acts on the other. These two forces form a couple which causes the coil to rotate.

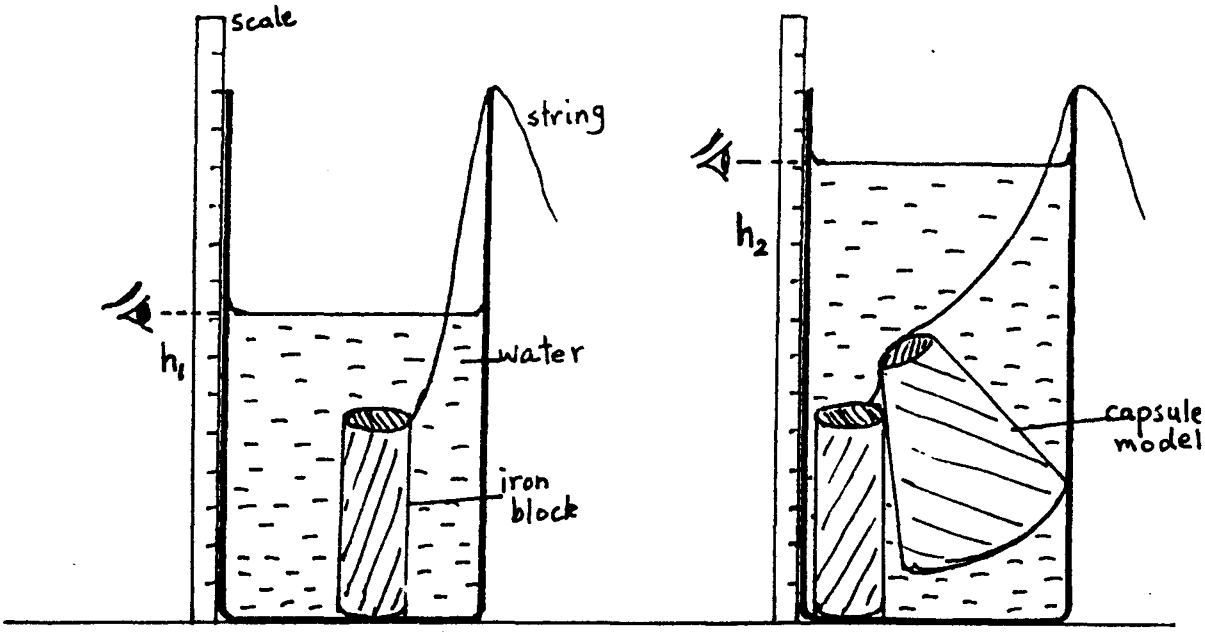
(ii) The commutator.

Nov. 1997

Paper 3

1. (a) (i) Mass $=$ Volume $\times$ density
$= 36 \times 765 = 27540$ kg.
(ii) Weight $= m \times g$
$= 27540 \times 9.5 = 261\,630$ N

(b) (i) Labelled Diagrams



Experimental procedure :

1- Get the mass, m, by using a top-pan balance.
2- Use a wide tank containing water and an iron block and measure the height of water level, h_1 (the cross sectional area of tank, a, is known).
3- Tie the capsule model to the iron block and immerse them in the water and measure the new height, h_2 (in meters).

How the result is worked out :

The mass of model $= m$ (kg)

The volume of model $= (h_2 - h_1)\,a$ (m^3)

Density of model $= m / (h_2 - h_1)\,a$ (kg/m^3)

(ii) The materials used must be the same as those of the actual capsule in order to get a value for the density equal to the density of the capsule.

(c) (i) During QR, the weight of the capsule equals the upward friction of the air. The combined forces on the capsule equal zero, the acceleration is zero and the velocity is uniform.

(ii) At R the capsule hits the ground and stops ; the velocity suddenly drops to zero.

(d) (i) The decrease in potential energy = m gh

$$= 1200 \times 9.7 \times 800 = 9312000 \text{ J}$$
$$= 9.3 \text{ MJ}$$

(ii) The heat energy (due to friction) increases throughout the fall.

(iii) The gravitational potential energy of the capsule is changed to kinetic and heat energy during the fall. When the capsule hits the ground all the energy changes to sound energy and heat energy both in the capsule and in the ground.

---

2. (a) (i) 1- The distance between the molecules of water are smaller than those in solid ice ; and are much smaller than those in water vapour or steam.

2- The molecules of water can vibrate and can move about exchanging the places with each other.

(ii) At 20°C, the average kinetic energy per water molecule is larger than that of solid ice. This value of kinetic energy allows the molecule to move freely and exchange there places and remain in the liquid state.

(b) The fast moving molecules near the surface of the liquid have enough kinetic energy to overcome the attractions of neighbouring molecules and can escape out of the surface of the liquid, i.e., they evaporate.

(c) (i) The depth of water in the tank has no effect on the amount of water evaporating. The depth of water does not affect the number of molecules at the surface and does not affect their average speed, thus it does not affect the amount of evaporation.

(ii) Fitting a lid on the tank decreases the amount of evaporation. The lid prevents the air currents above the surface of water, and it prevents water molecules from escaping away, some of water molecules may fall back to the liquid and reduces the amount of evaporation.

(iii) When the temperature of water is reduced, the amount of evaporation decreases. At a lower temperature, the average kinetic energy per molecule is less and the average speed decreases which reduces the possibility of molecules escaping from the water.

(d) The plastic tank would have the lowest rate of evaporation, because it is a bad conductor of heat. The temperature rise of water in the plastic tank would be the least and the rate of evaporation would be also least.

(e) The volume of water $= a \times h$

$= 100 \times 0.005 = 0.5\ m^3$

Mass of water $= \rho \times V$

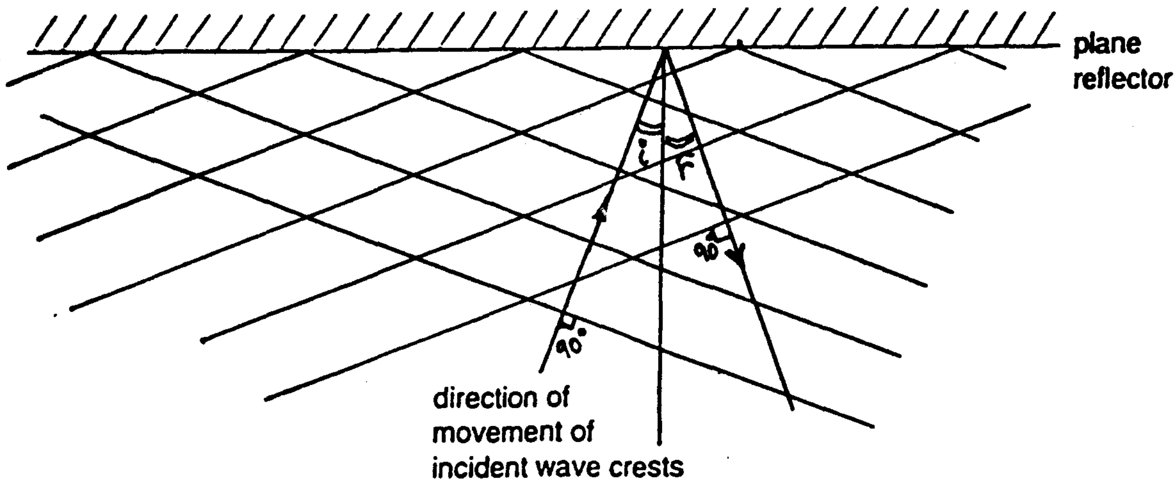
$= 1000 \times 0.5 = 500\ kg$

$P \times t = m \times L$

$P \times (3 \times 10^4) = 500 \times (2 \times 10^6)$

$P = 3.33 \times 10^4\ W$

3.



(ii) Angle of reflection = 20°

(iii) Wavelength $= 1 \times 20 = 20$ cm
$= 0.20$ m

$$f = \frac{\text{Velocity}}{\text{Wavelength}} = \frac{3 \times 10^8}{0.2} = 1.5 \times 10^9 \text{ Hz}$$

(b) (i) The image is virtual, upright, of the same size and at the same distance behind the mirror.

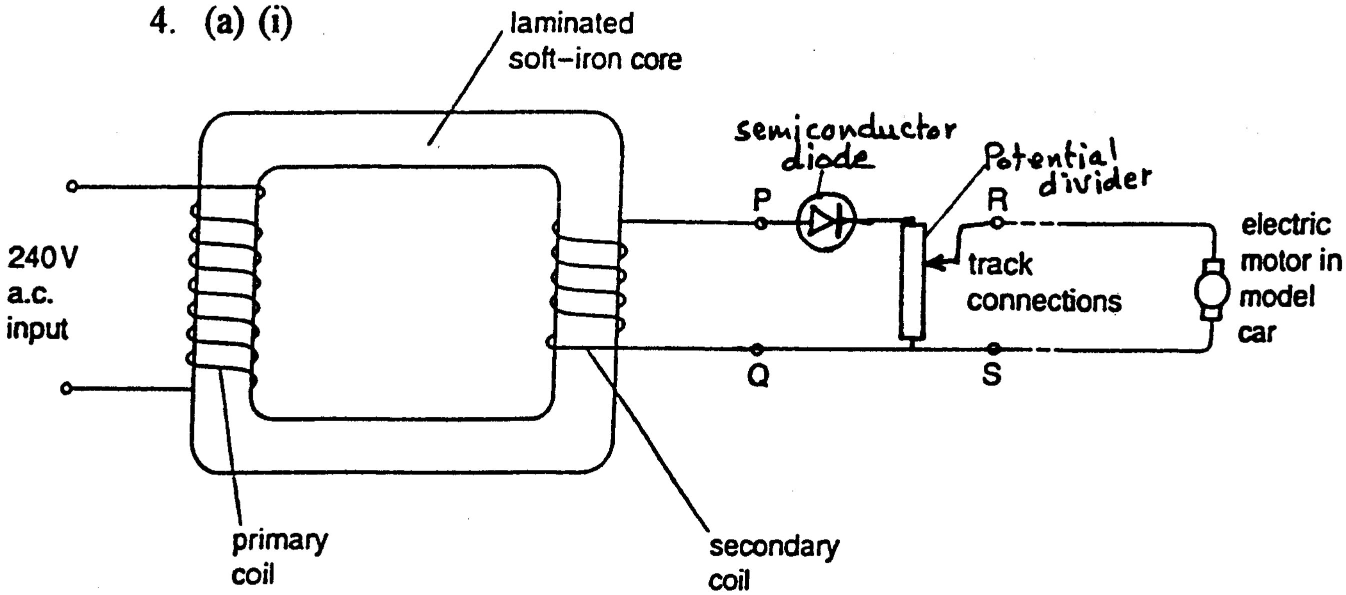
(ii) advantage 1 : the image is erect ,
" 2 : the image is at the same distance as the object.
disadvantage : the field of view of the plane mirror is rather small.

(c) (i) 1. The ray does not change direction at P or at S because it is falling perpendicular to the surface.
2. ... because the angle of incidence in the glass is greater than the critical angle.

(ii) A fibre with cladding is better, because the total internal reflection occurs always irrespective of the refractive index of the medium outside the optical fibre (it can be used in any outer medium).

---

4. (a) (i)



(ii) When the p.d. increases, the current in the motor increases which increases the speed of the motor.

(iii) $\frac{V_1}{V_2} = \frac{N_1}{N_2}$ or, $\frac{240}{15} = \frac{960}{N_2}$

$$N_2 = \frac{15 \times 960}{240} = 60 \text{ turns}$$

(iv) Because the resistance of the rectifier circuit reduces the 15 V a.c. to about 12 V.

(v) ... because the direction of the magnetic field is reversed each half cycle of the a.c. voltage.

(vi) The a.c. voltage in the primary coil produces an alternating magnetic field in the soft-iron core. This changing magnetic field passes through the secondary coil and induces an a.c. voltage across PQ.

(b) (i) e.m.f. of 15 V means that the p.d. across the terminals PQ (when it is not supplying a current) is equal to 15 V.

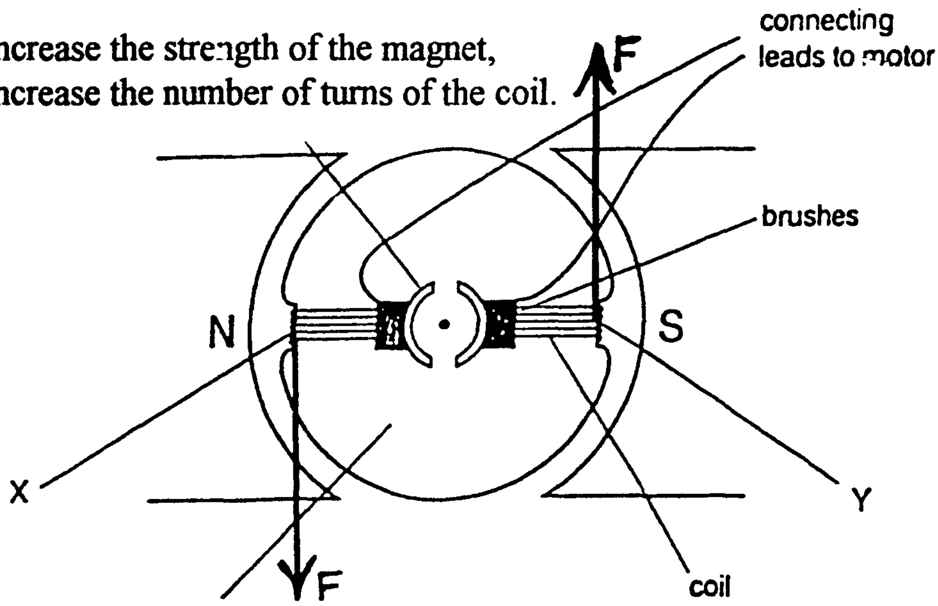
(ii) Power of 24 W means that the energy taken by the electric motor is 24 joules every second.

(iii) $P = \frac{V^2}{R}$, or

$$R = \frac{V^2}{P} = \frac{(12)^2}{24} = 6\ \Omega$$

(c) (i) 1- increase the strength of the magnet,
2- increase the number of turns of the coil.

(ii)



(iii) The poor electrical contact increases the resistance in the circuit and thus decreases the current which decreases the speed of rotation of the motor and car slows down.

5. (a) The binding energy of the electrons in the synthetic fibres is smaller than it is in natural fibres. Therefore, the electrons can move from or to synthetic fibres easier than natural fibres.

(b) (i) Some electrons have moved from the plastic to the fibres. The solid plastic which lost electrons became positively charged, and the fibres which gained the electrons became negatively charged.

(ii) ... because the electric charge produced escapes through the metal comb to the hand and to the ground because the metal is a good conductor of electricity.

(c) (i) The α-particle source ionizes the air ; the natural air molecules are changed to positive ions and negative ions due to the collisions of alpha particles with them.

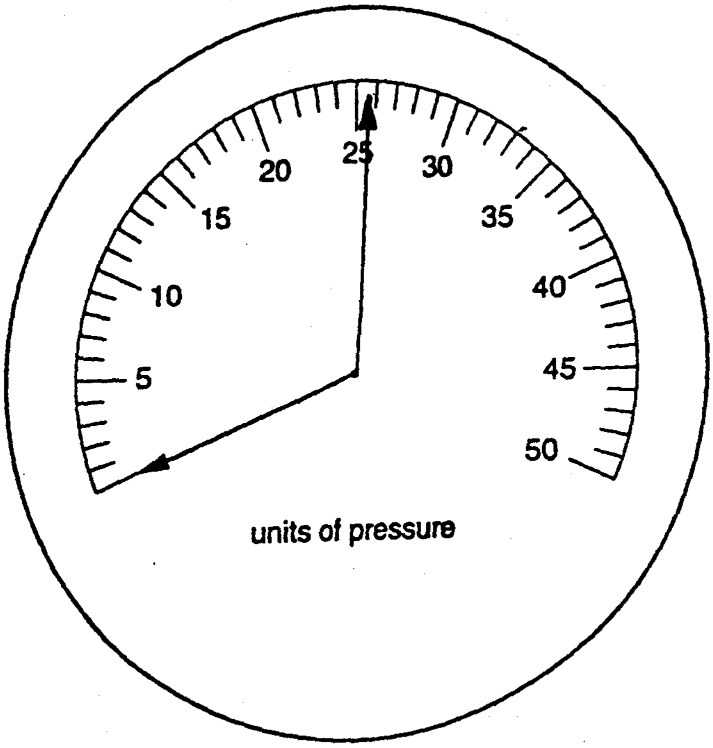
(ii) Alpha-particle source has a very strong ionizing power, but the beta-particle source has a weaker ionizing power. Gamma sources are the weakest ionizing agents.

(iii) A large p.d. is used on the plates so that the negative plate would strongly attract the particles carrying positive charges ; and the positive plate would attract strongly the particles carrying negative charges.

Nov. 1997

Paper 6

1. (a) (i)



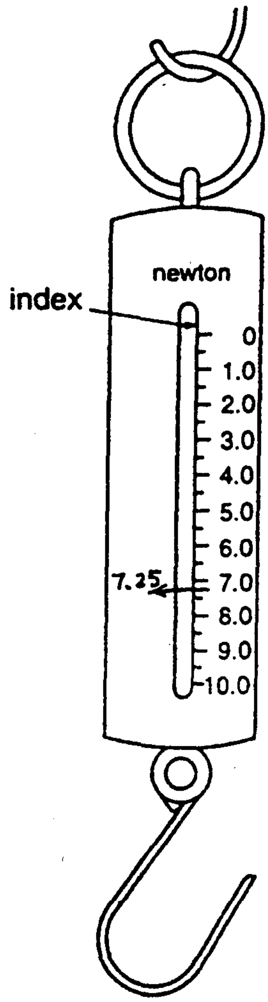
(ii) seen by A : (greater than 25.0)
seen by B : (equal to 25.0)

pointer reading/units	*seen by A*	*seen by B*
greater than 25.0	✓	
equal to 25.0		✓
less than 25.0		

(b) (i)

(ii) greater that 5.0 N.

(iii) 1- Hang the 5.0 N weight in the Newton-meter.
2- Record the reading "R" where the index stops.
3- The zero error = (5.0 – R).



---

2. (a) Reading at m_1 = 28.0 cm
Reading at m_2 = 46.6 cm

(b) $u = m_2 - m_1$
$= 46.6 - 28.0 = 18.6$ cm

(c) $v = m_3 - m_2$

(d)

m_1 / cm	m_2 / cm	m_3 / cm	$u = (m_2 - m_1)$ / cm	$v = (m_3 - m_2)$ / cm

3. (a) (i) $\theta_B = 65\ °C$

$\theta_A = 60\ °C$

(ii) $t_B = 1300$ seconds

$t_A = 1000$ seconds

(b) The lid used on the plastic cup helped to reduce the heat losses from the hot drink. After 1000 seconds, the temperature of cup A dropped to 60°C while the covered cup B dropped only to 65°C. In other words,the temperature of the uncovered cup A dropped to 60°C in 1000 seconds, while the covered cup B needed 1300 seconds to reach the same temperature.

(c) Variable : The substance from which the lid is made.
Explanation : If the lid is made of insulating material, this helps to reduce the heat lost.

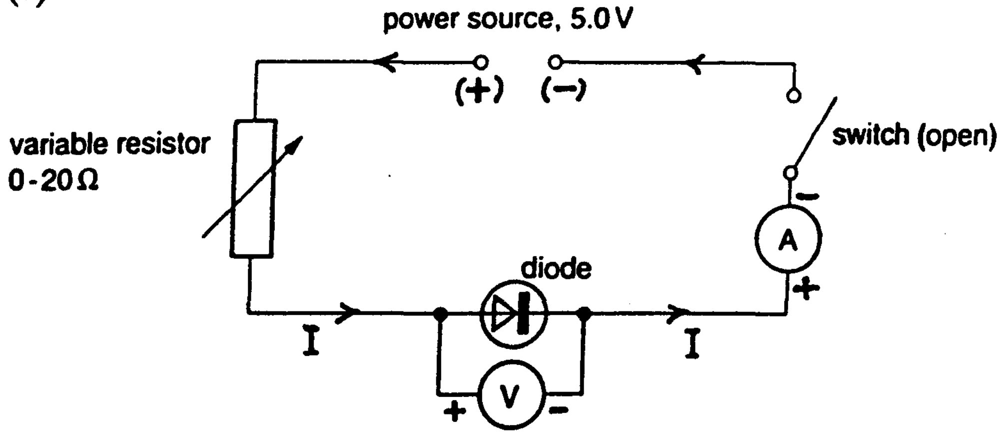
---

4. (a) Because the total resistance of the circuit is a little greater than 20 Ω due to the small resistance of the diode.

(b) 1- Set the variable resistor to its maximum value, so as to obtain the minimum current.
2- Switch on the circuit and record the values of the ammeter reading (I) and the voltmeter reading (V).
3- The resistance of the diode $R = \frac{V}{I}$.
4- Repeat the steps 2 and 3 several times while decreasing the resistance of the rheostat gradually and determine the value of R each time.
5- Determine the average value of R from all the results obtained.

(*) To ensure that the current was never larger than 0.5 A, one can add to the circuit a resistance of 10 ohms in series with the diode.

(c)



5. (a) Graph (page 310).

(b) Increase in s = 2.1 mm

(c) When the lamp is moved to a distance $\ell = 93$ mm, a very small movement towards the screen produces a sudden increase in the size of the shadow.

June 1998

Paper 1

1	D	11	C	21	C	31	C
2	C	12	A	22	A	32	C
3	A	13	B	23	A	33	B
4	C	14	D	24	C	34	A
5	A	15	D	25	D	35	A
6	A	16	D	26	D	36	B
7	C	17	C	27	C	37	B
8	B	18	A	28	B	38	C
9	D	19	D	29	B	39	D
10	A	20	C	30	C	40	C

June 1998

Paper 2

1 . The rock moves to the left.

The rock accelerates.

---

2 . Stage 1 and stage 3.

---

3 . (a) (i) The temperature of glycerine rises faster than the temperature of water.

(ii) $\cancel{m} c_1 \theta_1 = \cancel{m} c_2 \theta_2$

Because the rate of heat energy supplied is the same for both liquids; the liquid with greater thermal capacity (water) will have smaller rise in temperature (and vice versa).

(b) (i) The temperature rises gradually to a certain value (the boiling point) then it stops rising and remains constant. The constant value for each liquid is different from that of the other liquid.

(ii) The temperature of each liquid rises until it reaches the boiling temperature of that liquid then it remains constant while boiling.

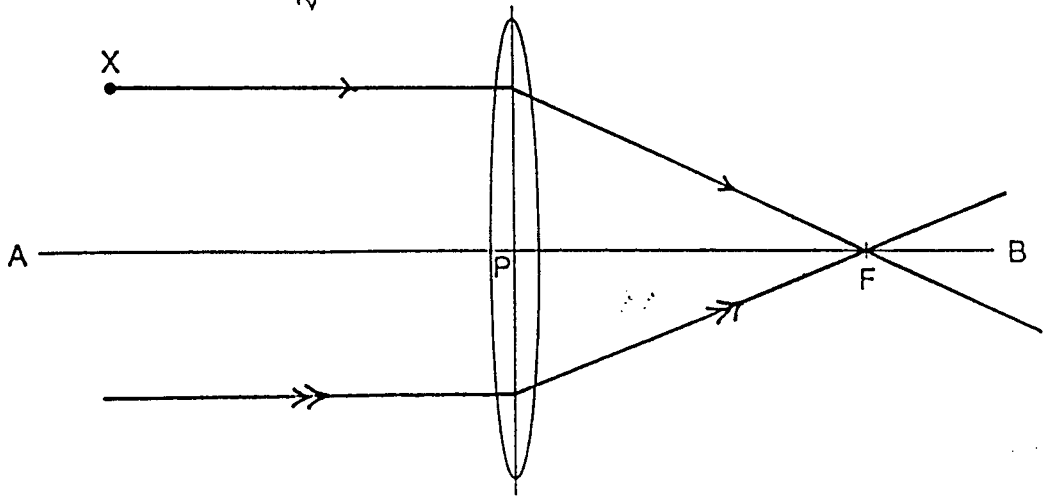
---

4 . (a) The <u>fast</u> moving molecules <u>near</u> the surface of the liquid can escape from the liquid.

(b) The molecules having large kinetic energies escape from the liquid, leaving behind the less energetic molecules. The average kinetic energy thus decreases causing the temperature decrease so the liquid cools down.

---

5 . (a , b)



(c) ....."parallel to the principal axis AB".....

---

6 . (a) (i) electron

(ii) proton

(iii) neutron

(b) The nucleus

(c) $^{7}_{3}Li$

---

7 . (a) just below 6V

(b) 3V

---

8 . (a) (i) it increases the reading on the balance.

(ii) ... because the force of repulsion increases.

(b) (i) The balance reading decreases.

(ii) ... because the aluminium is not a magnetic material and it produces <u>no</u> repulsive force.

---

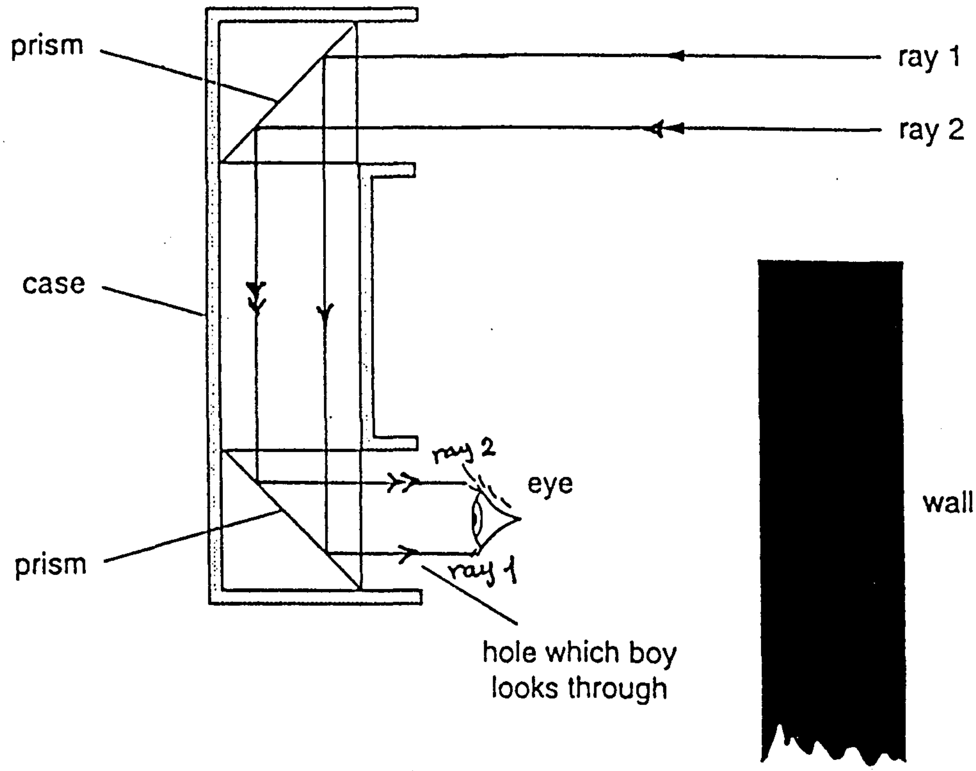
9 . (a) (i) The same way up.

inverted left to right.

behind the mirror

(ii) 3.0 + 3.5 = 6.5 m

(b) (i)



(ii) The image will be inverted (upside down).

The upper ray no.1 will come out of periscope below the ray no.2.

(iii) The boy will not see the football match, because the rays 1 &2 will not be totally internally reflected by the prism because the angle of incidence of the rays (45°) are now smaller than the new critical angle (47°).

---

10. (a) $time = \frac{2d}{v} = \frac{2 \times 0.6}{0.8} = 1.5s$

(b) (i) A distant hard wall

(ii) $v = \frac{2d}{t}$

$330 = \frac{2d}{1.6}, \; d = 264 \quad m$

(c) The sound wave is a longitudinal wave, while

The water wave is a transverse wave.

(d) frequency = no. of teeth × no. of revolutions per second

$= 40 \times \frac{600}{60}$

$= 400$ Hz

---

11 . (a) (i) $V = I \cdot R$

$= 15 \times 3 = 45$ V

(ii) $V = 45$ V

(iii) $V = 2000 - 90 = 1910$ V

(b) (i) 1. $R = 4 + 6 = 10\ \Omega$

2. $I_1 = \frac{V}{R} = \frac{4}{10} = 0.4\,A$

(ii) 1. I_2 is greater than I_1

2. When the two resistors are connected in parallel, their combined resistance becomes less, therefore the current I_2 is greater.

---

12 . (a) 1. Move the scale closer to the glass tube until it touches the tube.

2. Move the scale down until its zero mark touches the surface of mercury.

3. Take the scale reading at the top of the meniscus of the mercury.

(b) (i) longer tube : no difference

(ii) wider tube : no difference

(c) The reading on a mountain decreases because the atmospheric pressure decreases at great heights.

(d) The reading would decrease, because the water vapour has some pressure which would force the mercury down in the tube.

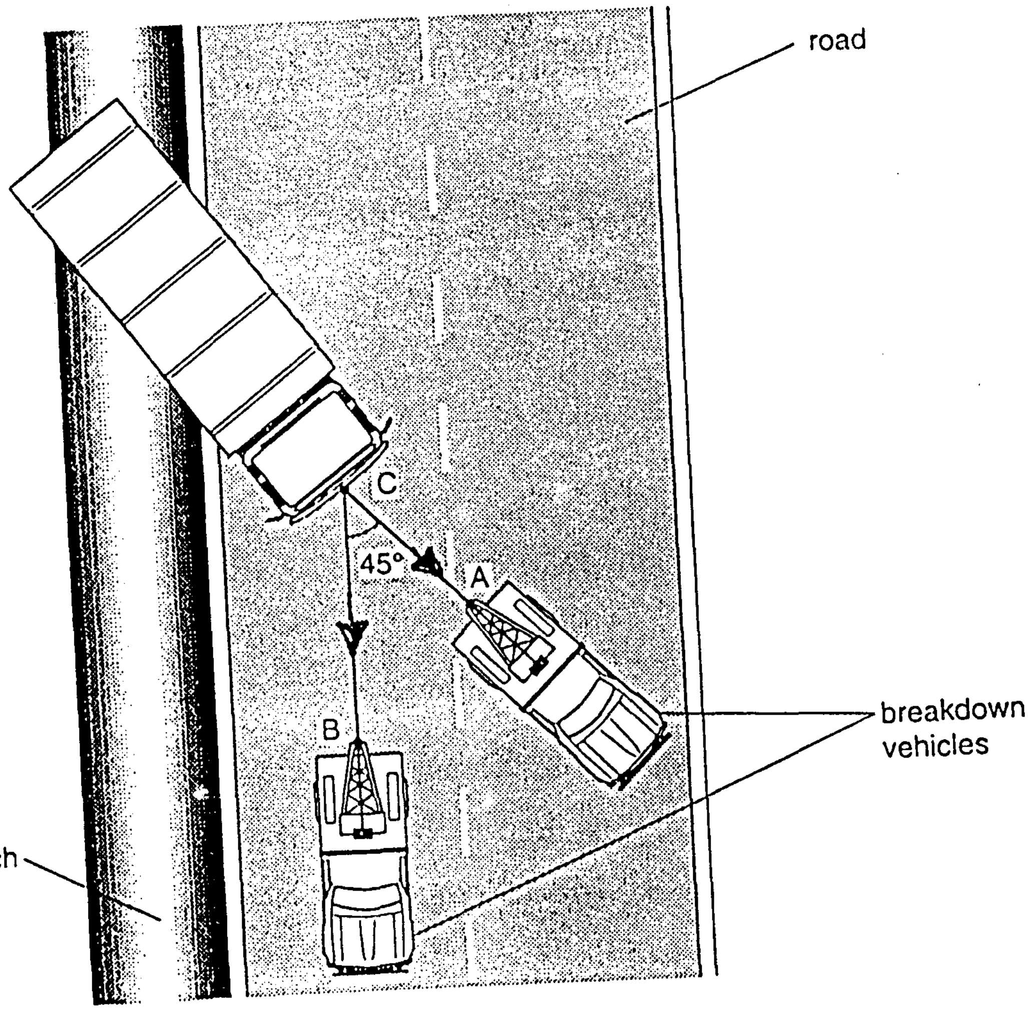
(e) The length of the tube in a water barometer is much longer.

Since $P = h\rho g$, therefore as the density ρ becomes smaller, the height h should become longer to give the same pressure (g is always constant).

June 1998

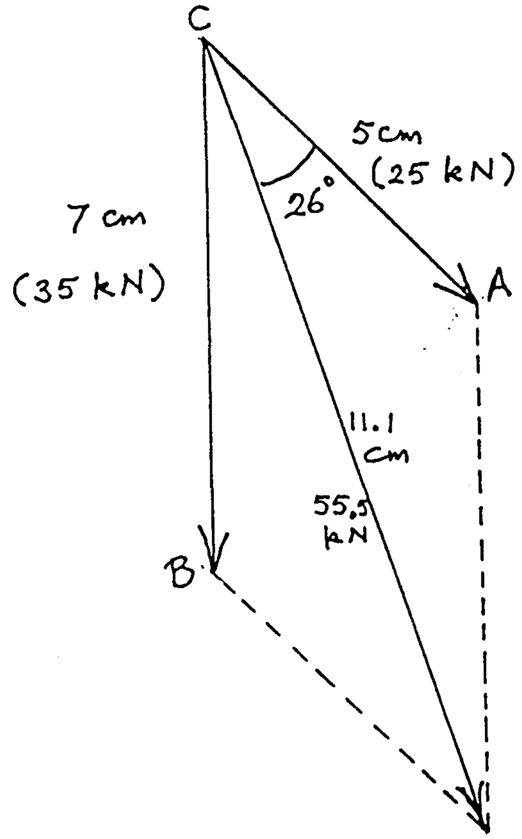
Paper 3

1 . (a) (i)



The vector quantity has both magnitude and direction, while the scalar quantity has magnitude only (it has no direction).

(ii)



The magnitude of the resultant force = 11.1 × 5

= 55.5 kN

The angle it makes with CA = 26°

(b) (i) The lorry starts from zero velocity and accelerates with uniform acceleration during the first 30 seconds.

The acceleration decreases gradually until it becomes zero when the time is about 70 seconds.

From 70s to 100s the lorry moves with uniform velocity (zero acceleration)

(ii) 1. From 90s to 100s the resultant force is zero.

2. The acceleration is the same indicates that the resultant force is constant.

(iii) 1. Momentum change $= m \cdot \Delta V$

$$= (1.5 \times 10^4) \times 5$$
$$= 7.5 \times 10^4 \ kgm\ /s$$

2. Resutant Force $= \dfrac{Momentumchange}{time}$

$$= \frac{7.5 \times 10^4}{20} = 3.75 \times 10^3 \ N$$

3. Kinetic energy $= \dfrac{1}{2} mv^2$

$$= \frac{1}{2}(1.5 \times 10^4)(25)$$
$$= 1.875 \times 10^5 \ J$$

---

2 . (a) (i) A thermocouple thermometer

(ii) 1. It can measure a very large range of temperatures (from -200°C to 1500°C).

2. Its thermal capacity is very small so it responds rapidly to changing temperatures.

(b) (i) The molecules of the liquid are in continuous ransom motion, having an average kinetic energy proportional to its temperature. Some of the <u>fast</u> moving molecules <u>near</u> the surface of the liquid can overcome the attractive forces of other molecules and can escape from the liquid surface into the air above, i.e., they evaporate.

(ii) 1. The surface area of the liquid is very large.

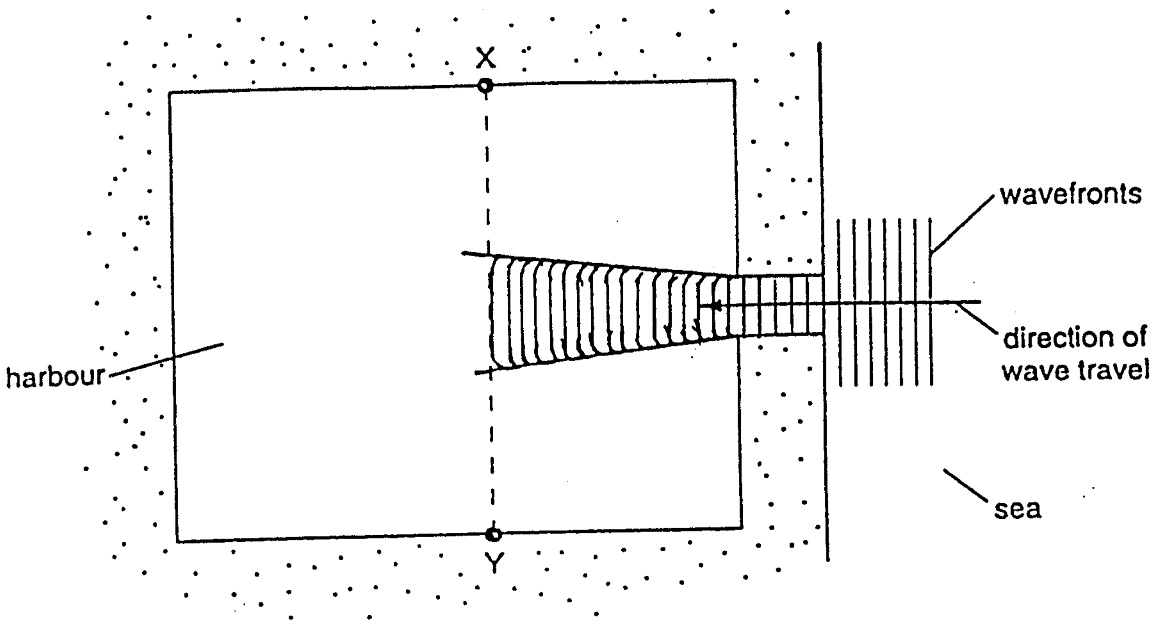
2. The temperature of the liquid is raised to very high values.

(c) $P = mL$

rate of evaporation $= \dfrac{P}{L} = \dfrac{30 \ kW}{210 \ kJ\ /kg}$

$$= 0.143 \ \text{kg/s}$$

3 . (a)



(b) Diffraction of waves

(c) (i) As the width of harbour becomes less than the wavelength, the diffraction of the emergent wave increases, the wavefronts become circular in shape and spread in all directions.

(ii) The window is very wide compared to the wavelength of light, so no diffraction can be observed.

(d) $f = \dfrac{v}{\lambda} = \dfrac{2.0}{2.2} = 0.9\,Hz$

---

4 . (a) $I = \dfrac{P}{V} = \dfrac{5000}{240} = 20.8\,A$

(b) (i) $P = 35 \times 60 = 2100$ W

The generator is suitable because the power of lamps required is less than the output of the generator.

(ii) New needed power $= 35 \times 150 = 5250$ W

$= 5.25$ kW

This new power is greater than that which can be supplied by the generator, thus it is not suitable in this case.

(c) 1. In parallel connection, the potential difference across each lamp is the same (it is 240V in this case)

In series connection, the total potential difference is divided between the lamps resulting in small value for p.d. (it is $\frac{240}{35} = 6.9$ V)

2. In parallel connection, the total resistance of the circuit is reduced so the current (and power) in each lamp is greater and it lights brightly.

In the series connection, the total resistance is much greater – the current in each lamp is very small and it lights dimmly.

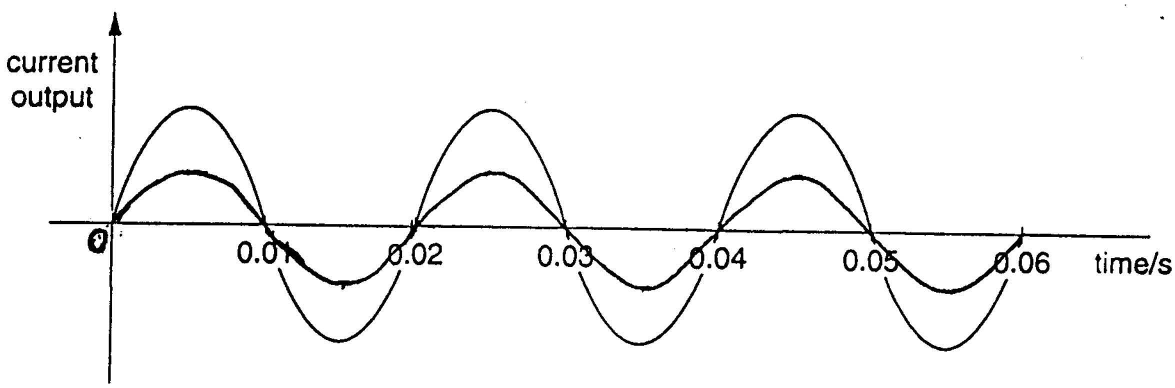
(d) $P = \frac{V^2}{R}, R = \frac{V^2}{P}$

$$R = \frac{(240)^2}{60} = 960\ \Omega$$

(e) (i) from graph : periodic time, T = 0.02 s

$$f = \frac{1}{T} = \frac{1}{0.02} = 50\, Hz$$

(ii)



(f) (i) As the coil rotates, it cuts the lines of the magnetic field of the permenant magnet so an e.m.f. is induced in the coil.

(ii) 1. Increasing the number of turns of the rotating coil increases the maximum power output.

2. Increasing the speed of rotation of the coil increases the maximum power output.

N.B. (also using a stronger magnet, and winding the coil on a soft-iron armature would increase the power output.)

---

5 . (a) (i) Runner A wins, because the pulse from A reaches the detector before that of B.

(ii) $8 - 5 = 3$ ms

(b) (i) These counts are due to the background radiations.

They are slightly different due to the statistical variations of the random processes.

(ii) Beta and gamma radiations only.

(iii)The beta-rays from the source are greatly deflected by the perpendicular magnetic field and reach the point C giving the high count rate of 163 counts / minute.

The gamma-rays travel in a straight line (because they are not deflected by magnetic fields) and they reach the point B giving the high count rate of 186 count / minute.

Since there are no alpha rays, no rays can reach the point A which records the background radiations only (21 count / minute).

June 1998

Paper 6

1 . (a)

d/mm	T_{max}/°C	T_R / °C
17.5	38.4	16.0
35.0	27.7	5.3
70.0	23.8	1.4
140.0	22.7	0.3

(b) When the distance d increases, the temperature rise T_R decreases.

(c) 1. Place a ruler in a horizontal direction very close to the lamp and the bulb of the thermometer.

2. Take a reading, r_1, at the center of the lamp filament; and another reading, r_2 at the center of the bulb of the thermometer.

3. The distance, d $= r_1 - r_2$

4. Repeat the above steps several times and get the average value of d.

---

2 . (a) $\theta_{av} = (24.0 + 24.5 + 25.0 + 24.5) \div 4$

$= 24.5°$

(b,c)

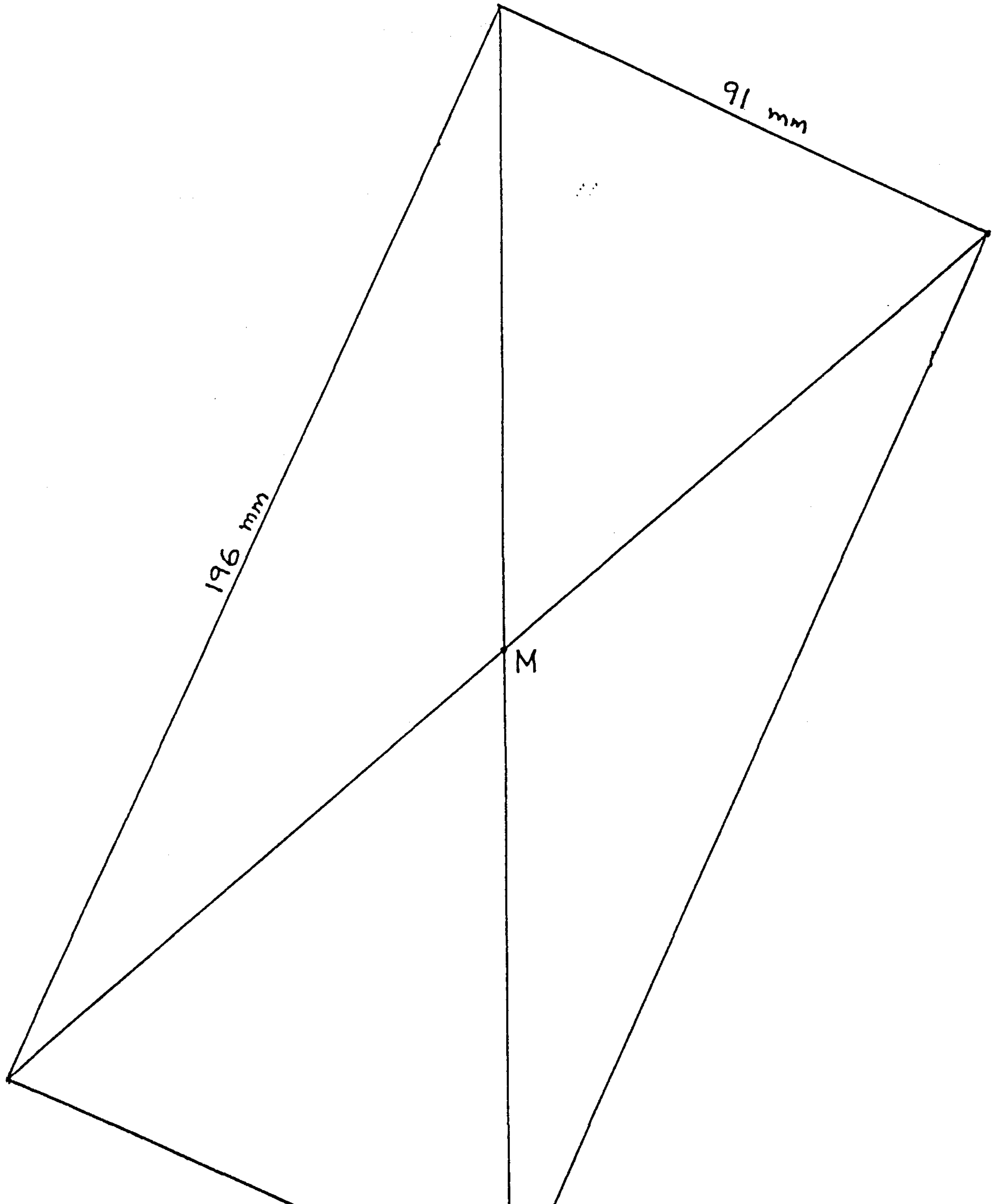


Fig. 2.3

(d) (i) $\theta_L = 24.5 - 2.0 = 22.5°$

(ii) .... Because the vertical line of the weight (beginning from the centre of mass) remained passing through the base area of carton.

(if the weight line passes outside the base area, the carton falls down).

---

3 . (a) (i)

potential difference	V/V
V_p	4.7
V_1	0.6
V_2	1.7
V_3	2.4

(ii) 1. The potential difference of the power supply equals the sum of the potential differences across R_1, R_2 and R_3

2. $$\frac{V_1}{V_2} = \frac{R_1}{R_2}$$

$$\frac{0.6}{1.7} = \frac{5.0}{R_2}$$

$$\therefore R_2 = \frac{5 \times 1.7}{0.6} = 14.2\,\Omega$$

(b) The line of sight of the eye should be perpendicular to the scale when taking the reading of the pointer to avoid parallax error.

(c) ... to allow the pointer to move freely without any friction.

---

4 . (a)

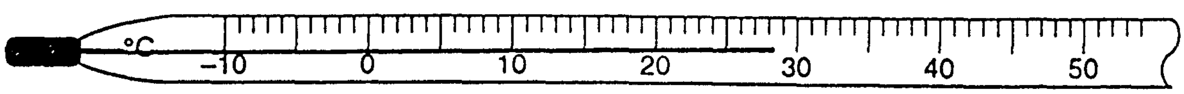


Fig. 4.2

(b) It is transferred quickly to make sure that its temperature does not fall during the transfer.

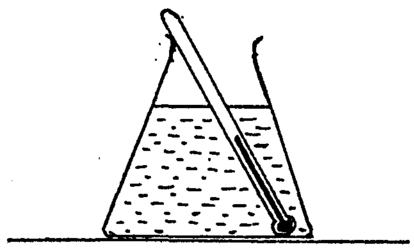
(any heat loss during the transfer should be minimized).

(c) ... to make sure that the temperature of the metal block has reached the temperature of boiling water (100°C).

(d) (i) ... to make sure that all the heat energy lost from the block is absorbed by the cold water.

(ii) The thermal capacity of the larger volume of water is greater, therefore its temperature rise is smaller.

(e) One can use a conical flask with larger base area which is more stable, so it does not fall over easily.



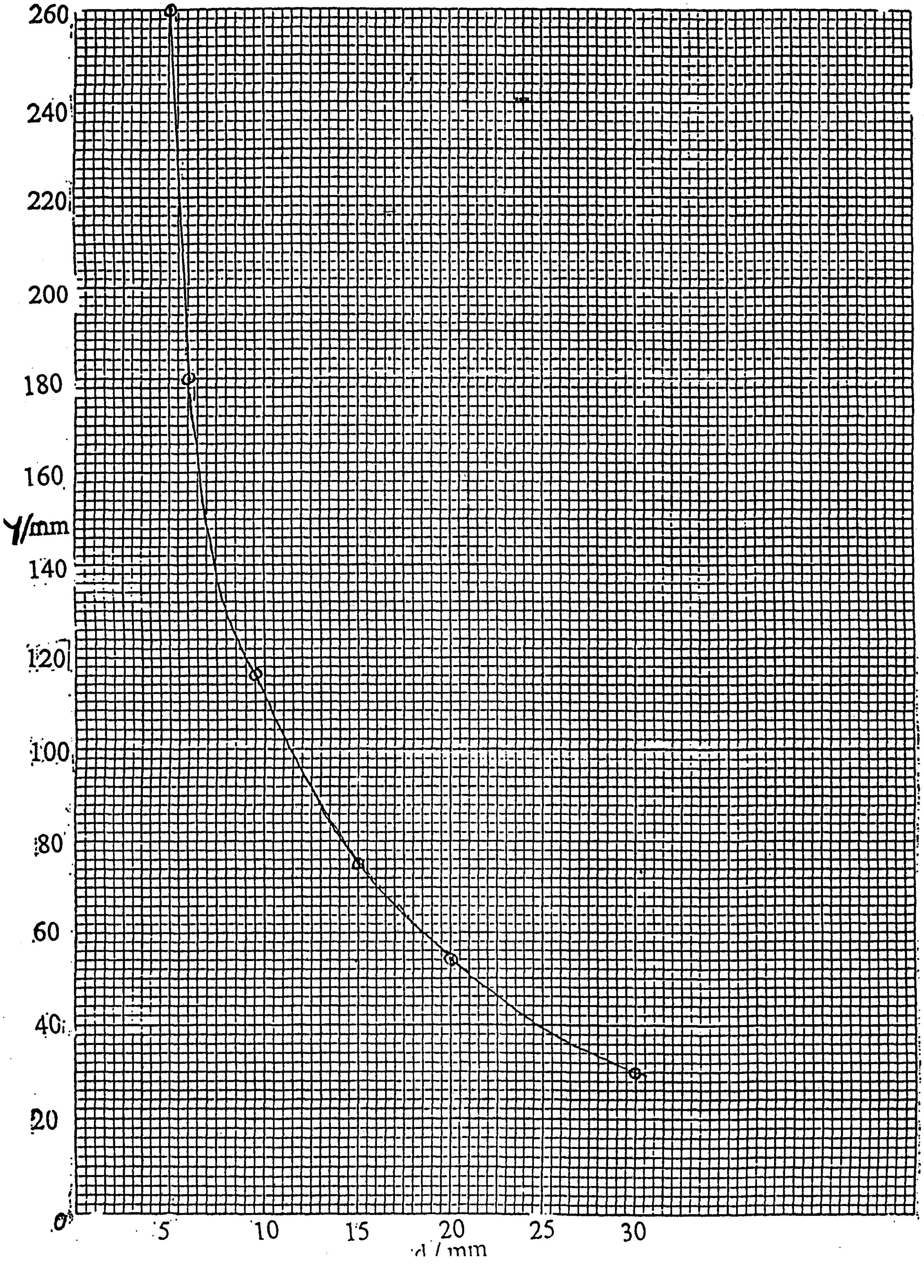
---

5 . (a) (i) Graph : see page 285

(ii) The distance y increases as the value of d decreases.

(b) (i) Decrease the diameter of the lens used, by decreasing the opening of the diaphragm (using a narrow aperture).

(ii) The small aperture allows less light to reach the film, so it requires a longer exposure time. The shutter should be adjusted to increase the exposure time.



Y/mm
260
240
220
200
180
160
140
120
100
80
60
40
20
0
5
10
15
20
25
30
d / mm

November 1998

Paper 1

1	B	11	D	21	C	31	B
2	A	12	D	22	B	32	D
3	C	13	B	23	D	33	C
4	D	14	C	24	A	34	A
5	A	15	D	25	B	35	D
6	C	16	A	26	C	36	D
7	D	17	B	27	D	37	C
8	A	18	D	28	A	38	D
9	D	19	D	29	A	39	A
10	D	20	C	30	B	40	D

November 1998

Paper 2

1. Mass is a measure of the quantity of matter in a body and is measured in kilogram. Weight is related to mass but it is a force and is measured in newton.

---

2. (a) a measuring cylinder.

(b) 1. Measure the mass of the empty measuring cylinder, m_1 , by using a top-pan balance.

2. Pour the milk in the measuring cylinder and find the total mass, m_2.

3. The mass of the milk $= m_2 - m_1$

(c) Density of milk $= \dfrac{\text{mass of milk in kg}}{\text{Volume of milk in } m^3}$

---

3. (a) The moment of a force is the turning effect of the force about a fixed point (fulcrum).

(b) (i) The concrete block is used to balance the weight of the long jib and the hanging load.

(ii) The weight of the load is likely to be smaller than the weight of the concrete block (because its distance is longer).

---

4. (a) .. because the metal is good conductor of heat.

(b) The fins rapidly absorb the heat energy from the electronic component, then they lose this heat to the surroundings by heat emission and convection currents of air.

---

5. (a) The ceiling-mounted pull-cord switch.

(b) .. because one can use the switch through the insulating cord and avoid touching the damp switch which might be dangerous.

6. (a)

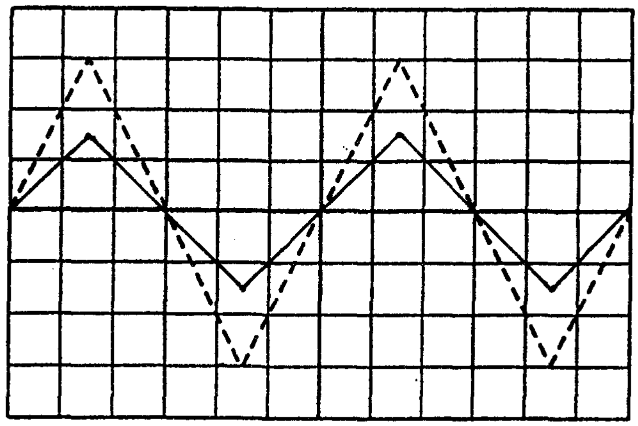


Fig. 6.2

(b)

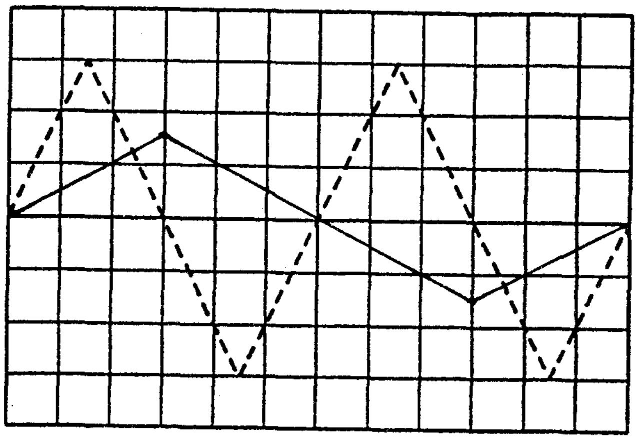


Fig. 6.3

(c)

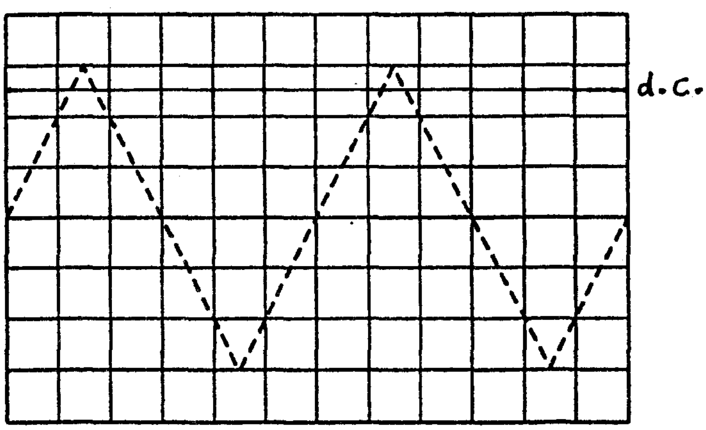


Fig. 6.4

7. (a) The pointer of G deflects in one direction rapidly and returns back to zero.

(b) The deflection occurs in the opposite direction.

(c) Move the wire AB from N to S (or in reverse direction) parallel to the magnetic field.

---

8. (a) time $= \dfrac{\textbf{Distance}}{\textbf{velocity}} = \dfrac{30}{50} = 0.6$ hours

(b) walking time $= \dfrac{d}{v} = \dfrac{1.5}{5} = 0.3$ hrs

train's time $= \dfrac{d}{v} = \dfrac{30}{100} = 0.3$ hrs

waiting time $= 0.1$ hrs

The total time taken = 0.3 + 0.3 + 0.1 = 0.7 hrs

Mr. B arrives after Mr. A

(c)

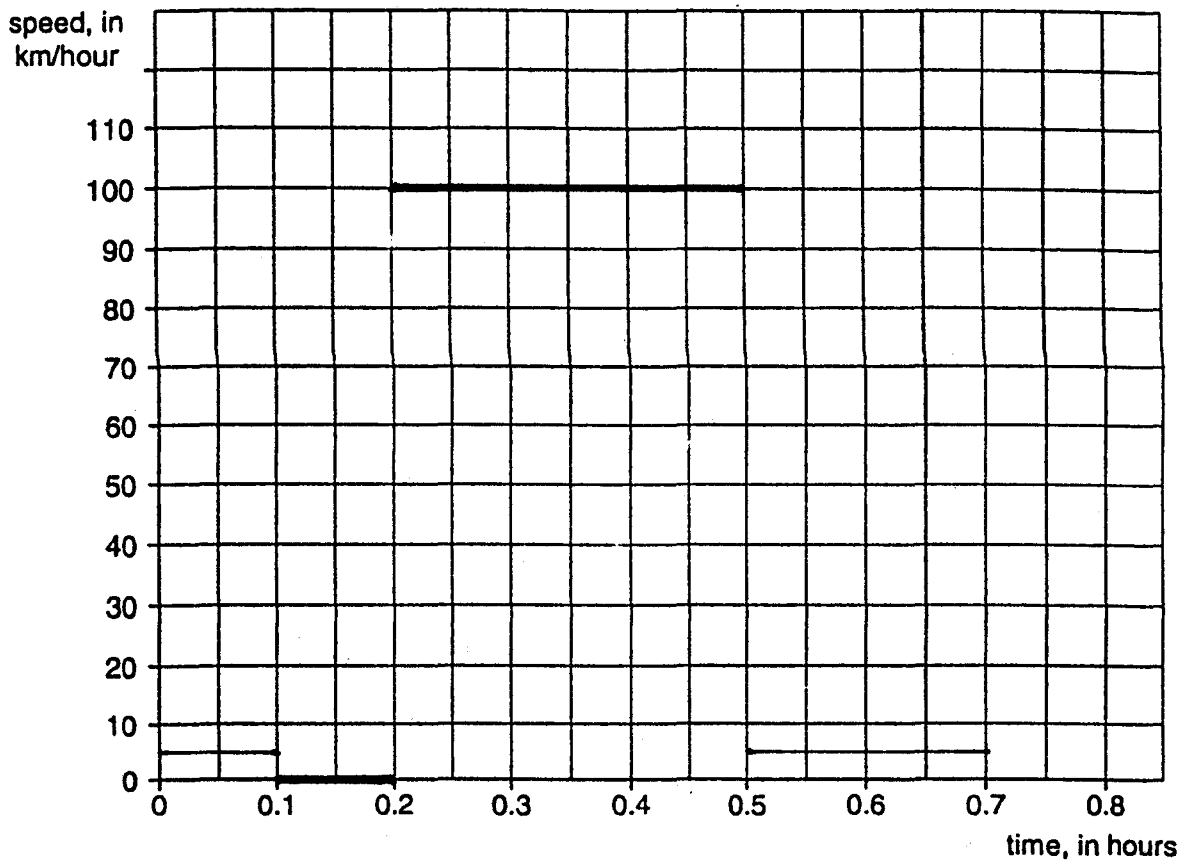


Fig. 8.2

9. (a) a glass rod,

a plastic rod.

(b)

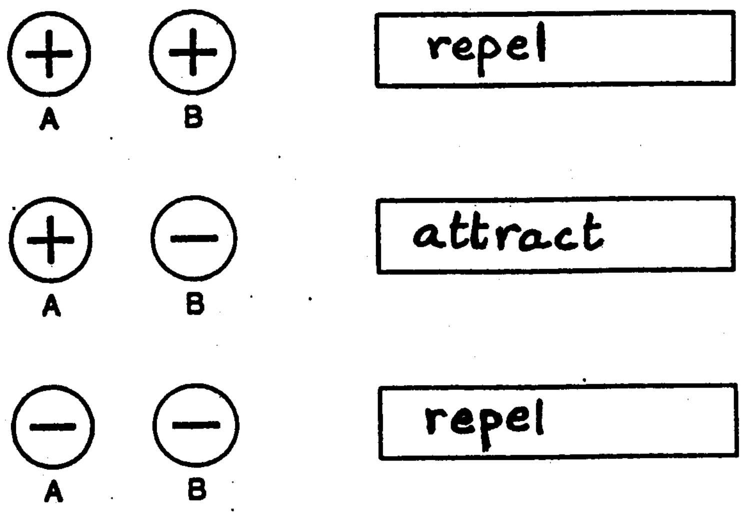


Fig. 9.1

10. (a) (i) Refraction

(ii) The speed of light in glass is less than its speed in air.

(iii)

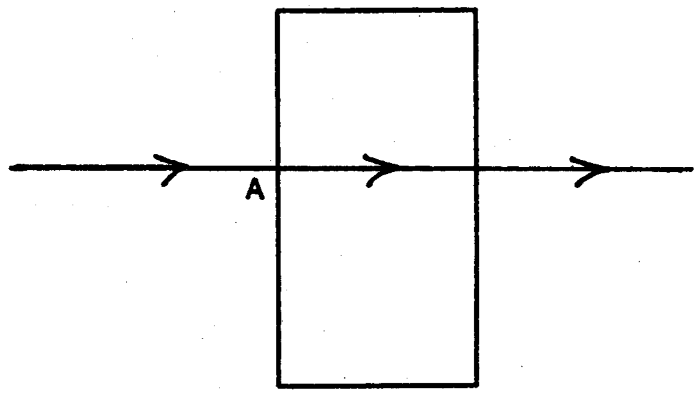


Fig. 10.1

(b) (i) The angle of incidence X should be greater than 30° , because the angle in the air must be larger than the angle in the denser glass.

(ii) The angle Y should be equal to 45° . Since the angle of incidence in glass is 45° which is greater than the critical angle, then there will be total internal reflection.

(c)

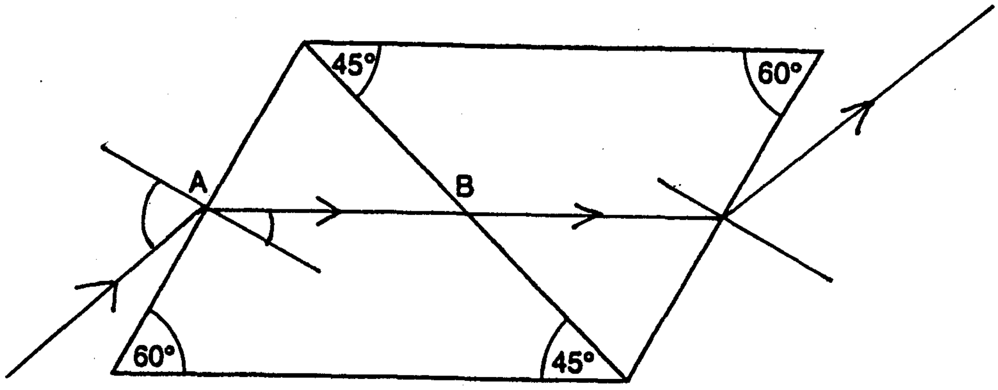


Fig. 10.3

11. (a) (i) might both be magnets.

(ii) must both be magnets.

(b) (i) The springy iron reed is attracted and touches the iron contact.

(ii) The circuit is connected to W and Y

(c) (i)

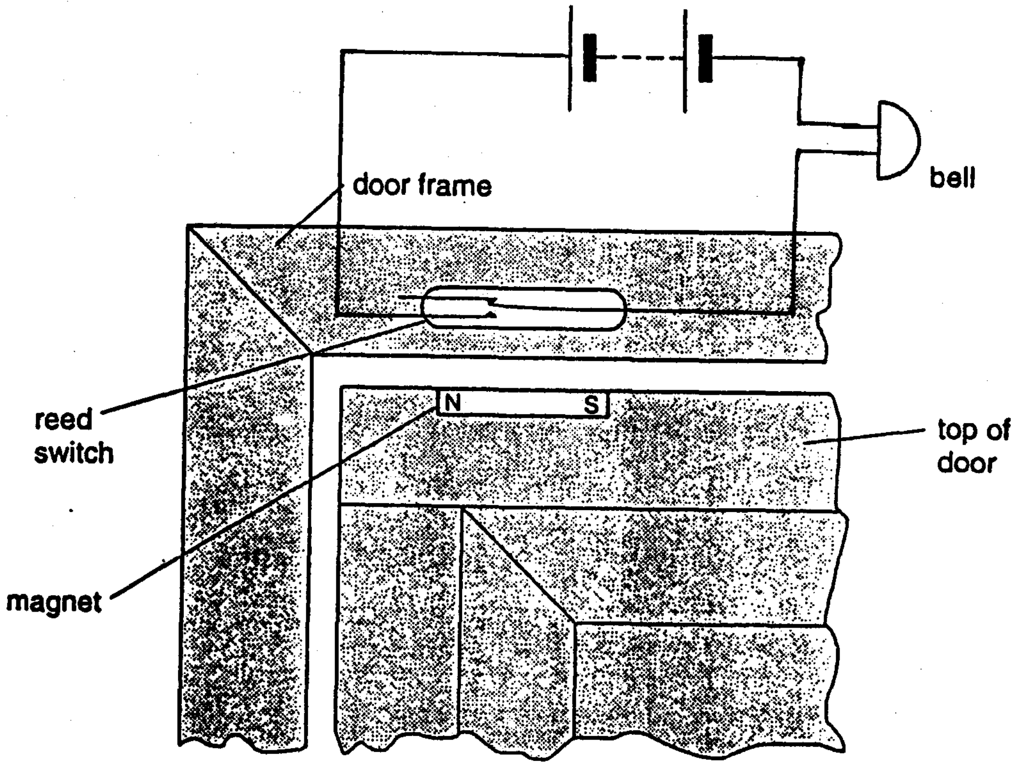


Fig. 11.3

(ii) The magnet magnetises the springy iron and opens the circuit.

(iii) When the door is opened, the magnet moves away from the reed switch which closes the circuit and the bell rings.

(iv) When the door is rapidly closed, the bell stops ringing.

12. (a) Beta particles are electrons emitted from the nuclei of radioactive atoms.

(b) most penetrating : gamma rays

beta rays

least penetrating : alpha particles

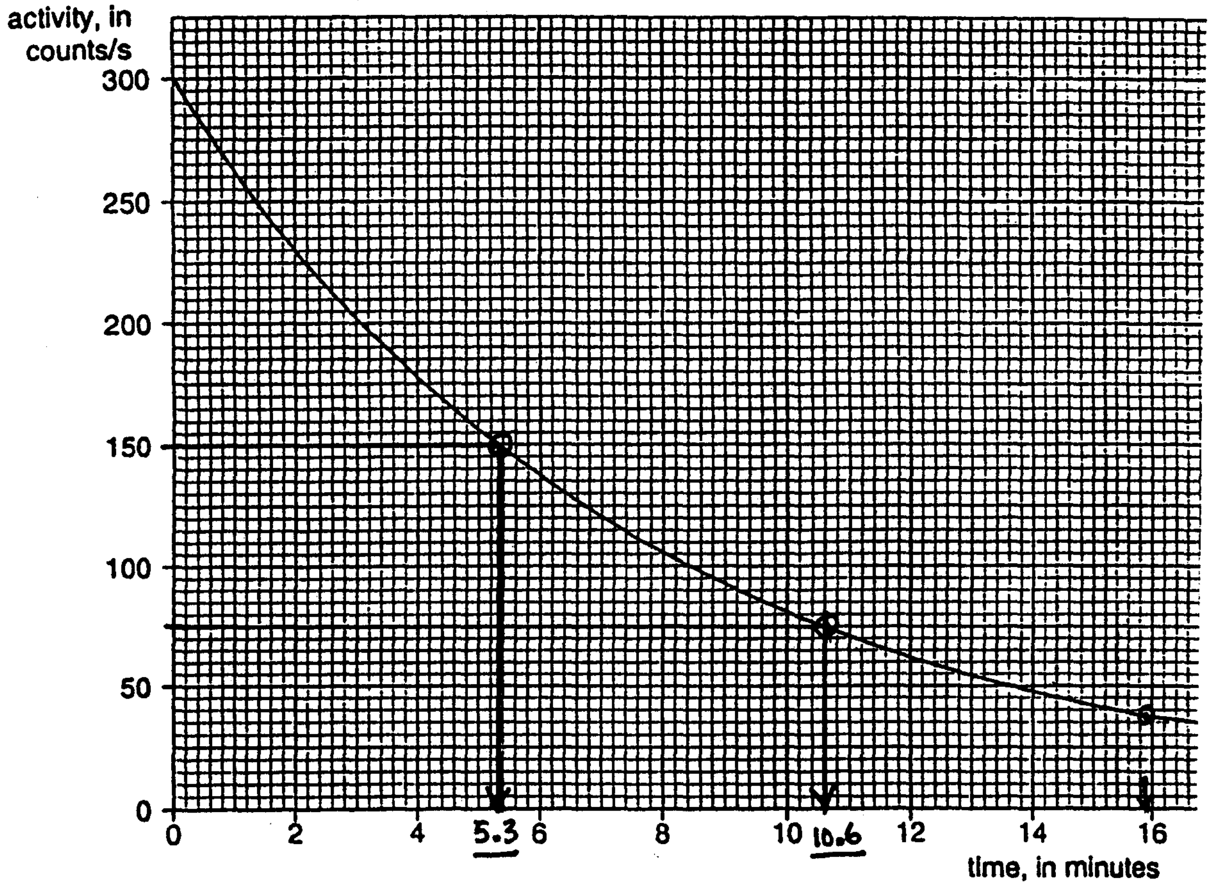
(c) (i) 1. At 11 or 12 minutes

2. paper became thinner

3. because the count rate increases as the thickness decreases.

(ii) No, because alpha particles cannot penetrate through the paper to reach the counter.

(iii) 1.



The half-life of source =5.3 minutes

2. No, this source is not suitable because it activity dies down rapidly; it must be replaced every few hours.

November 1998

Paper 3

1. (a) (i) The conditions for equilibrium are:

1. The clockwise moment of the load box about the pivot is equal to the anticlockwise moment of the effort about the same pivot.
2. The sum of downward forces of load box and effort equals the upward reaction force of the support.

(ii) 1. The effort needed to raise the load is smaller than the load (because effort's distance is longer).

2. It is easier to pull down than to pull up and one can use his weight to help in lifting.

(iii) 1. The steel rod of the lever can end with a rim (or perpendicular edge) to prevent the load box from slipping down the lever.

2. The load box should be deeper so that the building materials would not fill completely (to avoid spilling of materials).

(b) (i) The load box is raised vertically upwards and there is no danger of spilling down its contents.

(ii) In method 2 , the effort required equals the load raised. But in method 1, the effort done is less than the load (because the distance of the effort from the pivot is greater than that of the load).

(c) (i) gravitational potential energy.

(ii) Energy gained = (m g) h

$$= 1700 \times 2.4$$

$$= 4080 \text{ J}$$

(iii) Grav. P. E. = kinetic energy

$$4080 = \frac{1}{2}mv^2$$

$$4080 = \frac{1}{2} \times 170 \times v^2$$

$v^2 = 48$ and $v = 6.9\ m/s$

(d) (i) The extension of each spring is directly proportional to the applied load.

(ii) When the load is 1700 N, each spring will carry half this load (850 N).

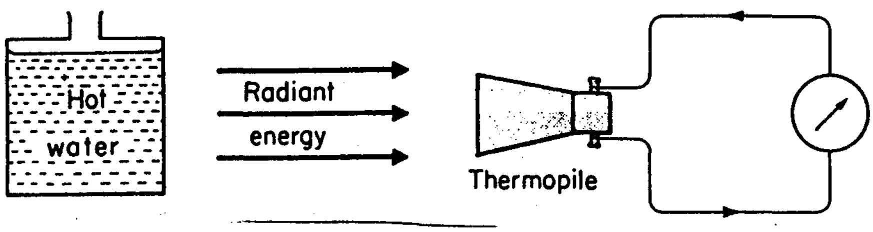
Extension of each spring = 0.85 m

The length of each spring = 1 + 0.85 = 1.85 m

(iii) If the rope breaks, the springs lengths will be 1.85 m and the load will hang above the ground (0.55m above the ground). This system prevents the load from falling to the ground if the rope breaks.

---

2. (a)



method:

1. Bring a hollow copper cube and paint each side with one of the different available coatings (matt black, white gloss, shiny aluminium, and black gloss).
2. Fill the cube with hot boiling water, and place a thermopile (or a blackened bulb thermometer) at the same distance from each face in turn.
3. For each face, the steady deflection obtained on the galvanometer (or the thermometer) is recorded.
4. Repeat the experiment and find the average value recorded for each face.

List of Readings:

Type of paint	Steady Galv. deflection			Average Deflection
	1^{st} exp.	2^{nd} exp.	3^{rd} exp.	
Shiny aluminium				
White gloss				
Black gloss				
Matt black				

Conclusion:

The surface which produces the largest deflection of galvanometer (or greatest temperature reading of thermometer) is that which gives the highest rate of emission of infra-red radiation.

(It is known experimentally that matt black surfaces are best heat radiators).

(b) The power used for vaporisation $= 12\text{ KW} \times \frac{70}{100} = 8.4\text{ KW}$

$$P \times t = m \times L$$

$$\frac{m}{t} = \frac{P}{L} = \frac{8.4}{2500} = 0.0034\ {}^{kg}\!/_{s}$$

$$= 3.4\ {}^{g}\!/_{s}$$

3. (a)

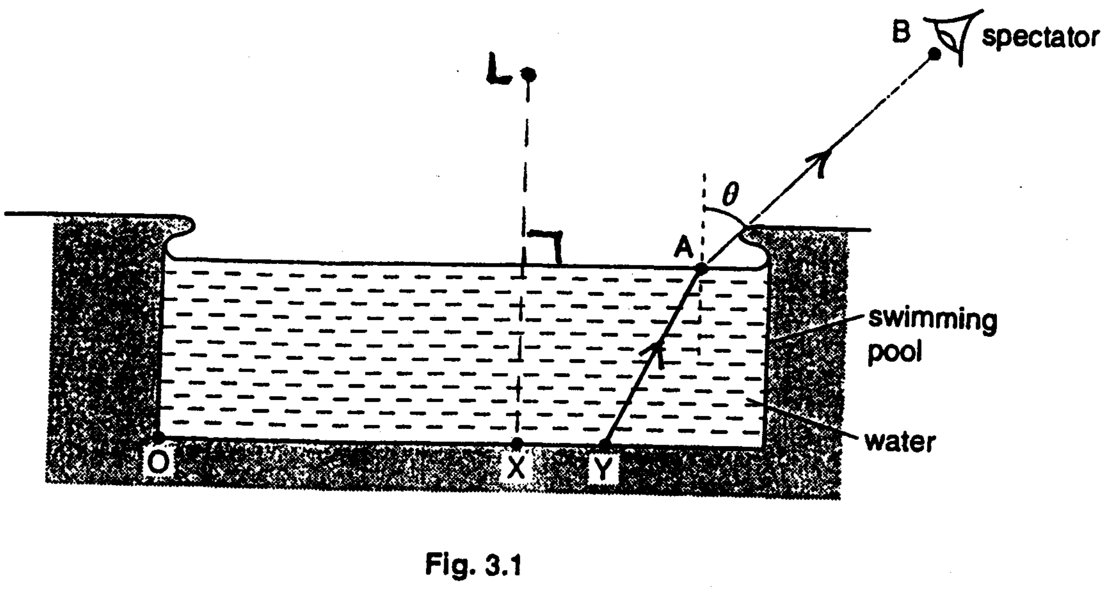


Fig. 3.1

Light rays emitted from any point along the length OY emerge from the water and are refracted away from normals towards the spectator's eye so he can see the whole of OY.

(b) The image of the lamp L should be behind the reflecting surface (water surface) and as far behind it as the lamp is in front. Also, the line joining L & X should be perpendicular to water surface.

(c) frequency $= \frac{\text{Speed}}{\text{Wavelength}} = \frac{3 \times 10^{8}}{5 \times 10^{-7}} = 6 \times 10^{14}\, Hz$

(d) refractive index of water $= \frac{\text{speed in air}}{\text{Speed in water}}$

$$n = \frac{3 \times 10^{8}}{2.25 \times 10^{8}} = 1.33$$

(e) $n = \frac{\sin \hat{i}}{\sin \hat{r}}$

$1.3 = \frac{\sin 45}{\sin r}$

angle in water, $\hat{r} = 33°$

---

4. (a) (i) The alternating electric power in the primary coil continuously reverses its direction every half cycle and changes its value between maximum and minimum values. This produces a continuously varying magnetic field in the primary coil.

(ii) The varying magnetic flux produced in the primary coil is concentrated in the laminated soft iron core and is passed through the core to the secondary coil.

(iii) The continuously varying magnetic flux flowing through the secondary coil produces induced electric power and an alternating e.m.f. is generated across the secondary coil.

(b) $\frac{V_1}{V_2} = \frac{N_1}{N_2}$; $\frac{V_1}{12} = \frac{600}{30}$

$\therefore V_1 = \frac{12 \times 600}{30} = 240\,V$

(c) (i) $I = \frac{V}{R} = \frac{12}{48} = 0.25\,A$

(ii) Q = I.t = 0.25 x 20 = 5 Coulomb

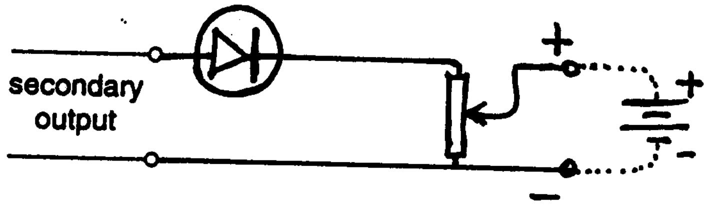
(iii) $I_1 V_1 = I_2 V_2$

$I_1 \times 240 = 0.25 \times 12$

$I_1 = 0.0125\ A$

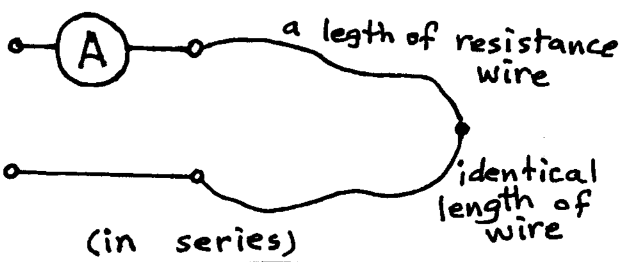
$I_1 = 12.5\, mA$

(d)



1. The semiconductor diode is used to change a.c power to d.c.
2. The potential divider is used to reduce the d.c. voltage to 6 V which is the value required for charging the battery.

(e) (i) use two identical lengths of resistance wire connected in series as shown.



(ii) use two identical lengths of resistance wire connected in parallel as shown.

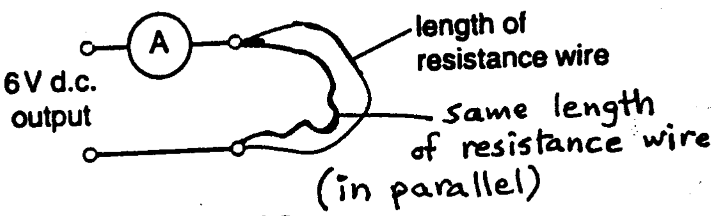


Fig. 4.3

5. (a) (i) 1. ^{235}U and ^{238}U have identical chemical properties.
2. ^{238}U has atomic mass, and thus density, which is greater than that of ^{235}U.

(ii) ^{238}U nucleus contains protons and neutrons.
The number of protons =92
The number of neutrons = 238 – 92 = 146

(b) (i) Because most of the volume of the atom is an empty space, thus most of the alpha particles pass through it in straight lines without scattering.

(ii) The scattering of alpha particles through angles greater than 90° is due to direct collisions with the central nucleus. Since the volume of the nucleus is very small compared to that of the atom, therefore the probability of direct scattering with the nucleus is very small.

November 1998

Paper 6

1. (a)

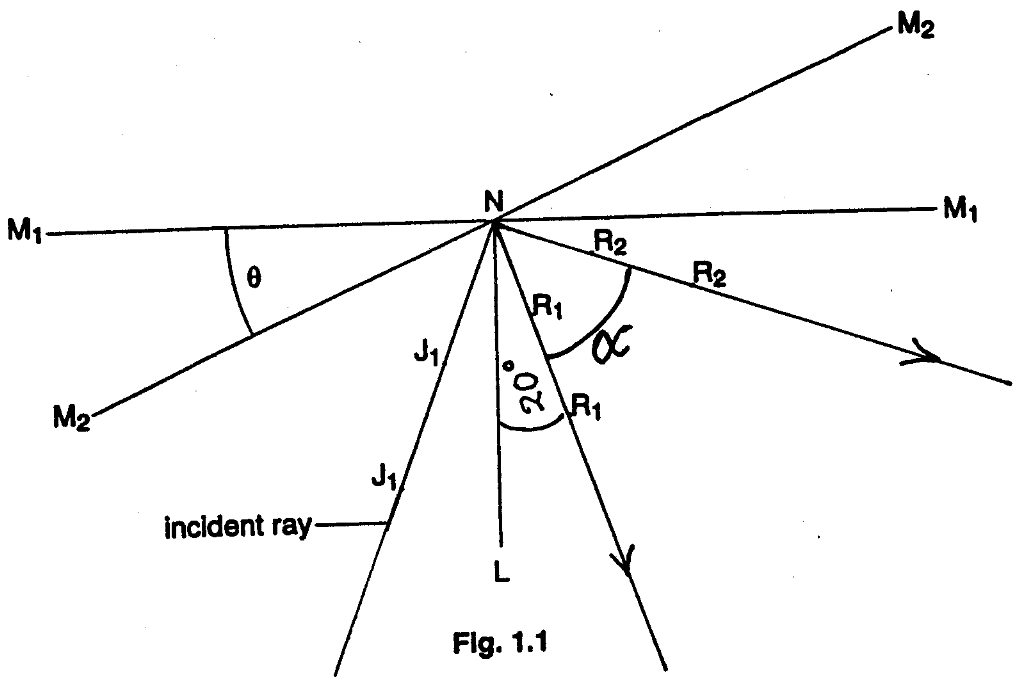


Fig. 1.1

angle of reflection = 20°

(b) (i) α = 50 °

(ii) θ = 25 °

(iii) $\dfrac{\alpha}{\theta}$ = 2

(c) The line of sight of the eye is kept perpendicular to the rule's edge (or to the scale of protractor) to avoid the parallax error.

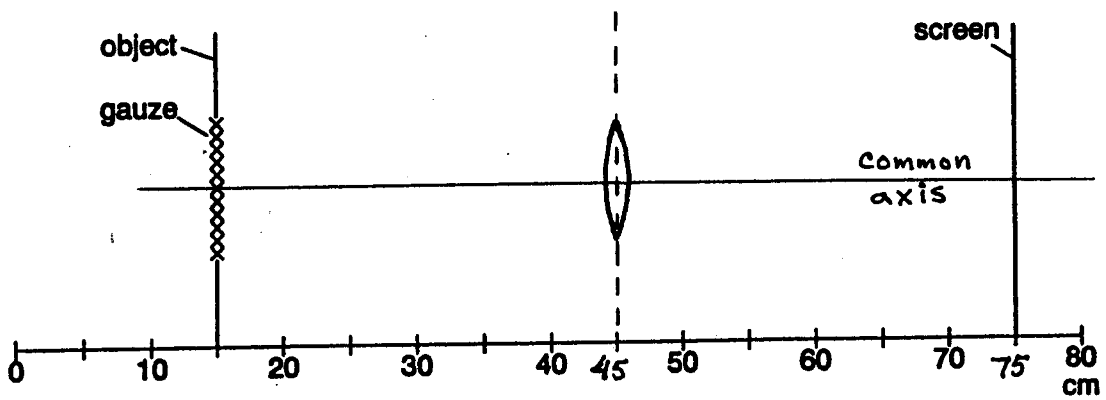
---

2. (a) (i) image distance for horizontal wires = 24.5 cm
image distance for vertical wires = 16.5 cm

(ii) s = 8.0 cm

(b) (i) β = 0 °

(ii)



(c) (i) The centers of the object, lens and screen should have the same height above the bench.

(ii) The object, lens and screen should be perpendicular to the common axis of the apparatus.

---

3. (a) (i) choice of wire : W_1

length of wire : 60 cm

(ii) When choosing W_1, one uses the longest length which could be measured more accurately.

(b) (i) power supply = 2V ; range of ammeter : 0 to 1A.

(ii) Since the maximum current is 0.8A, the 0-1A ammeter gives the greatest deflection so the current can be measured with greater accuracy.

(iii) The 3V and 6V power supplies are not acceptable because they would produce current greater than 0.8A as required; only the 2V power supply gives a current less than 0.8A.

$$(I = \frac{V}{R} = \frac{2}{3} = 0.67\ A)$$

---

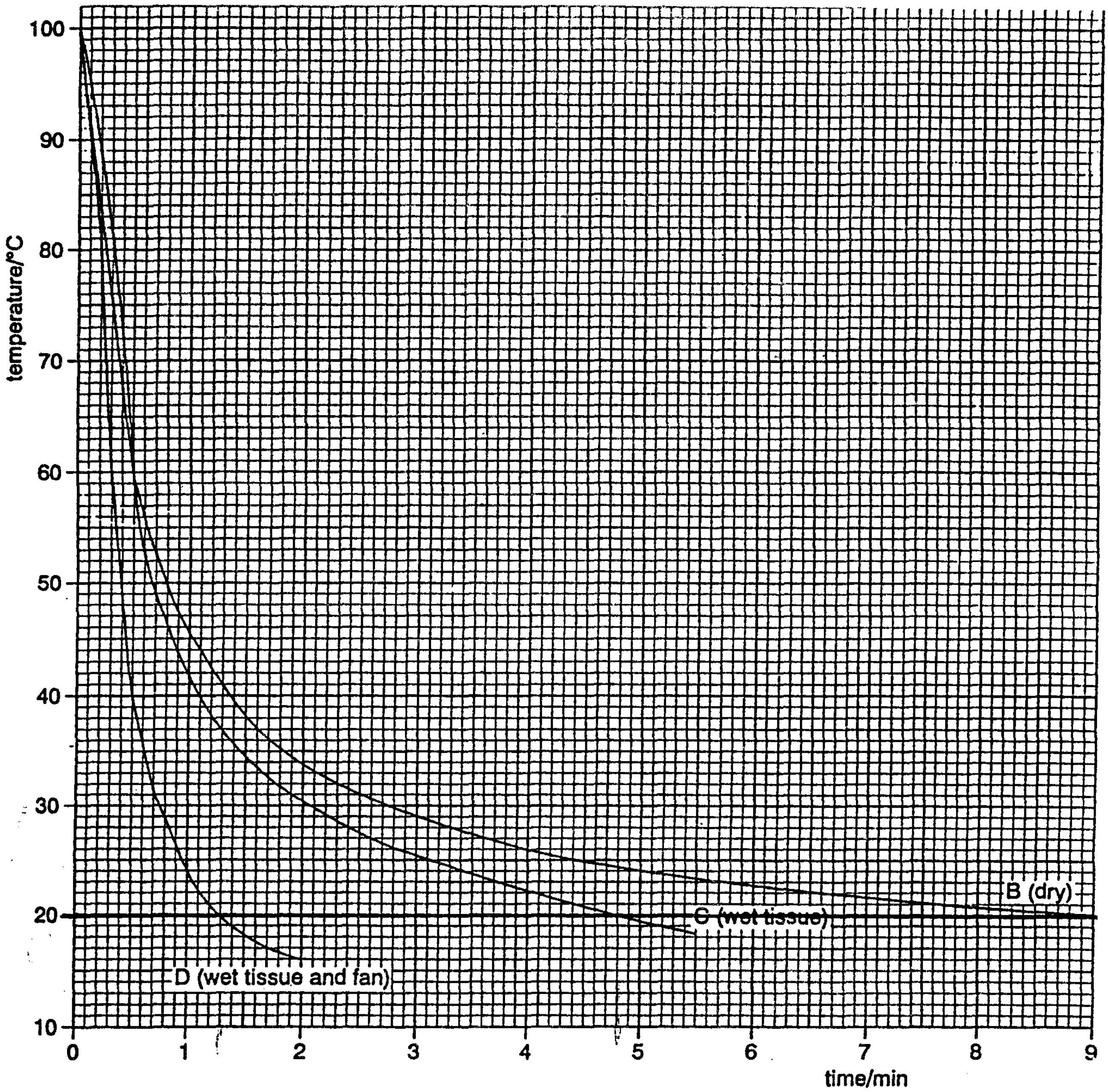
4. (a) $t_B = 9.0$ min

$t_C = 4.8$ min

$t_D = 1.3$ min

(b) Yes, evaporation causes cooling of thermometer more quickly.

(c) (i)

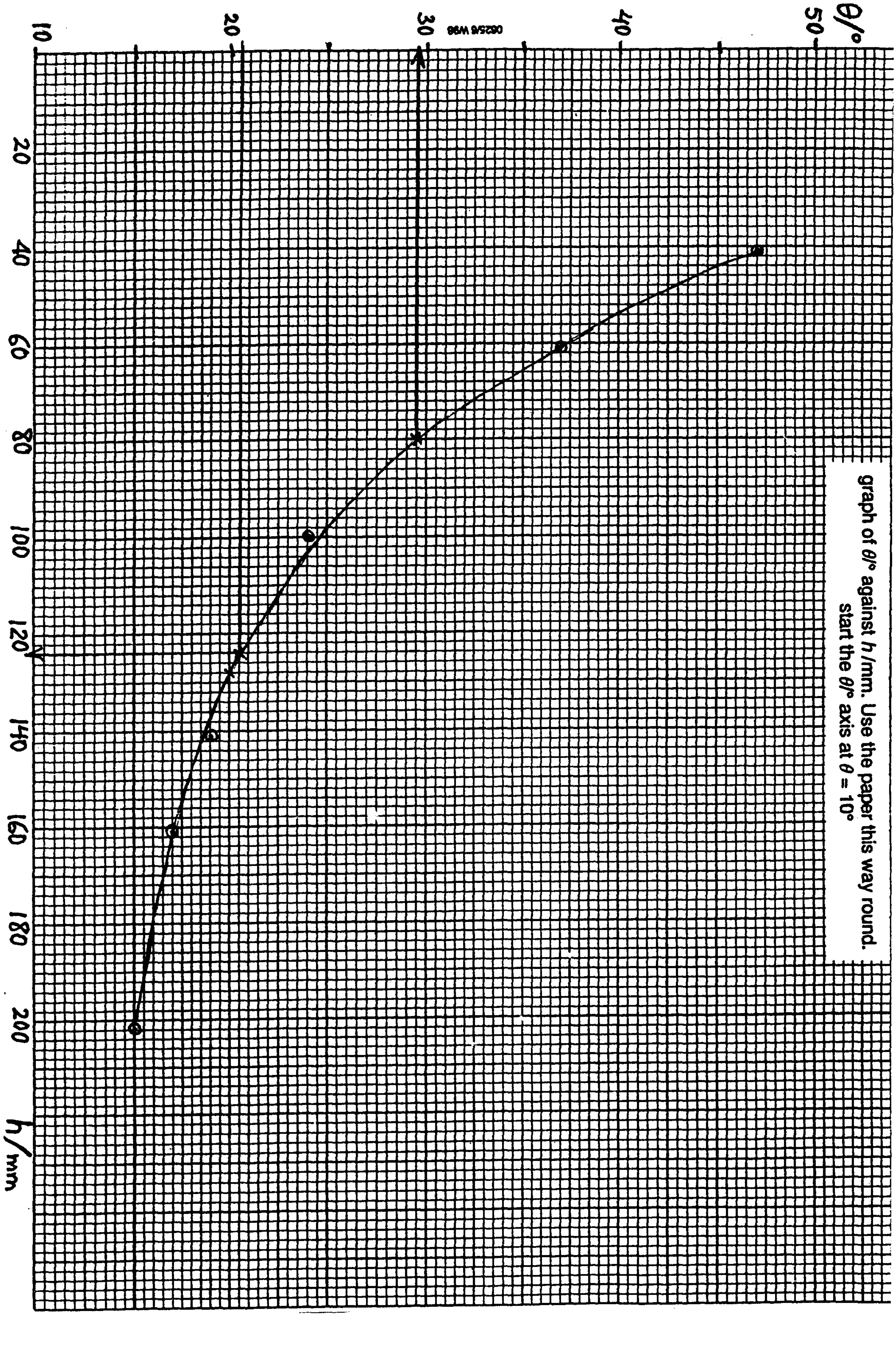


(ii) The cooling would continue until all water evaporates and the tissue becomes dry; then the temperature of the thermometer starts to rise gradually until it reaches the room temperature (20°C).
This rise occurs because the cool dry thermometer gains heat energy from the surroundings.

---

5. (a) see the graph (page 16)
(b) When block A is pushed a little and then released, it is more likely to fall back to its original position than block B. (Block A can be tipped to a greater angle before it falls over)

block	h/mm	θ/°
A	80	29.5
B	124	20.5


graph of θ/° against h/mm. Use the paper this way round.
start the θ/° axis at θ = 10°
θ/°
10
20
30
40
50
0625/6 W98
20
40
60
80
100
120
140
160
180
200
h/mm

June 1999

Paper 1

1	D	11	C	21	B	31	B
2	C	12	C	22	A	32	D
3	B	13	C	23	D	33	A
4	D	14	A	24	A	34	A
5	D	15	B	25	C	35	A
6	C	16	B	26	A	36	B
7	B	17	C	27	C	37	A
8	B	18	C	28	B	38	A
9	C	19	C	29	C	39	C
10	D	20	A	30	A	40	D

June 1999

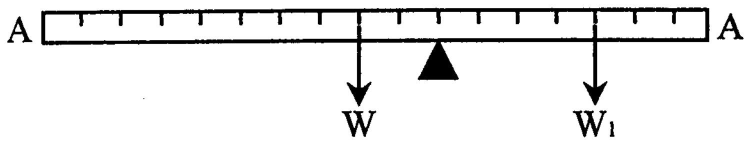
Paper 2

1. distance = 25 - 5 = 20 cm.

$$v = \frac{d}{t} = \frac{20}{50} = 0.4 \text{ cm/s.}$$

2. a) (i) W_1 is heavier.
   (ii) Move W_1 towards the pivot to balance the beam.

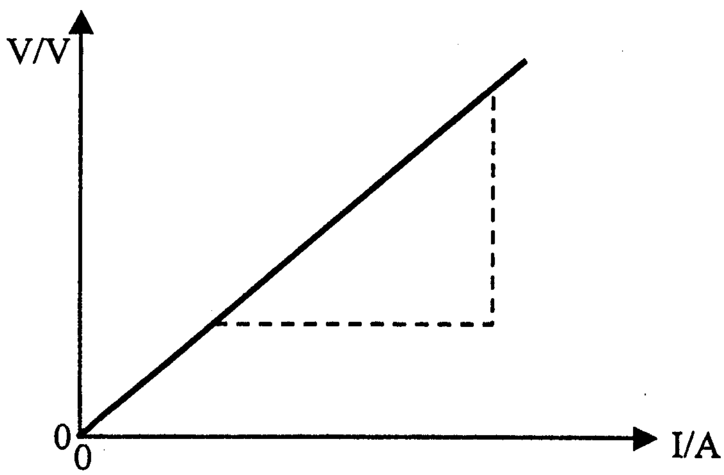
b)



3. a) molecules further apart in gaseous state.
   b) solid state: the molecules vibrate about their fixed positions.
   gaseous state: the molecules move freely in random directions.

4. a) A coal fire converts chemical energy into heat energy and light energy.
   b) When a ball falls from rest, its kinetic energy increases and its potential energy decreases.
   c) The source of energy in which hot rocks heat water is referred to as geothermal energy.

5. a)



b) The resistance of the conductor equals the gradient (slope) of the (V,I) graph.

6. a) Dispersion of light.
b) Spectrum of white light.
c) Red.
d) Red light only.

7. a) The coil will rotate.
b) The magnetic field produces a turning momement on the coil which is carrying the electric current, thus it will rotate.
c) The electric motor.

8. a) .. to avoid contamination of hand with the dangerous radioactive material.
b) .. because thick lead can absorb <u>most</u> of the gamma rays emitted.
c) .. to caution everybody to avoid the dangers of radiations from the radioactive materials.

9. a) (i) Volume $= 0.3 \times 0.2 \times 0.05$
$= 0.003 \; m^3$

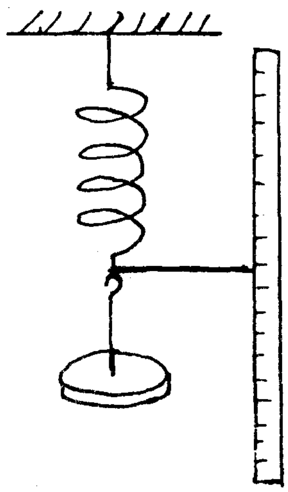
(ii) density $= \dfrac{m}{V} = \dfrac{2.4}{0.003} = 800 \; kg/m^3$

b) Weight = mg
$= 2.4 \times 10 = 24$ N

c) Pressure $= \dfrac{F}{A} = \dfrac{24}{0.3 \times 0.2} = 400 \; N/m^2$ (Pa)

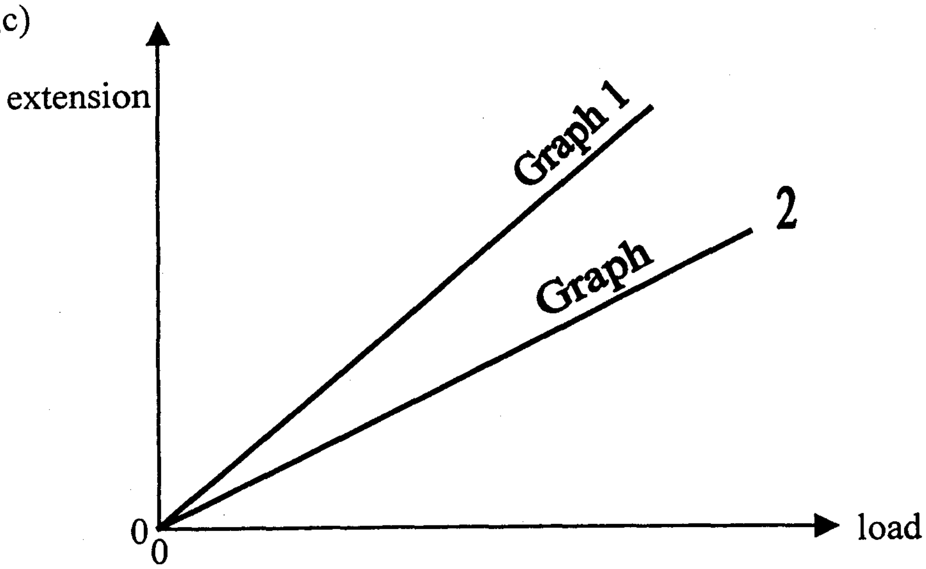
d) (i) The new mass is <u>half</u> the original mass (= 1.2 kg).
(ii) The density is the <u>same</u>.
(iii) The weight is <u>half</u> the original weight (= 12 N).
(iv) The pressure is <u>half</u> the original pressure (= 200 Pa)

10. a)



1. Fix a pointer at the lower end of the spring.
2. Place the rule near the spring and take a reading, r_1, where the pointer touches the rule.
3. Hang the load from the lower end of spring and record the new reading, r_2, of the pointer.
4. The extension $= r_2 - r_1$

(b,c)

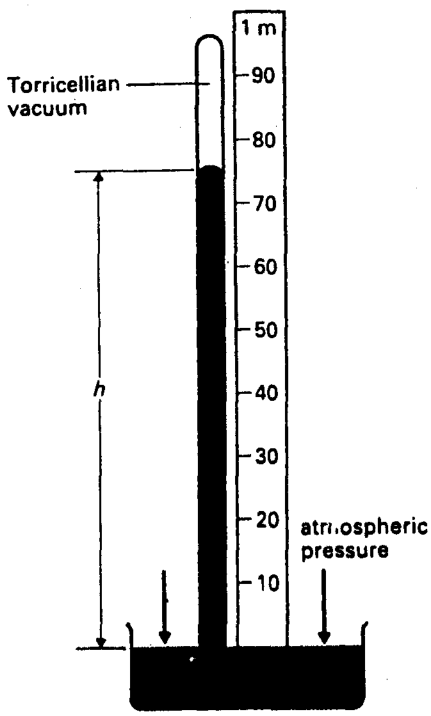


d) (i) The trolley accelerates from rest until it reaches its constant terminal velocity.

(ii) It also accelerates from rest and reaches the same terminal velocity because the applied force is the same and trolley's friction is the same.

---

11. a) (i)



(ii) Atmospheric pressure.

b) (i) 5 cm

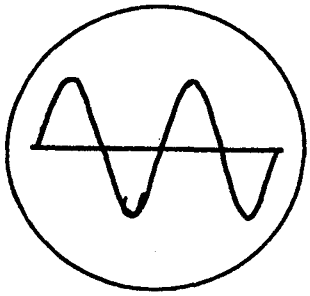
(ii) it indicates the difference between the gas pressure and the atmospheric pressure.

(iii) the gas pressure is less than the atmospheric pressure, because the mercury level is higher on the gas side.

(iv) The mercury level on the gas side will be lower, and the mercury level on the atmospheric side will be higher.
(v) The difference between liquid level becomes greater.

---

12. a) (i) between A and H.
(ii) between G and F.
(iii) between B and E.
b) (i)



(ii) a straight vertical line at the center of the screen.
c) The high-pitched voice has higher frequency than the low-pitched voice. (the higher pitch produces greater number of vibrations on the screen).

June 1999

Paper 3

1. a) Speed = frequency x circumference.

$= 0.2 \ (2\pi r)$.

$= 0.2 \times 2 \times 3.14 \times 10$.

$= 12.56$ m/s.

b) (i) The velocity is 12.56 m/s to the east.

(ii) The speed has a constant value (12.56 m/s) but the velocity changes because the direction of point P is always changing.

c) As the arm P is moving in a circular motion about the point O, there must be a centripetal force acting towards the centre O.

d) (i) 1. The speed of water decreases due to the friction with the air.

2. The speed decreases suddenly to zero when the water hits the ground and stops.

(ii) 1. $x = ut + \frac{1}{2}gt^2$

$= 0 + (\frac{1}{2} \times 10 \times 0.6 \times 0.6)$

$= 1.8$ m

2. Distance = area under (v,t) graph.

$= \frac{1}{2}(10+9) \times 0.6$

$= 5.7$ m

e) 1. The water at Q hits a small area which produces high pressure, whereas at R the area is larger and the pressure produced is thus smaller.

2. Also, at Q the direction of force is perpendicular but at R the direction of the force is inclined and the perpendicular componeut of the force is smaller giving a smaller pressure.

---

2. a) $P \times t = m \cdot c \cdot \theta$

$30000 \times 18000 = 54000 \times c \times 2$

$c = 5000$ J/kg.k

b) (i) 1. Water molecules have greater average kinetic energy and greater average speeds than air molecules. When water molecules collide with air molecules at the surface they loose some of their energies which causes their temperature to cool down. (This is called conduction)

2. When water molecules at the surface cool down, they become more dense and sink down in the pool allowing the warmer more energetic molecules to go up, this circulation is called convection currents.

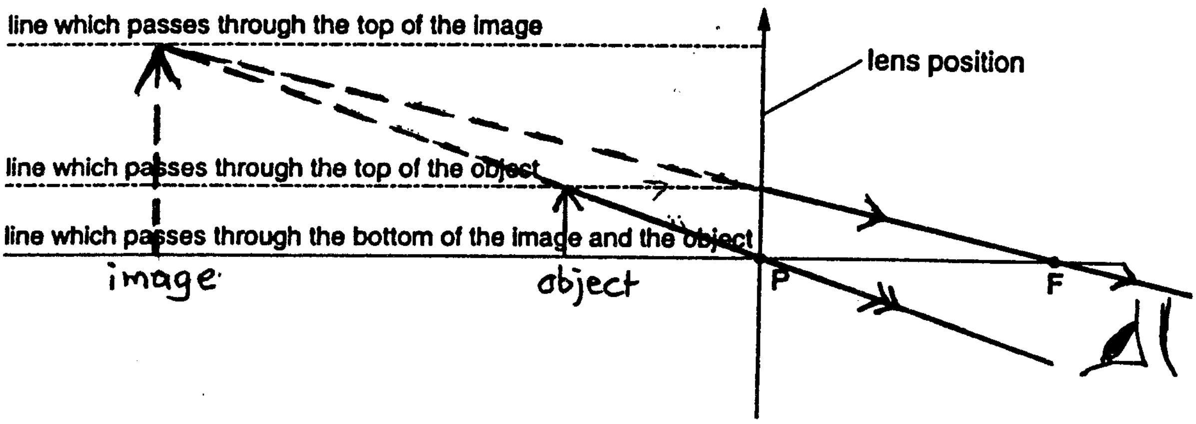
(similar convection currents also occur in air)

3.Some water molecules may loose some heat by emitting infra red radiation.

4. Some of the fast moving molecules near the surface of the water can escape from the surface leaving behind them the slower less-energetic molecules which causes the water to cool down.

(ii) The loss of heat led to a smaller value for the rise in temperature θ, and this in turn led to a higher value of the specific heat capacity.

3. a)



(i) the scale used, 1 : 1

(ii) the distance of image, 8 cm

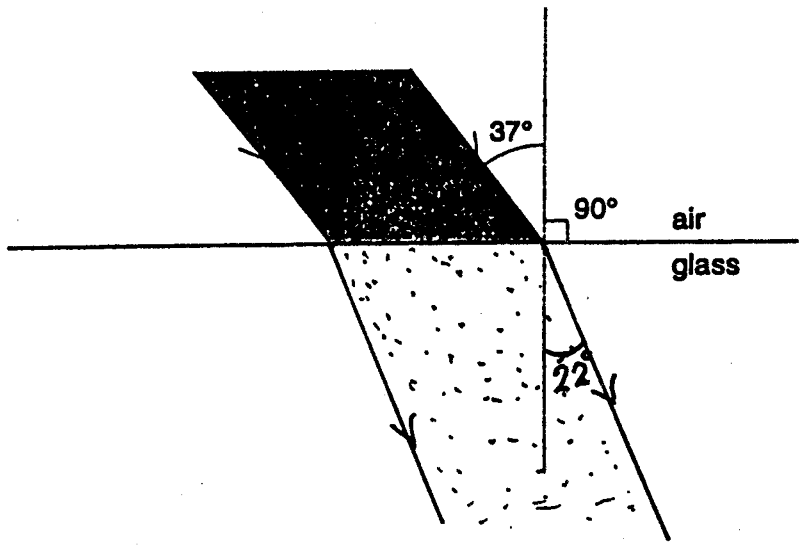
(iii) the distance of object, 2.6 cm

b) (i) Light having one single colour. (and single frequency and wavelength)

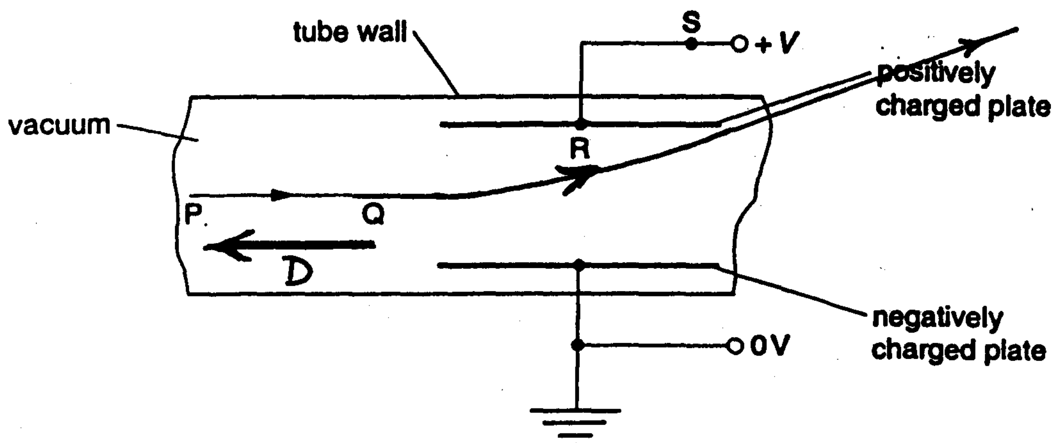
(ii) Speed of light = 3×10^8 m/s

(iii) $n = \dfrac{\sin \hat{i}}{\sin \hat{r}} = \dfrac{\sin 37}{\sin 22} = 1.6$

(iv)



4. a) (i)



(ii) The electron beam is negatively charged so it is attracted towards the positive plate and is deflected towards R.

b) (i) Total charge $= 10^{14}(1.6 \times 10^{-19})$

$= 1.6 \times 10^{-5}$ C

(ii) Current $= \dfrac{charge}{time}$

$$I = \frac{1.6 \times 10^{-5}}{10} = 1.6 \times 10^{-6} \text{ A}$$

$= 1.6 \ \mu\text{A}$

c) (i) Energy $= V I t$

$= 10000 \times 2.1 \times 10^{-6} \times 600$

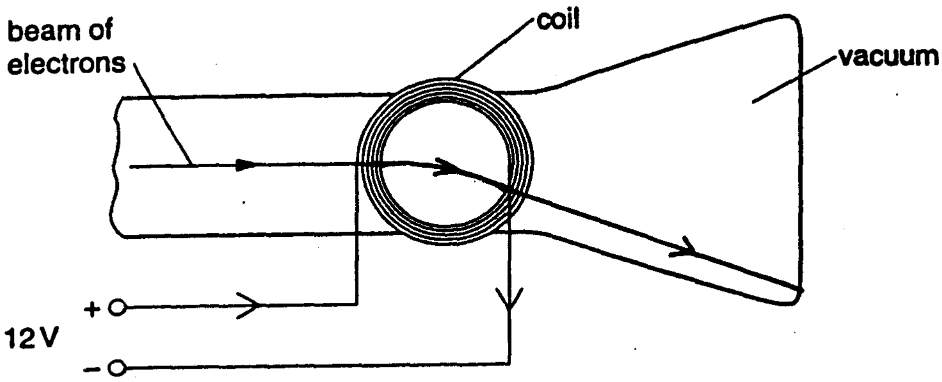
$= 12.6$ J

(ii) Power $= V I$

$= 10000 \times 2.1 \times 10^{-6}$

$= 0.021$ W

d) (i)



The conventional current is directed to the left, and the magnetic field is into the paper ; thus using Fleming's left hand rule gives a force directed down wards.

(ii) $I = \frac{V}{R} = \frac{12}{100} = 0.12$ A

(iii) The deflection of the electron beam will increase and will be reversed to the upward direction.

5\. a) (i) The radioactive isotope ionizes the air, i.e, it changes the neutral atoms to positive ions and negative ions. The positive ions are attracted towards the copper gauze and the negative ions are attracted towards the positive copper wire, thus an electric current passes in the air between them producing the sparks.

(ii) 1. The gamma source produces almost no ionisation, therefore no sparks are seen.

2. The beta source has weak ionising power, therefore few sparks are seen every second.

3. The alpha source has strong ionising power, therefore many sparks are produced per second.

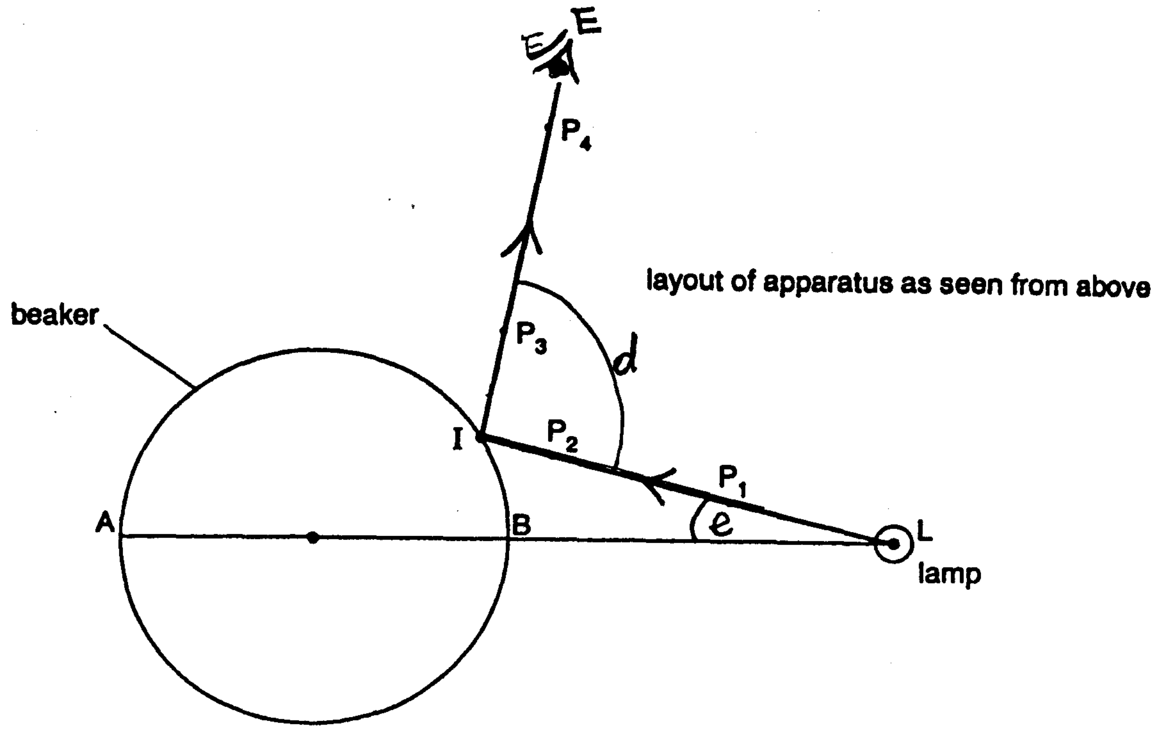
b)

	α	β	γ
mass	4 units	Negligible $\left(\frac{1}{1840}\right)$	zero
constitution	2 protons + 2 neutrons	a negative electron	elect. magn. wave
charge	+ 2 units	- 1 unit	zero

June 1999

Paper 6

1. a)



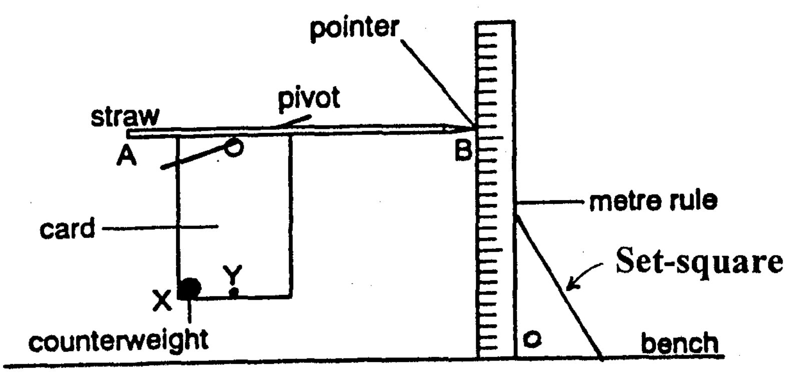
b)

	$\frac{angle}{°}$
d	92
e	14

c) $\frac{d}{e} = \frac{92}{14} = 6.6$

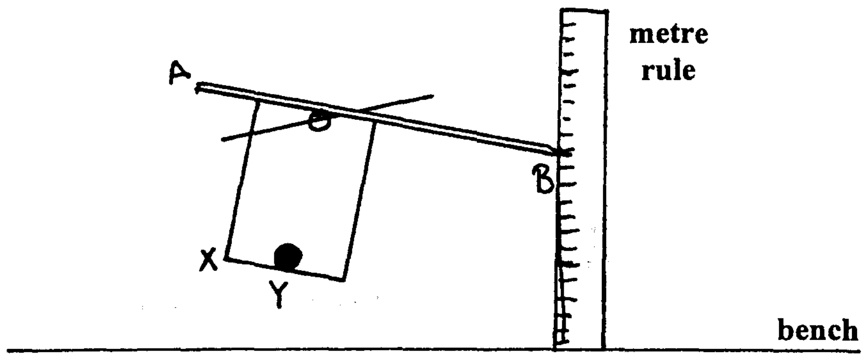
d) (ii) The coloured water is an advantage because the amount of light transmitted through it is rather small, and most of the light is reflected at the surface which produces a clear image of the lamp.

2. a)



Place a set-square on the bench such that it touches the metre rule; if their edges are exactly parallel, this indicates that the metre rule is perpendicular to the bench.

b)



c) pointer reading = 25.7 cm.

d)

Number of clips	h / cm

e) (i) $n_a = 9.5$

$n_w = 4.5$

(ii) 1. F acts in upward direction.

2. The magnitude of F equals the weight of five paper clips.

---

3. a) (i) average value for $\theta = \dfrac{26.8 + 26.8 + 27.0 + 26.9 + 27.0 + 27.0}{6}$

$= 26.9°C$

(ii) largest temp. difference = 0.1°C

The largest temp. difference is 0.37 % (less than 1%) therefore we can assume that the temperature remained constant.

b) (i) Exp. 1, volume = 0

Exp. 2, volume = $(14 - 10.9) \times 2 = 6.2\ cm^3$

Exp. 3, volume = $(14 - 0.1)\ \times 2 = 27.8\ cm^3$

(ii) average rate of flow = $\dfrac{27.8}{5} = 5.56\, cm^3/h$

c) The rate of flow of water depends on the rate of evaporation of water from the paper tissue; and the rate of evaporation increases considerably by the draught flowing over the surface of the tissue.

4. a) X is a variable resistor (rheostat).
Y is an ammeter.

b) The variable resistor can change the resistance of the circuit which changes both V and I across R.

c) 1. Set the rheostat at its maximum resistance then switch on the circuit.
2. Record the value of the current I from ammeter, and the value of the potential difference V from the voltmeter; then find the value of $R = \frac{V}{I}$
3. Repeat the above step several times by decreasing the resistance of rheostat several times.
4. Find the average value of R from the above values determined for R.

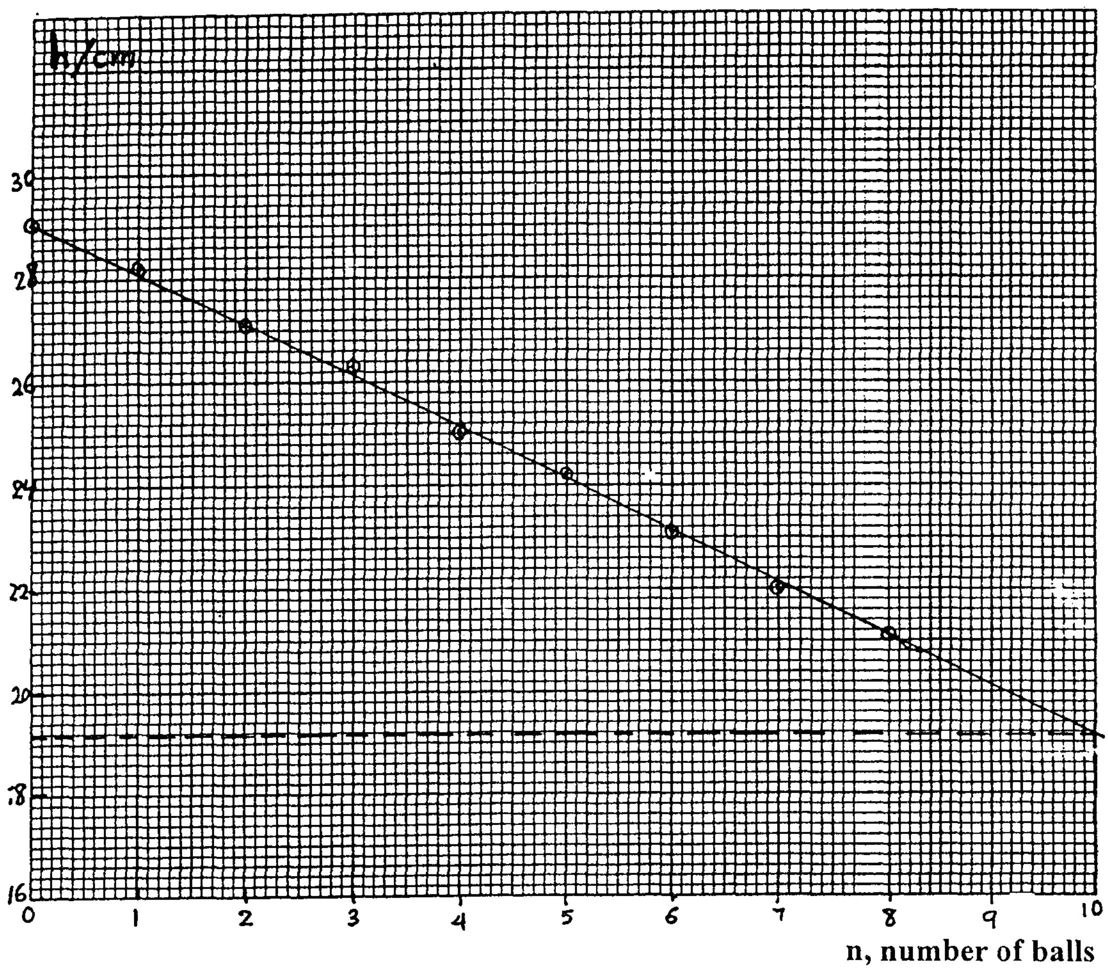
d) V = I R
= 0.10 x 9.5 = 0.95 V
max. reading = 1.0 V

5. a) (i) The graph paper (page 12)
(ii) h = 19.1 cm.

b) Because the straw is far from the metre rule, the set-square is used to get an accurate reading and avoid the error due to parallax.

c) The straw vibrates until the force of weight balances the upthrust force.

d) The value of h measured would be lower than it should.



November 1999

Paper 1

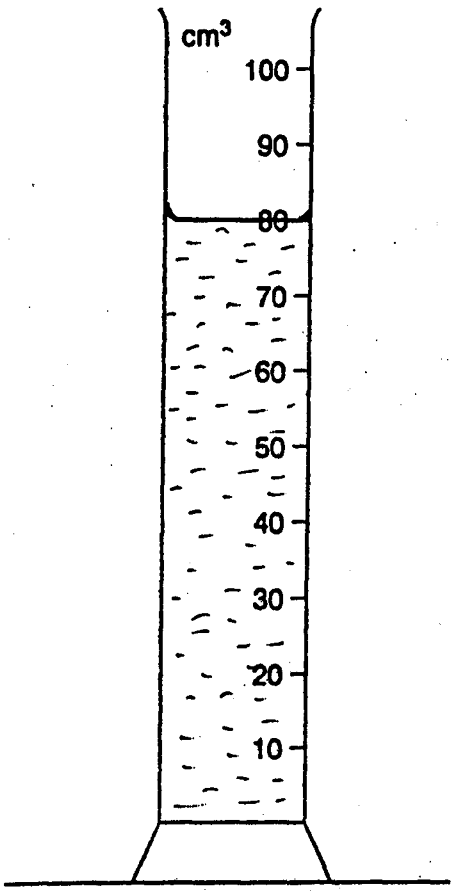
1	A	11	B	21	D	31	A
2	C	12	C	22	D	32	D
3	C	13	B	23	C	33	C
4	D	14	A	24	D	34	A
5	C	15	A	25	D	35	D
6	B	16	B	26	B	36	D
7	C	17	B	27	C	37	C
8	B	18	B	28	A	38	C
9	C	19	A	29	A	39	B
10	B	20	D	30	B	40	A

November 1999

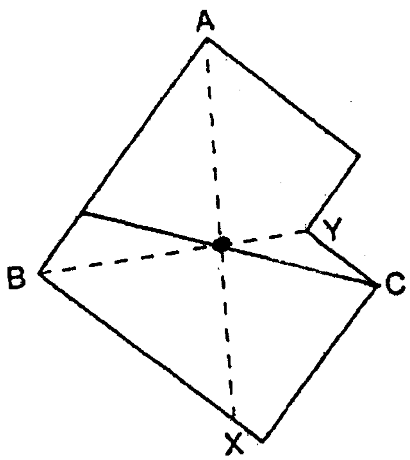
Paper 2

1. (a) Volume $= 8 \times 5 \times 2 = 80\ cm^3$

(b)



2. (a,b)



3. (a) Magnet A is attracted and moves towards B.

(b) Magnet A is repelled and moves away from C.

(c) Magnet A is attracted and moves towards the iron bar.

(d) Magnet A does not move (no effect).

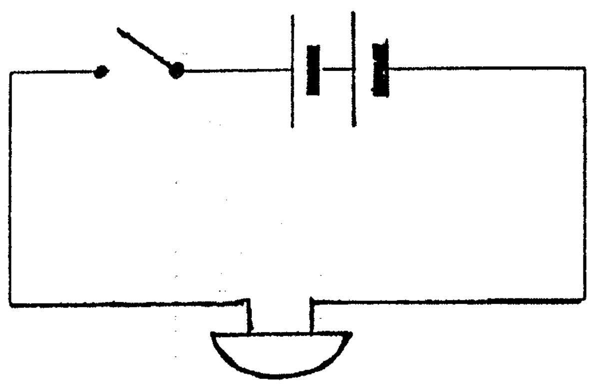
4. (a) (i) during BC.

(ii) … because he is climbing the hill against gravity and increasing his gravitational potential energy.

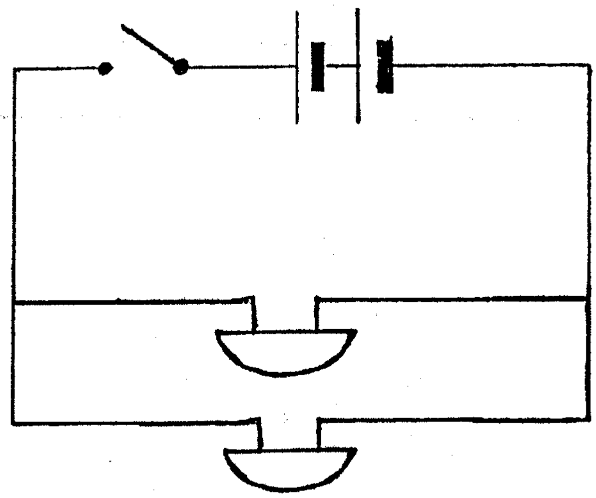
(b) (i) his power is greater than when walking.

(ii) … because he is doing the same work in less time which increases the power needed.
(power = work / time).

5. (a)

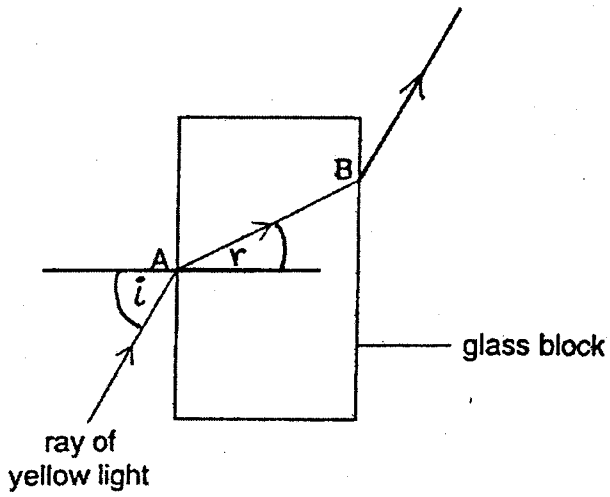


(b) (i)



(ii) because the current drawn from the battery is doubled, so the energy used is greater.

6. (a,b)



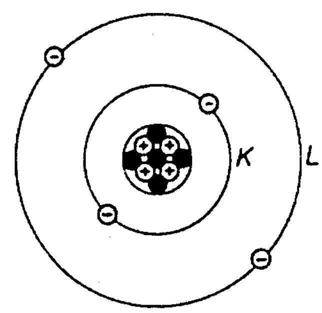
7. It is placed near the bottom so as to produce convection currents in the liquid to heat all the liquid. When liquid is heated, it expands and becomes less dense, so it rises up and is replaced by cooler liquid; this circulation is called convection currents.

8. The atom is made of:

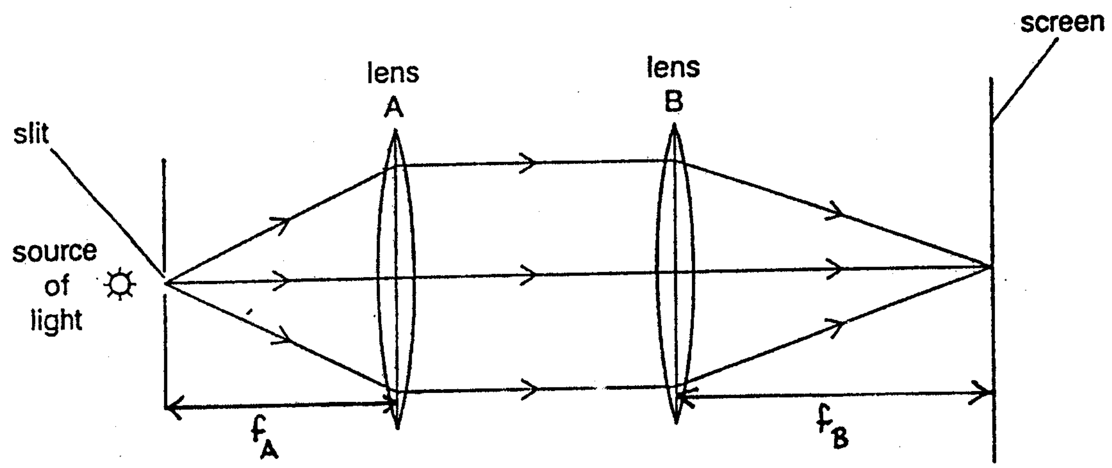
(i) a central nucleus which is very small compared to the atom, and carries positive charges.

(ii) negative electrons revolving around the nucleus in several shells or orbits.

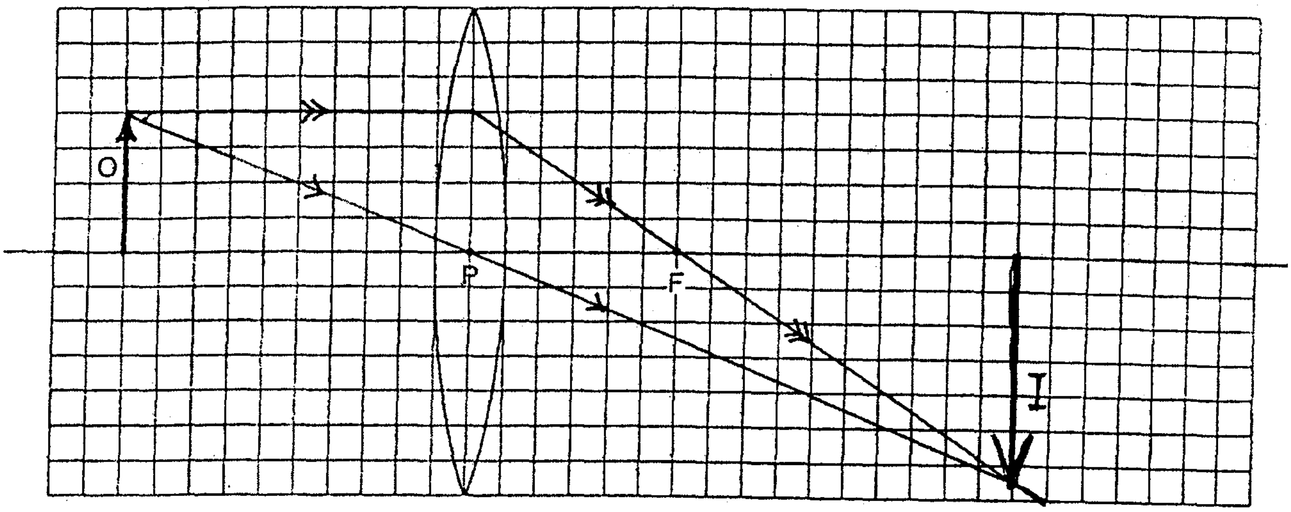
(iii) the atom is neutral because its positive and negative charges are equal.



9. (a)

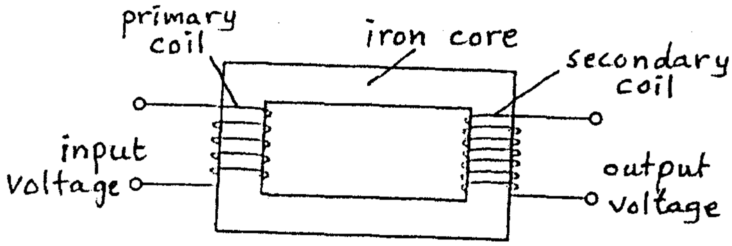


(b)



(iii) real ; inverted ; larger than object.

10. (a)



(b) Copper is very good conductor of electricity and its resistivity is very small.

(c) (i) $\frac{V_s}{10} = \frac{1500}{500}$ $\qquad V_s = 30V$

(ii) Zero.

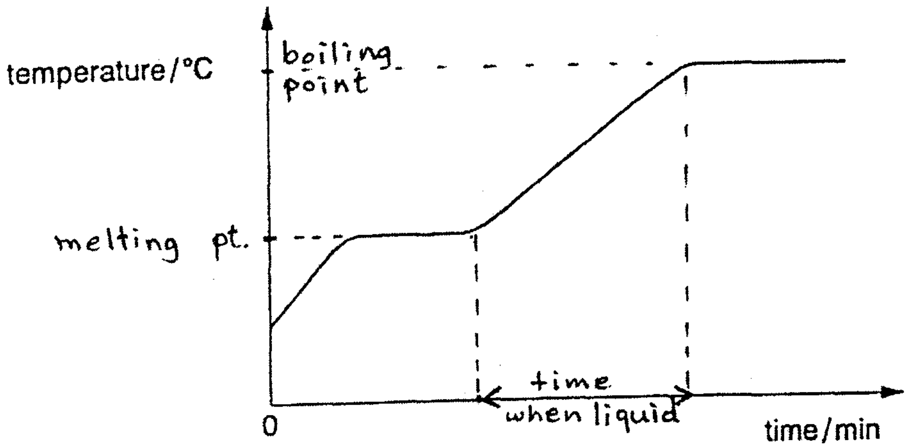
(d) The output potential difference equals the input potential difference.

11. (a) (i) The change in voltage of a thermocouple.
(ii) The change in resistance of a resistor.
(iii) The change in resistance of a thermistor.
(iv) The change in volume of a gas (at constant pressure).
[choose two of them]

(b) A scale must be defined by two fixed reference points which are easily obtainable. The distance between the fixed points is divided into a number of equal divisions, each division is one degree.

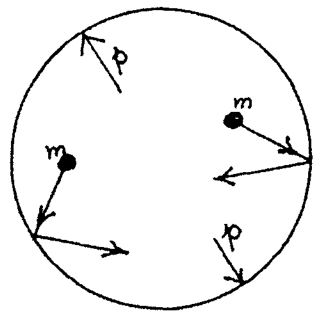
(c) The <u>upper</u> fixed point is the temperature of steam above pure boiling water under normal atmospheric pressure. Its value is 100° C.
The <u>lower</u> fixed point is the temperature of pure melting ice under normal atmospheric pressure. Its value is 0° C.

(d)



12. (a) The air molecule is in constant random motion. It moves in straight lines and is only affected by collisions with other molecules. The average speed of the molecule is proportional to the temperature of the gas.

(b) The molecule near the inside surface of the football, hits the wall and bounces back with the same speed (elastic collision).



(c) When the molecules of air collide with the wall of the ball they bounce back producing out ward forces on the wall.
The total force divided by the area of the wall gives the pressure exerted by the air on the wall of the ball.

(d) When the air is heated, air molecules gain kinetic energy and they move faster. They hit the wall harder and more frequently so the force exerted is greater and the pressure produced becomes higher.

November 1999

Paper 3

1. (a) (i) Potential energy $= m \cdot g \cdot h$
$= 200 \times 10 \times 6$
$= 12000$ J

(ii) K.E. $= \frac{1}{2} \times mv^2$

$12000 = \frac{1}{2} \times 200 \times v^2$

$v = 10.95$ m / s

(b) (i) Kinetic energy of the falling mass is converted to work done to drive the pile into the ground; also some energy is changed to sound energy and to heat energy in the falling mass, in the pile and in the ground.

(ii) When the falling mass is suddenly stopped, its large momentum rapidly reaches zero which produces a large force.
(force = rate of change of momentum)

(c) 1. Some energy is lost due to friction in the ropes, pulleys and suspension system; it is converted to heat and sound.

2. The efficiency of the motor is less than 100 % due to energy lost in the coils of the motor and is wasted as heat and sound.

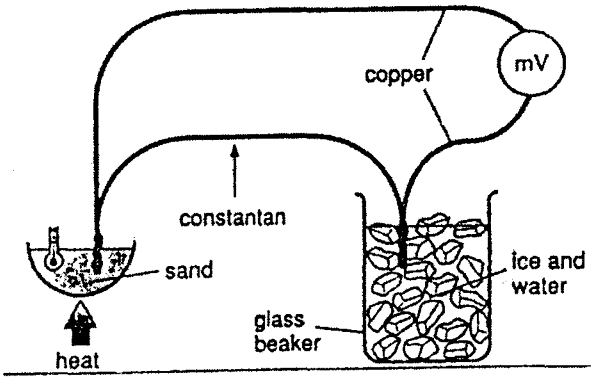
(d) 1. Increase the falling mass.
2. Increase the distance of fall.
3. Decrease the cross section of the pile.

---

2. (a) 1. Determine the mass, m , of metal block by using a top-pan balance.
2. Assemble the apparatus as shown in Fig. 2.1 .
3. Determine the initial temperature, θ_1 , by using the thermocouple.
4. Switch on the electric heater and start the stop-watch simultaneously. Record the power of heater used, P.
5. After several minutes, switch off the heater and stop the stop-watch to determine the time, t , and the final temperature, θ_2.
6. Calculate the rise in temp, $\theta = \theta_2 - \theta_1$

(b) $P \times t = m c \theta$
$200 \times 150 = 1 \times c \times 50$
$c = 600$ J / kg K.

(c) (i)



(ii) The temperature difference between the two junctions produces an electric voltage which is measured by a millivoltmeter. The voltmeter can be calibrated to give the temperature difference.

(iii) 1. It has a very large range, its range can start from -200° C to about 1500° C.

2. Its thermal capacity is very small, so it can respond rapidly to any change in temperature.

3. (a) The angle between PQ and RS = 160°

(b) The angle of incidence of PQ is greater than the critical angle, so PQ is totally internally reflected into the fibre and does not leave it.

(c) (i) $n = \dfrac{1}{\sin(\text{critical angle})}$

$1.50 = \dfrac{1}{\sin C}$

$\therefore$ critical angle = 46.5°

(ii) The angle of incidence of ray TQ is smaller than the critical angle, so the ray is refracted into the air and leaves the fibre.

(d) (i) Monochromatic wave means a wave which has one single frequency and a single wavelength (i.e., it has a primary colour which cannot be dispersed).

(ii) speed $= f \times \lambda$

$= (4\times10^{14})(5\times10^{-7})$

$= 2\times10^{8}$ m / s

(iii) $n = \dfrac{\textit{speed}\ \text{of light in air}}{\textit{speed}\ \text{of light in glass}}$

$\therefore$ speed of light in air = n x speed in glass

$= 1.5\times(2\times10^{8})$

$= 3\times10^{8}$ m / s

4. (a) (i) 1- Increase the strength of the permanent magnet in the generator.
2- Increase the number of turns in the coil of the generator.
3- Increase the speed of rotation of the coil.

(ii) When a magnetic pole moves inside a solenoid, it induces an electric current; but this induced current in the coil has a magnetic field which opposes (repels) the motion of the pole into the coil (Lenz's law).

(b) (i) $I_1 V_1 = I_2 V_2$

$80 \times 400 = I_2 \times 30000$

$I_2 = 1.07$ A

(ii) Transformer No.2 is a step-down transformer, it reduces the voltage from 30000 V to a lower value suitable for use in homes and factories.

(iii) When the voltage is increased greatly by transformer no.1, the current is reduced considerably, thus the power loss (I^2R) in the transmission cables becomes very small.

(c) (i) current at X = 7.7 - 4.6 = 3.1 A
current at Y = 3.1 - 2.3 = 0.8 A

(ii) $R = \dfrac{V}{I} = \dfrac{110}{0.8} = 137.5\Omega$

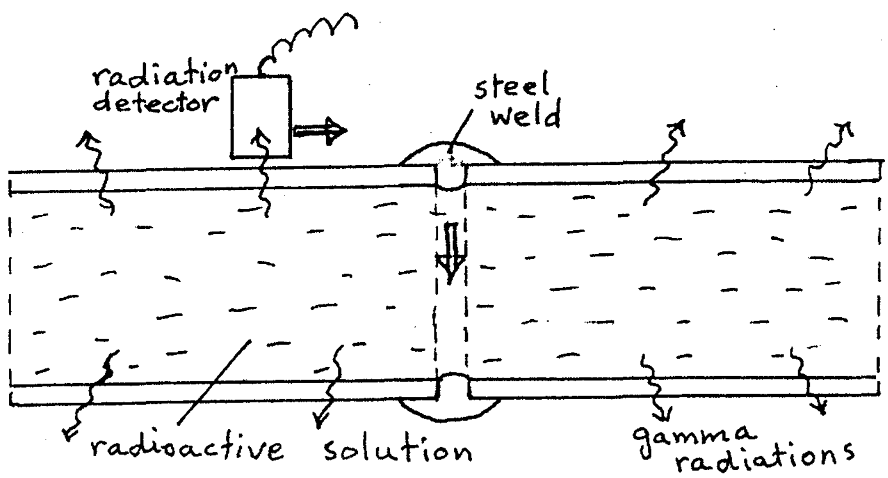
(iii) combined R = $\dfrac{R_1 R_2}{R_1 + R_2} = \dfrac{24 \times 48}{24 + 48} = 16\Omega$

(iv) Power in R = $I^2 R = (4.6)^2 \times 24$
$= 507.84$ W

(v) Energy = V I t
= 110 x 2.3 x 120
= 30360 J
= 30.36 KJ

---

5. (a)



1- Move the detector along the tube and record the average activity of the radioactive material penetrating through the 5 mm thickness of steel.

2- Move the detector around the steel weld and notice the value of the activity reaching the detector:

(i) if the activity is the same as the value recorded in 1, it indicates that the thickness of the weld is equal to pipe thickness.

(ii) if the activity reaching the detector is greater than the activity in 1, it indicates that the thickness of the weld is less than it should.

(b) (i) 1- Alpha radiations are absorbed completely by the steel. The activity recorded by the detector will be only the background.

2- Beta radiations are also absorbed by 5 mm of steel and the result would be similar to that in no. 1.

3- Gamma radiations can penetrate through the steel and can reach the detector which will record the activity of gammas reaching it.

(ii) Gamma emitter is the useful source for this test, because gamma radiations can penetrate the steel pipe and reach the outside detector.

(c) 1- Choose a gamma emitter with relatively low activity.

2- Choose a gamma emitter with a relatively short half-life.

3- The operator should move the detector by using long handles to stay as far as possible from the source of radiations.

November 1999

Paper 6

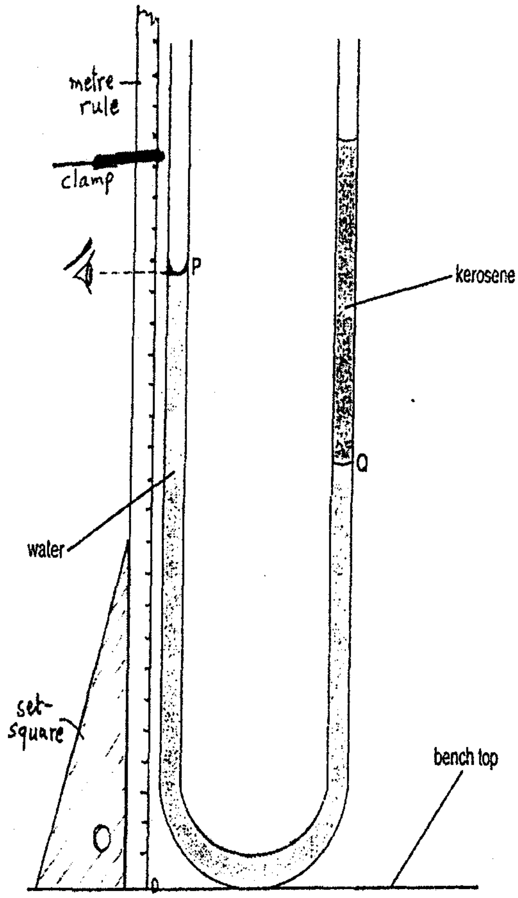
1. (a) The height of P from bench = 9.85 cm
The height of Q from bench = 6.75 cm
The difference, h = 9.85 - 6.75 = 3.1 cm

(b) 1- Place the rule on the bench in a vertical position (by the help of a set square) very close to the tube.

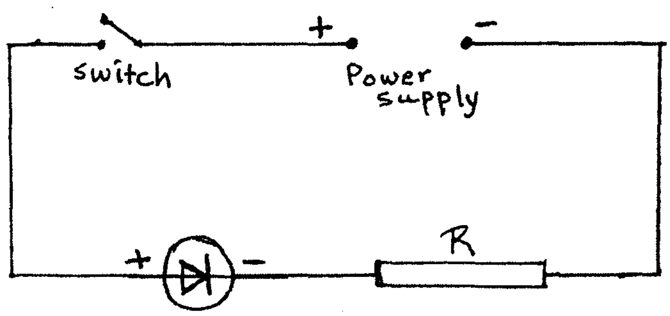
2- Take the reading of the scale at the point touching the bench and call it r_1 (it may be zero or some other value).

3- Take another reading, r_2, at the bottom of the water miniscus at P. Avoid parallax error by keeping the line of sight of the eye perpendicular to the scale.

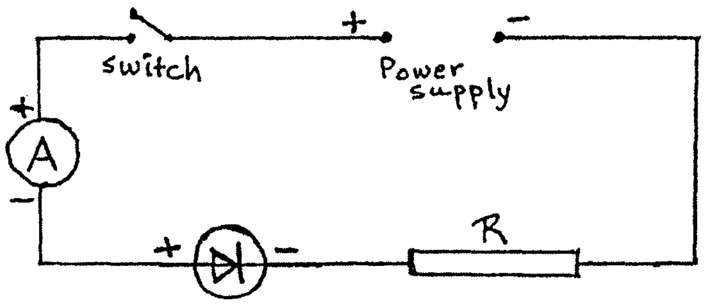
4- The height of P equals $(r_2 - r_1)$



2. (a)



(b) (i)



(ii) yes

.. because the value of the current is the <u>same</u> in all parts of a circuit connected in <u>series</u>.

(c) (i) I(max) $= \frac{V}{R} = \frac{3}{100} = 0.03$ A

(ii) It is assumed that other components in the circuit have negligible resistance.

---

3. (a) (i) 1- Ratio of masses $= \frac{1.08}{0.12} = 9$

2- Ratio of areas $= \frac{450}{56} = 8.04$

(ii) The values of h are all the same for each mass value irrespective of the area value. This proves that the value of h does not depend upon the value of surface area.

(iii) The value of height h increases as the mass of the ball decreases.

(b) For heaviest ball, the kinetic energy is converted to sound energy and heat energy in the ball and in the glass.

For lightest ball, some of the kinetic energy is converted to gravitational potential energy of the bouncing ball; and the rest of kinetic energy is changed to sound and heat energy in the ball and in the glass.

---

4. (a) (i) The lagging is used to reduce the heat gain from the outside enviroment.

(ii) The stirrer is used to distribute the heat evenly in the water and to get a uniform temperature for the whole liquid.

(iii) The hand lens magnifies the scale of thermometer and helps to get an accurate reading.

(b) (i) Temperature before .. = 18.7° C

temperature after .. = 9.0° C

fall in temperature = 18.7 − 9.0 = 9.7° C

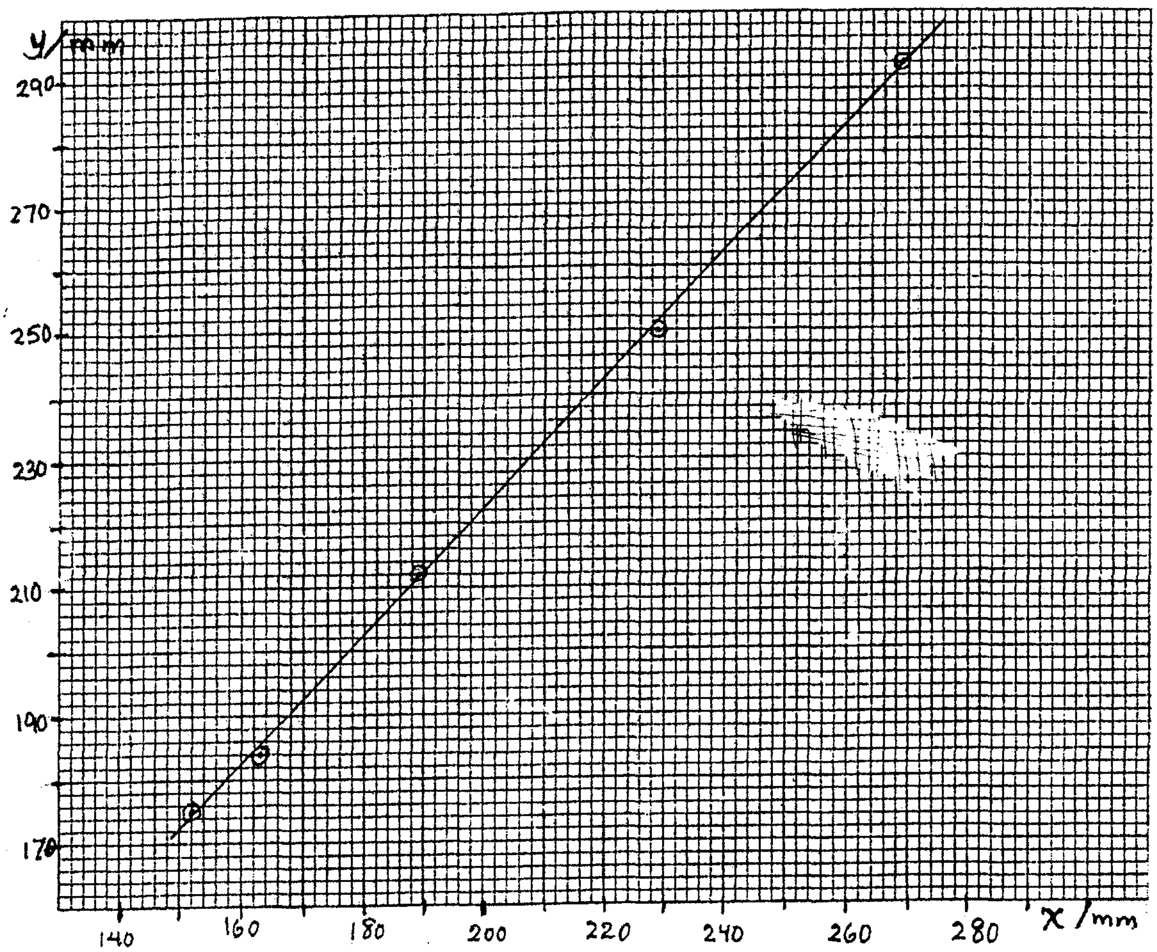
(ii) ... to get an accurate reading of the scale and avoid the error due to parallax.

(c) The line of sight of the eye should be perpendicular to the scale to avoid the error due to parallax.

5. (a)

y / mm	175	184	212	250	290
x / mm	152	163	189	229	269
(y-x) / mm	23	21	23	21	21

(y-x) is the displacement of image by glass block.



(b) (ii) When x increases, the value of (y – x) remains constant.
(iii) For a glass block of greater width, the value of (y – x) would be greater.

June 2000

Paper 1

1	B	11	D	21	C	31	A
2	A	12	C	22	B	32	B
3	C	13	D	23	B	33	A
4	B	14	D	24	A	34	A
5	D	15	A	25	C	35	C
6	B	16	B	26	D	36	B
7	C	17	C	27	A	37	D
8	A	18	D	28	B	38	C
9	D	19	A	29	D	39	B
10	B	20	A	30	D	40	A

June 2000

Paper 2

1. (a) Weight is a force.
(b) the mass of potatoes.
(c) .... because the volume of air spaces between small potatoes is less.

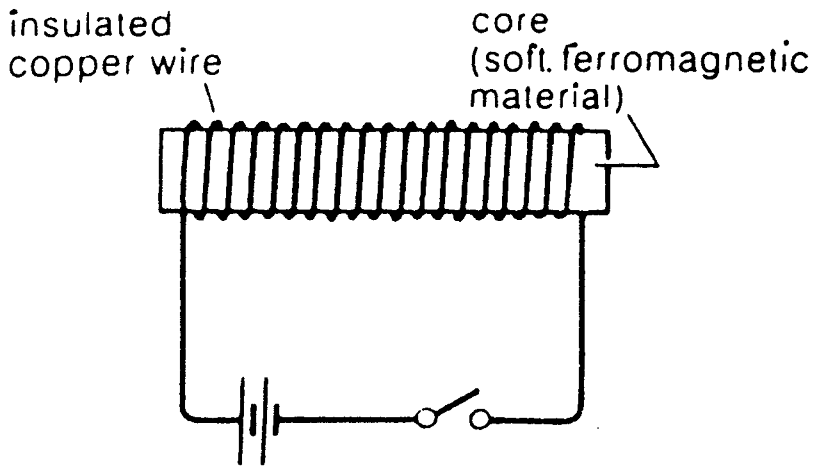
---

2. (a) 1. conduction.
2. convection.
3. radiation.

(b) (i) One can cover the dish.
(ii) this reduces heat loss by convection currents.

---

3. (a)



Wind the insulated wire around the iron bar making many turns to make an electromagnet.

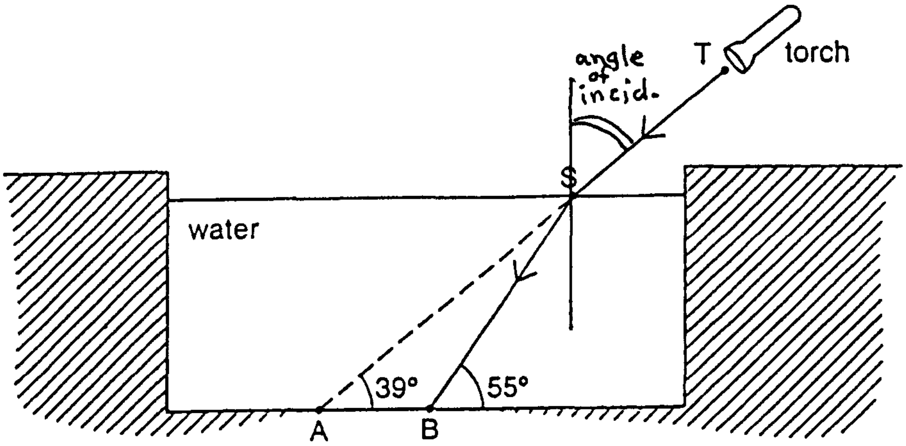
(b) Strip the plastic cover from the ends of the wire and connect them to the two poles of the battery and notice that the iron bar can attract iron filings, and drops them when the connection with the battery is off.

---

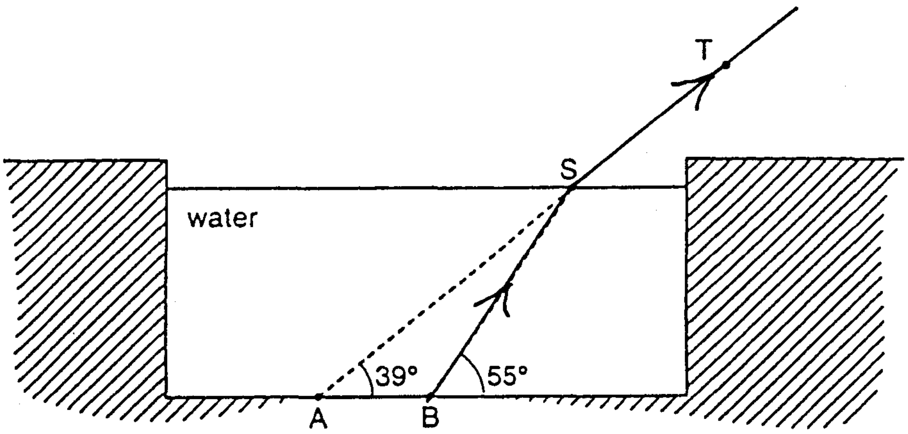
4. (a) Refraction of light.

(b) (i)

(ii)



(c) (i)



(ii) 1. The beam is totally internally reflected at S into the water.

2. because the angle of incidence in the water (51°) is greater than the critical angle for the water (50°).

5. (a) ... because the speed of sound is very much slower than the speed of light, so sound arrives later.

(b) (i) He can hear the sound reaching him directly from the lighting, then he hears its echo after reflection of sound on the mountain.

(ii) The second sound is quieter because it travels a longer distance, also, the mountain surface is not a perfect reflector.

(c) $V = \frac{2d}{t}$

$330 = \frac{2d}{4}$

$\therefore d = 660\ m$

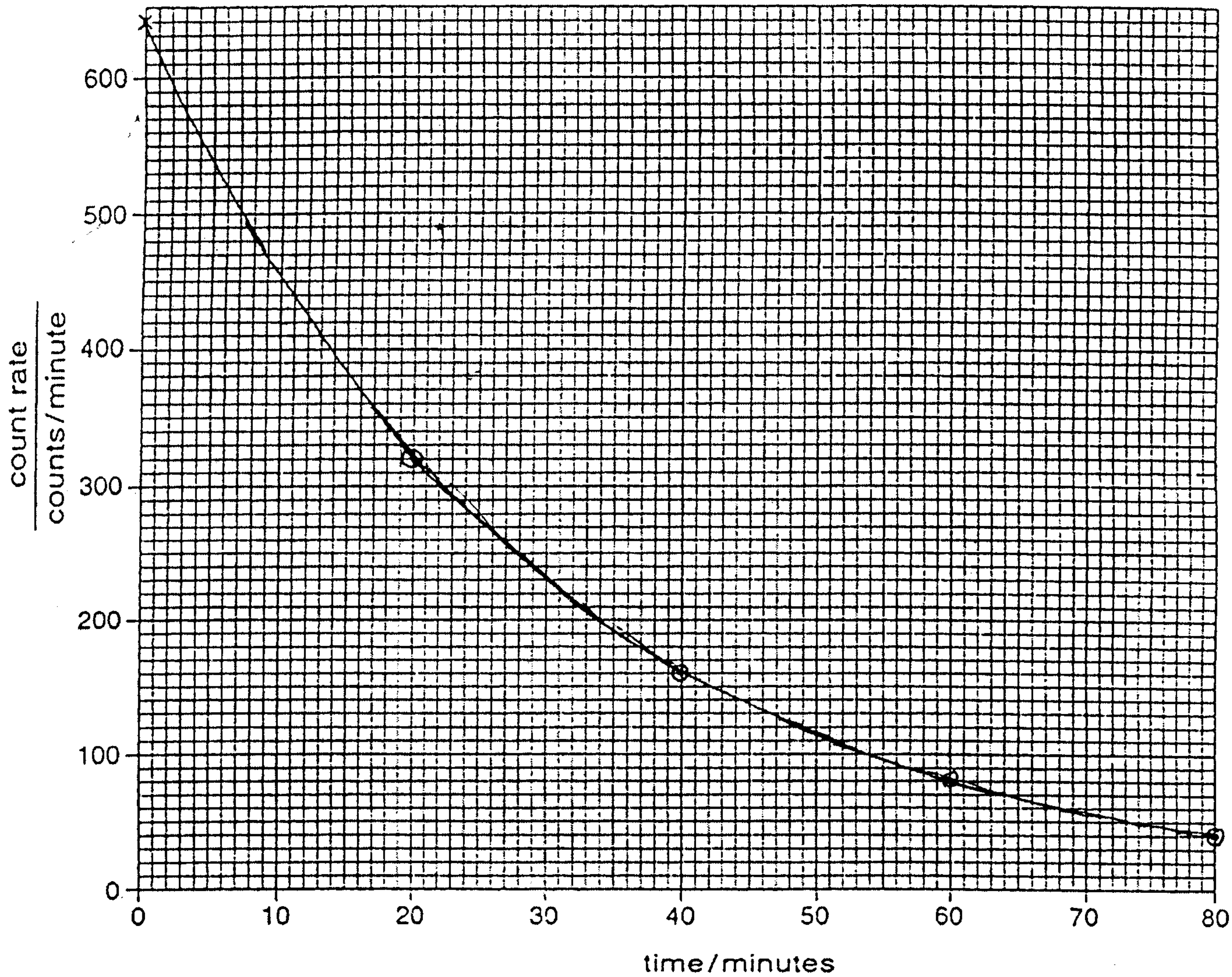
6. (a) (i) smoke particles
(ii) Air molecules bombard the smoke particles

(b) air molecules bombard the glass
smoke particles bombard the glass

7. (a) (i) gravitational potential energy
(ii) kinetic energy
(iii) .. blades of dynamo so that the generator produces electric energy.

(b) 1. energy extraction from the rise & fall of tides
2. energy extraction from the continuous motion of waves in the sea.

8. (a) (i) 320 counts / min.
(b) (i) 160 counts / min.
(c) , (d)



(e) an infinite time

(f) .. due to statistical fluctuations.

9. (a) (i) D

(ii) .. because it has largest base area.

(b)

	increases	decreases	stays the same
length AB		✓	
width BC		✓	
thickness CD		✓	
area touching the horizontal surface		✓	
mass of sheet			✓
weight of sheet			✓
density of metal	✓		
pressure on horizontal surface	✓		

10. (a) $R = \dfrac{V}{I} = \dfrac{12}{1.5} = 8\Omega$

(b) (i) voltmeter reading = 12 V

ammeter reading = 0.75 A

(ii) resistance of wire AC = 16 Ω

(c) (i) resistance per metre $= \dfrac{R}{L} = \dfrac{16}{1} = 16\ \Omega/m$

(ii) Length needed $= \dfrac{64}{16} = 4\,m$

11. (a) sound

(b) infra – red

(c) X – rays

(d) (i) 1. sound cannot travel in the vacuum of the moon.

2. radio waves can travel through a vacuum

(ii) Radio waves (electromagnetic waves)

12. (a) (i) hammer B

(ii) moment = Force x perp. distance

since B has greater weight (force) it produces greater moment because the distance of handles is constant.

(b) (i) hammer B

(ii) Work = Force x parallel distance

since B is heavier, the force needed is greater and the work done to lift it is greater.

(c) 1. The weight of hammer (in Newtons).

2. the time taken to lift it (in seconds).

(d) (i) Kinetic energy

(ii) 1. Heat energy in the nail and hammer.

2. Sound energy in the enviroment.

June 2000

Paper 3

1. (a) Velocity is a vector quantity which has both magnitude and direction; while speed is a scalar quantity which has magnitude only.

(b) (i) 1. 4.5 sec.

2. The firework starts with a large velocity, but its velocity decreases gradually due to deceleration of earth's gravity. Finally, the velocity becomes zero when the firework reaches its maximum height.

(ii) 1. deceleration = 10 m/s^2

2. total time = 4.5 x 2 = 9 sec.

(iii) initial velocity = initial gradient

$$= \frac{9}{0.2} = 45\ m/s \quad \text{upwards}$$

$\therefore$ final velocity = 45 m/s downwards

N.B. (calculation is not required)

$$s = ut + \frac{1}{2}at^2$$

$$100 = u \times 4.5 - \frac{1}{2} \times 10 \times (4.5)^2$$

$$\therefore u = 44.7 \text{ m/s}$$

---

2. (a) P x t = m x L

200 x 300 = (0.54 - 0.36) x L

$\therefore L = 3.33 \times 10^5\ J/kg$

(b) Molecules at the surface of ice block gain energy and vibrate more vigorously, some of this vibrational energy is transferred to neighbouring molecules and travels towards the centre of ice block. Very little amount of heat radiation can also travel from outside molecules towards the centre.

---

3. (a) (i) mass of bag of sand = 0.50 + 0.25

= 0.75 kg

(ii) Weight = m g

= 0.75 x 10 = 7.5 N

(b) The beam balances because :

1. The clockwise moment of the weights equals the anti clockwise moment of bag of sand.

2. The sum of weights of bag of sand and the masses equals the upward reaction of the pivot.

(c) Kinetic energy $= \frac{1}{2}mv^2$

$= \frac{1}{2}\times 0.5\times(1.2)^2$

$= 0.36$ Joules

(d) before : it is kinetic energy.
After : it is potential, heat and sound energies.

---

4. (a) The air molecule at P moves towards the wall ABCD, when it hits the wall it rebounds producing outward force on the wall and moves back toward another wall repeating the collision many times and moving in different directions.

(b) (i) When air molecules hit the wall ABCD and rebound back, they produce a force on the wall. This total force (divided by the area of the wall) produces the pressure on the wall.

(ii) Since motion of molecules is random in all directions, so the average number of collisions per second on each side of cube is equal, thus the pressure is equal on all the sides.

(c) $V_1P_1 = V_2P_2$

$0.09(1\times10^5) = 0.04\times P_2$

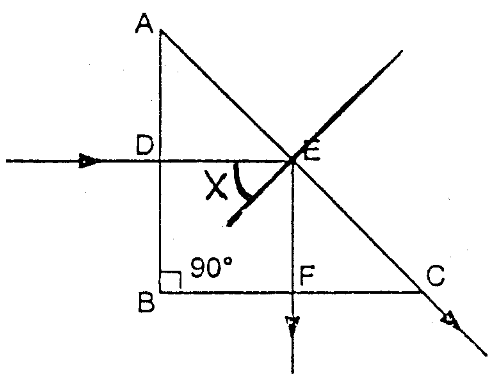
$\therefore P_2 = 2.25\times10^5\,Pa$

---

5. (a) ... because the light ray is perpendicular to the surfaces AB and BC.

(b) the speed of light decreases at D as it enters into glass, and the speed of light increases at F as it goes into air.

(c)



Critical angle = 45°

(d) refractive index $= \dfrac{1}{\sin 45} = 1.54$

6. (a) (i) A compression is a region where the molecules of air are very close to each other, and the pressure is higher than normal atmospheric pressure.

(ii) A rarefaction is a region where the molecules of air are farther away from each other, and the pressure is lower than normal atmospheric pressure.

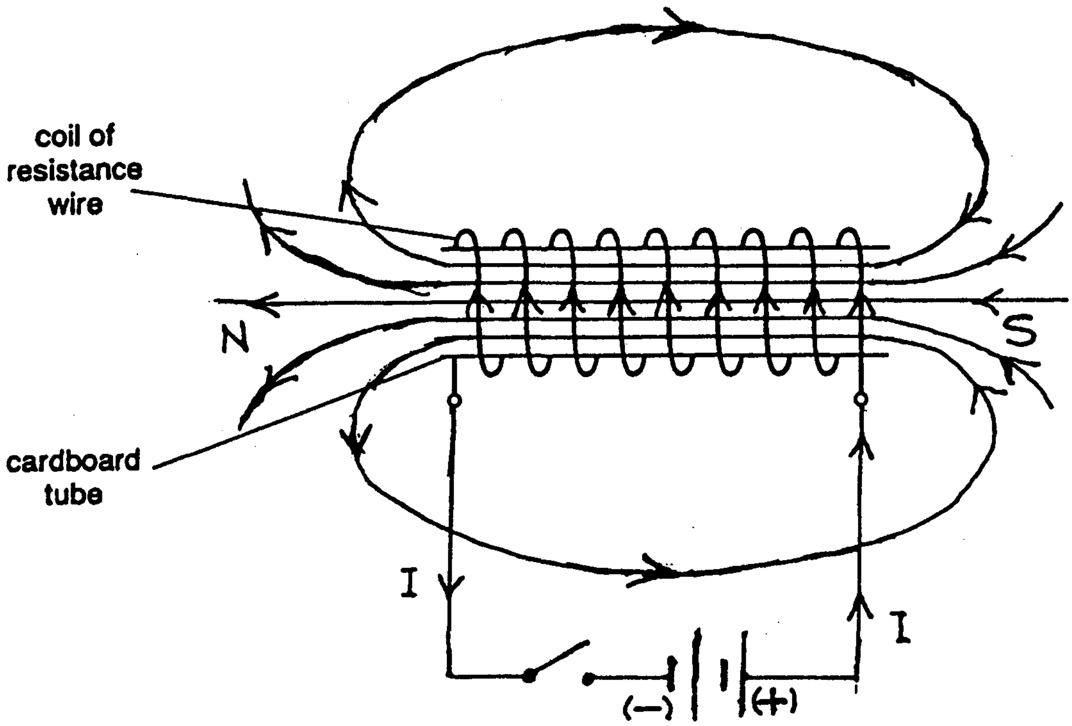
(b) $v = f \times \lambda$

$$f = \frac{v}{\lambda} = \frac{330}{2.5} = 132 \text{ Hz}$$

(c) $v = \frac{2d}{t}$

$$330 = \frac{2d}{1.2} \qquad d = 198 \text{ m}$$

7. (a)



(b) $I = \frac{Q}{t} = \frac{16}{40} = 0.4\,A$

(c) (i) E = V I t

= 1.2 x 0.4 x 40

= 19.2 J

(ii) $R = \frac{V}{I} = \frac{1.2}{0.4} = 3\Omega$

(d) $\text{emf} = \frac{E}{Q} = \frac{24}{16} = 1.5V$

* e.m.f. of a battery is the total energy needed to derive one unit of charge around the circuit. OR,
* e.m.f. of a battery is the potential difference across its terminals when it is not supplying a current.

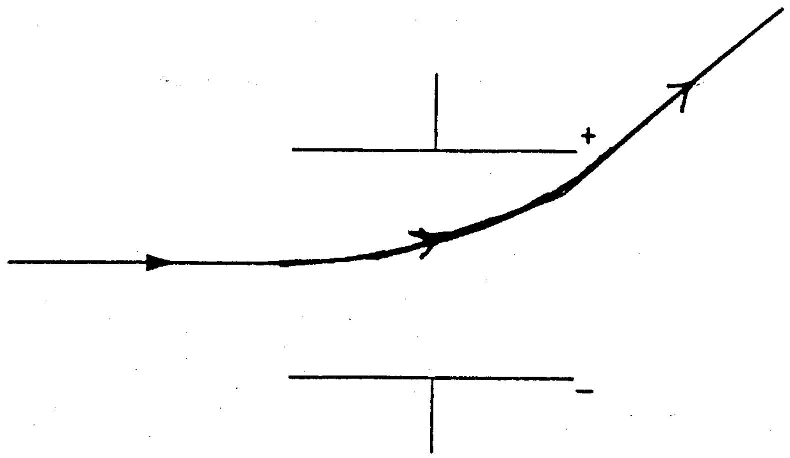
8. (a) The alternating current through the primary coil produces an alternating magnetic field which passes through the iron core and induces an alternating e.m.f. across the secondary coil.

(b) $V_1 I_1 = V_2 I_2$

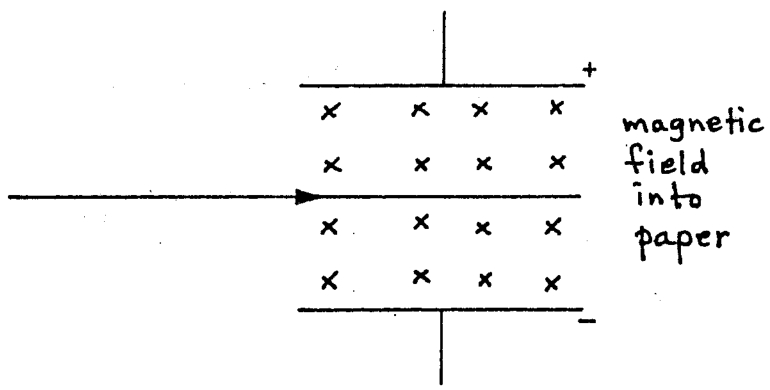
$240 \times I_1 = 12 \times 3.2$

$\therefore I_1 = 0.16$ A

9. (a)



(b)



The N – pole of the magnet should be placed above the paper so that the magnetic field is directed perpendicular to the paper and into it. The magnetic force acts downwards and cancels the upward force produced by the electric field of the charges.

10. (a) $^{228}_{90}Th \rightarrow ^{224}_{88}Ra + ^{4}_{2}He$

(b) (i) The count at Q is caused by gamma radiation, because it is the only radiation which can penetrate through 5 mm thick aluminium.

(ii) The count at P is caused by alpha, beta and gamma radiations emitted from the source, because all radiations (even alpha radiation) can reach the point P which is close to the source.

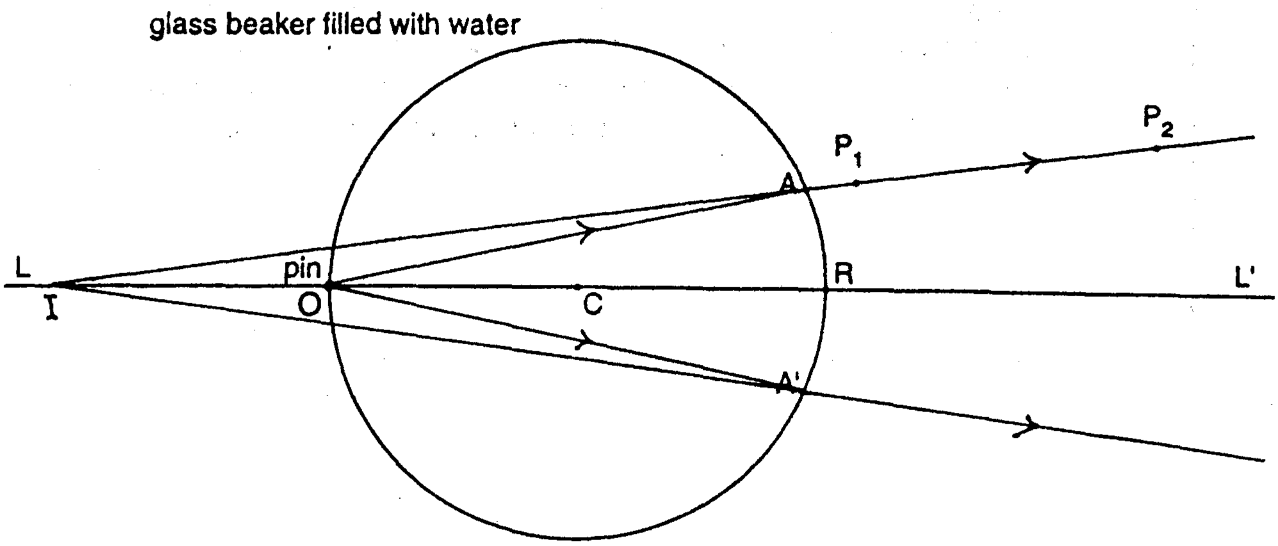
(c) (i) The neutral atoms or molecules of a gas can lose one electron (or more) when they are hit by the radiation. The neutral atoms are changed to "positive ions" and "negative ions", i.e., the gas is ionised.

(ii) Gamma rays are electromagnetic waves and its interaction with gas molecules is very weak, so it produces very little ionisation.

June 2000

Paper 6

1. (a,b,c)



(d) IR = 10.2 cm
OC = 3.3 cm
IR : OC = 3.1

2. (a) 1. Place the plotting compass so that its centre lies on the line of direction 80°

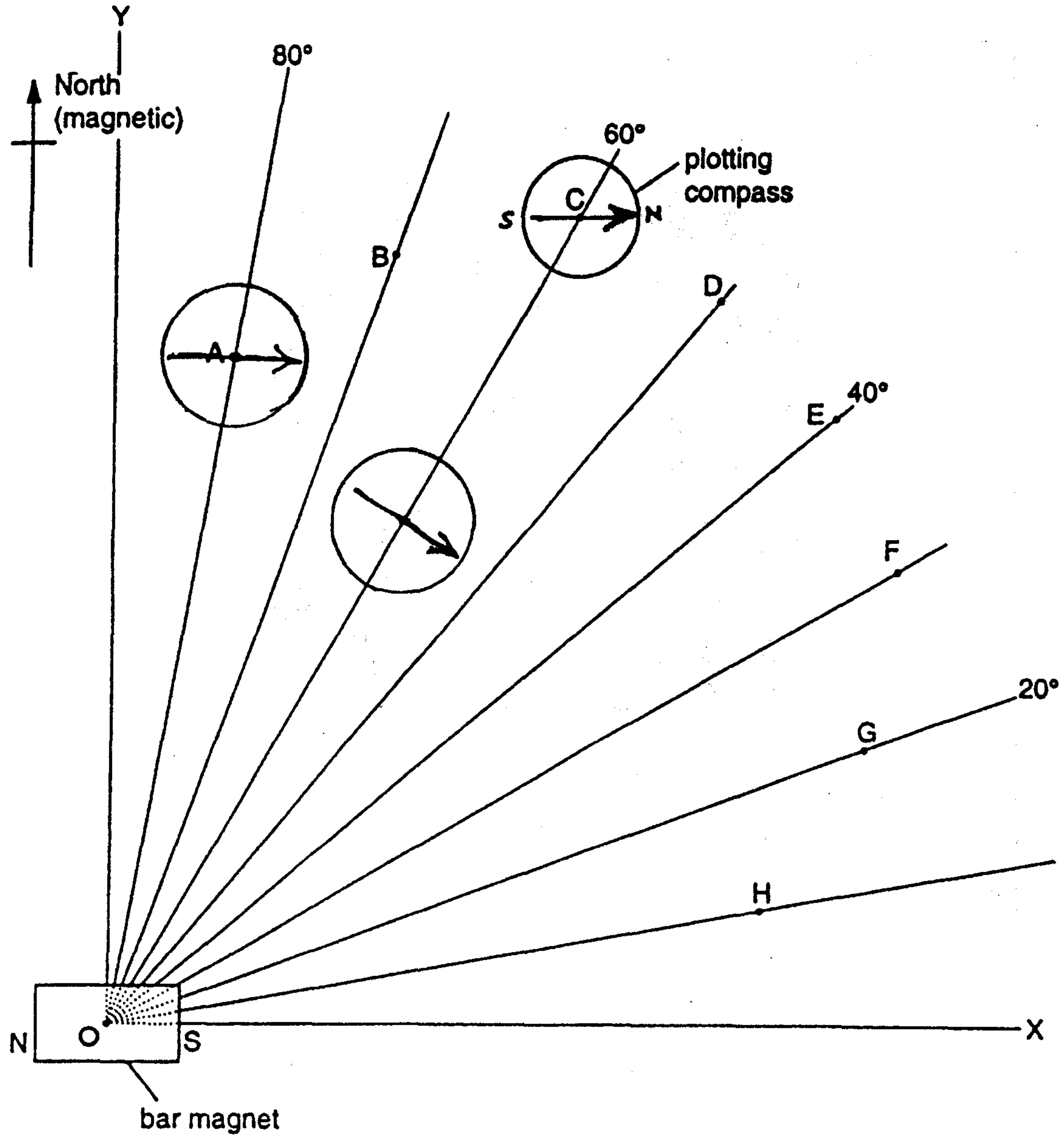
2. Move the plotting compass along this line until its small magnet becomes parallel to the line OX. To make sure that the magnet is parallel to OX, one can measure the vertical distance from the two ends of the magnet to the horizontal line OX as they should be equal in length.

3. To make sure that the small magnet is not sticking, one can tap on the compass gently and notice that the magnet is still in the horizontal direction.

4. To mark the central point A, one can draw a circle around the compass and determine the centre of the circle to be the point A.

5. The line of sight of the eye should be perpendicular to the line of 80° to avoid the error due to parallax when determining the point A.

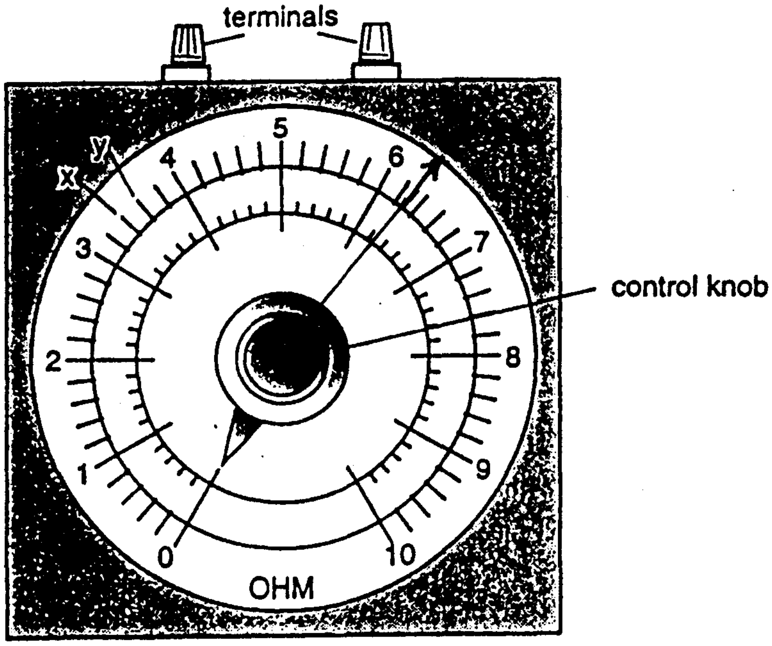
(b) (i)



(ii) When the compass is moved closer to the bar magnet the small magnet is deflected so that its north pole is points towards the south pole of the bar magnet because its attration is greater.

3. (a) range = 10 ohms

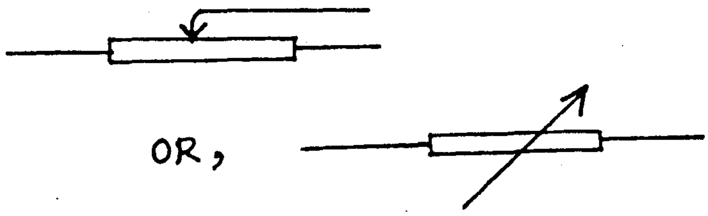
(b)



(c) (i) resistance at x = 3.4 Ω

(ii) change in resistance = 0.2 Ω

(d)



(e) connect the variable resistance in series in the circuit.

4. (a)

Exp. No.	m / g	$T_c/^\circ C$	$T_H/^\circ C$	$\theta = (T_H - T_C)/^\circ C$
1				
2				
3				
4				
5				

(b) (i) .. to show the average change of θ with change of m. This average compensates for the experimental errors of different readings.

(ii) 1. if value of θ were 0.8° C smaller, ...

2. if value of m were 3.0 g smaller, ...

(iii) Tick box no. 2

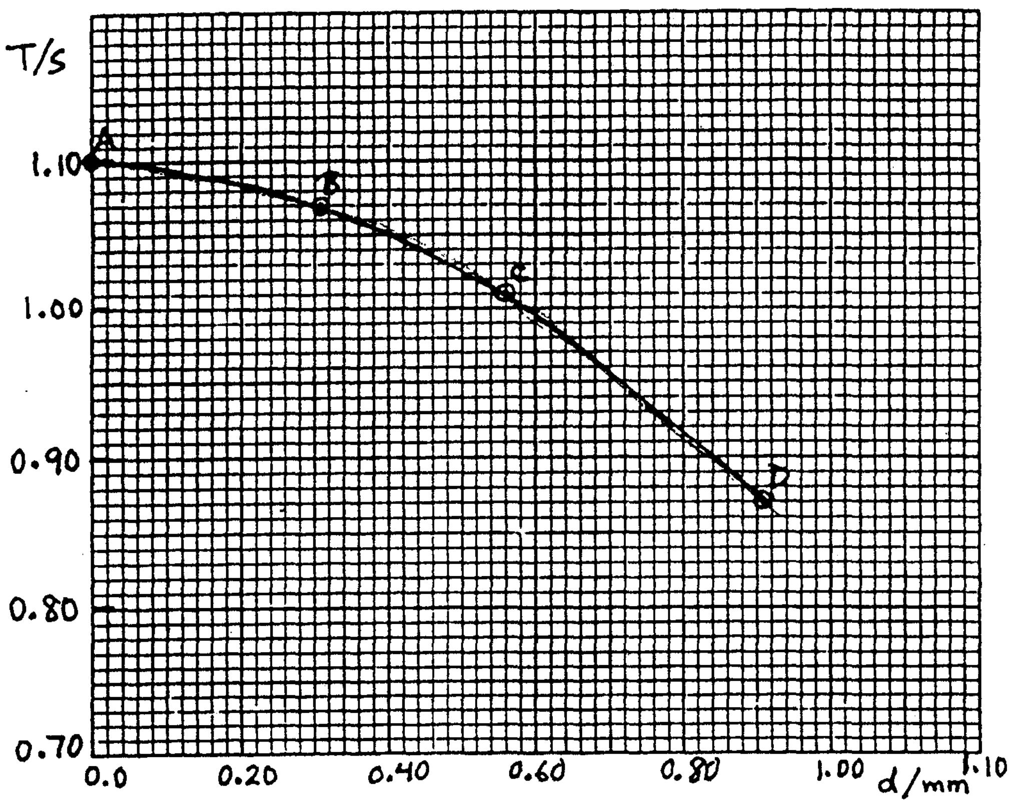
In the experiment, some heat can be lost to the surrounding during transferring the hot metal; so the recorded temperature can be less than it should and cannot be higher. Therefore choice no. 1 is not likely to happen.

5. (a)

test	suspension	d/mm	N	t/s	T/s
A	cotton thread	negligible	50	54.8	1.10
B	nichrome wire	0.31	50	53.4	1.07
C	nichrome wire	0.56	50	50.3	1.01
D	nichrome wire	0.91	50	43.3	0.87

(b) .. to get accurate values of T

(c) (i),(ii)



(iii) The period, T, increases as the values of d, the diameter of the wire, decrease.

(d) choice for the value of d = 1.10 mm

reason: to examine the graph and see if it will continue as a straight line.

November 2000

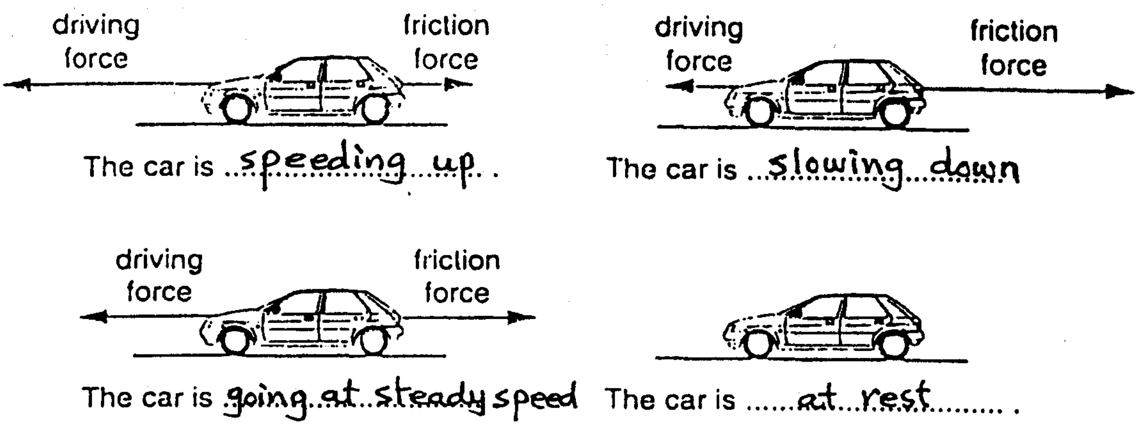
Paper 1

1	D	11	B	21	D	31	C
2	B	12	B	22	B	32	D
3	D	13	D	23	B	33	A
4	C	14	D	24	B	34	D
5	C	15	C	25	B	35	A
6	B	16	A	26	C	36	D
7	B	17	B	27	D	37	D
8	D	18	D	28	A	38	C
9	A	19	C	29	C	39	A
10	D	20	B	30	B	40	B

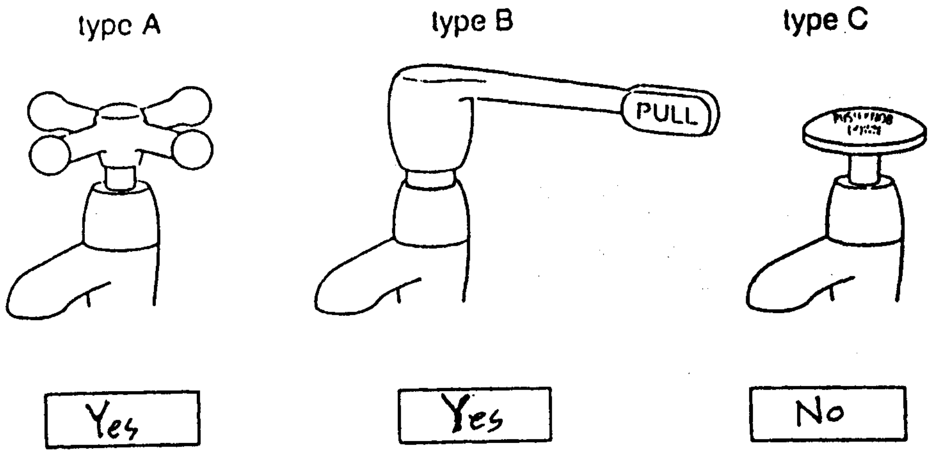
November 2000

Paper 2

1.



2. (a)



(b) increase the lengths of arms of the tap.

3. (a) (i) 31 m/s
   (ii) 6 m/s (also 11 and 22 m/s)
   (iii) 40 - 30 = 10 s

(b) Distance travelled = area under (v,t) graph.

$$= \frac{1}{2} \times 10 \times 15 = 75 \text{ m}$$

4. (a) A , D , E & H are correct.

(b) (i) Statement H
   (ii) Aftershave is better than water because it evaporates faster.

5. (a) … when the average kinetic energy …

(b) (i) beaker + water.

(ii) 1. mass of water = 250 g

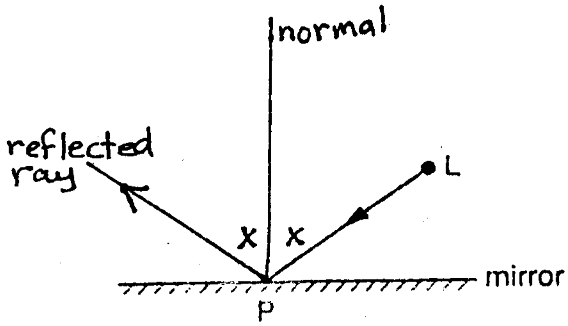
2. mass of sand = 250 g

3. energy needed for water = 1175 - 125 = 1050 J

4. energy needed for sand = 325 - 125 = 200 J

5. The amount of heat energy needed to raise the temperature of sand (ie, thermal capacity of sand) is much smaller than that of water; thus when the sun shines, the temp. of sand on the beach rises faster than temp. of the sea.

6. (a,b)



(c) (i)

(ii) 60 cm

7. (a) refraction

(b) (i)

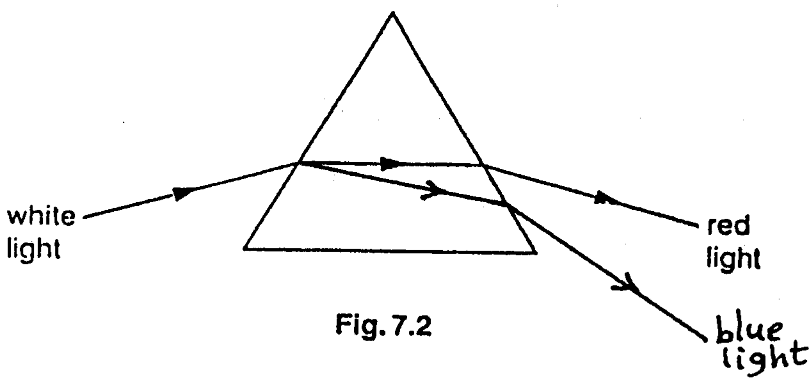
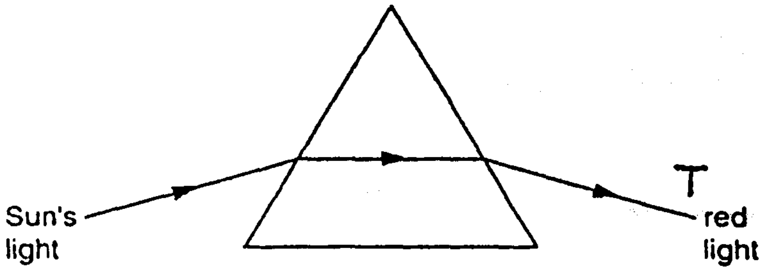


Fig. 7.2

(ii) dispersion of light.

(c)



8. (a) Density $= \dfrac{mass}{volume}$

(b) Density $= \dfrac{12.6}{1.4} = 9\ g/cm^3$

(c) No.

(d) The coin might be made from brass.

(e) aluminium.

9. (a) $R_{total} = R_1 + R_2$
$= 20 + 40 = 60\ \Omega$

(b) (i) Resistance $= \dfrac{P.d.}{current}$

(ii) $I = \dfrac{6}{60} = 0.1$ Amp

(c) $V = I.R = 0.1 \times 40 = 4$ V

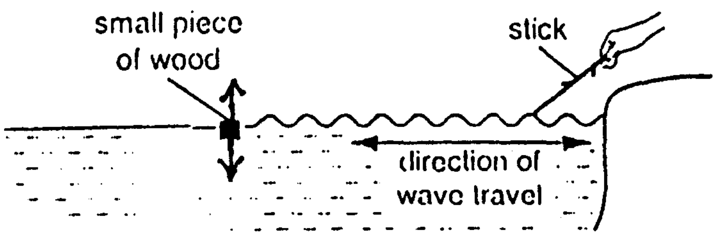
(d) $V_{out} = 4$ V

10. (a) (i) 6 wavelengths

(ii) wavelength $= \dfrac{90}{6} = 15$ cm

(iii) 1. Wavefronts are circular and equally spaced.
2. The depth of the pond is constant, because if the depth changes the wavelengths would also change.

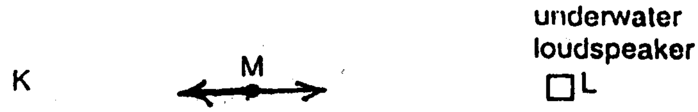
(iv)



The piece of wood vibrates in a vertical direction.

(b) (i) Water waves are transverse waves.
Sound waves are longitudinal waves.

(ii)



It vibrates in a horizontal direction (parallel to the direction of wave propagation).

---

11. (a) (i) A conductor is a material which allows the electric current to flow through it.
(ii) An insulator is a material which does not allow the electric current to flow through it.

(b) (i) Like charges <u>repel</u>.
(ii) positively charged glass, AND uncharged copper.

---

12. (a) (i) Proton no. = 84
(ii) nucleon no. = 210
(iii) no. of protons = 84
(iv) no. of neutrons = 210 - 84 = 126

(b) ${}^{210}_{84}Po \rightarrow {}^{206}_{82}Pb + {}^{4}_{2}\alpha$

November 2000

Paper 3

1. (a)

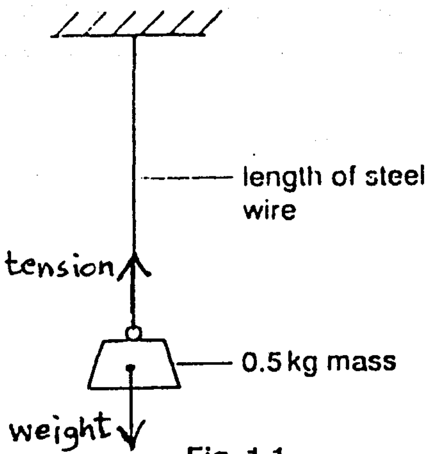
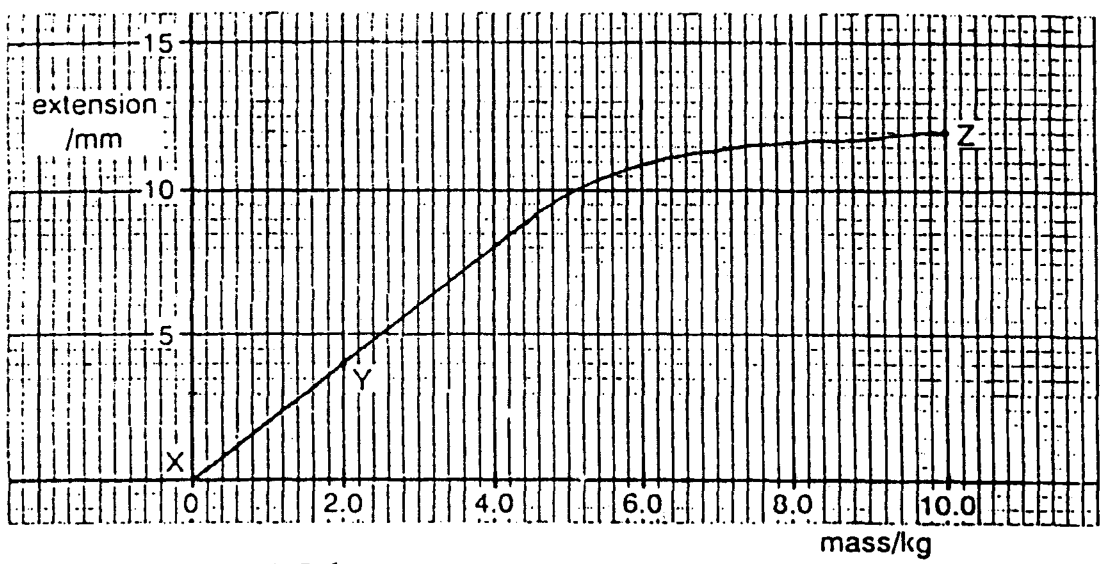


Fig. 1.1

First force = 5 N ; second force = 5 N

(b) The gravitational force of earth pulls the mass down causing its weight. The weight is balanced by the upward tension in the steel wire.

(c) (i)



(ii) mass = 1.5 kg
extension = 12 mm

2. (a) Sensitivity is the ability of a thermometer to detect small changes in temperature.

(b) (i) nitrogen gas.
(ii) because its expansivity is the greatest.

(c) (i) copper rod
(ii) it has smallest expansivity allowing to measure the largest range of temperatures.

(d) Equal temperature changes produce different distances on the scale.

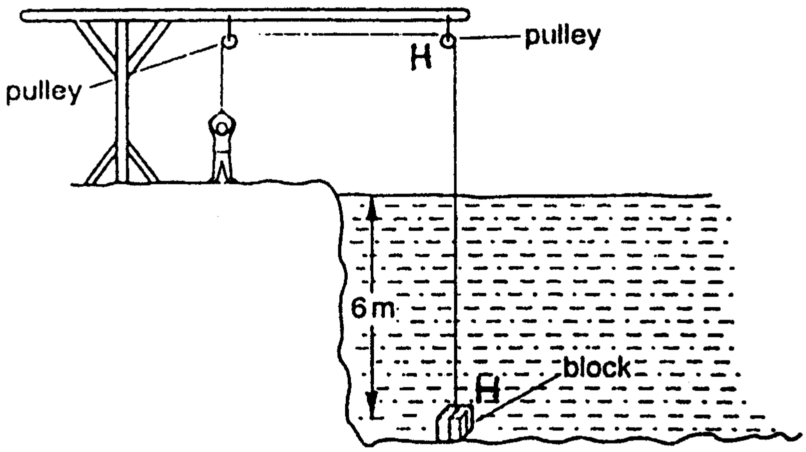
---

3. (a) Water pressure $= h \rho g$
$= 6 \times 1000 \times 10 = 60000$ Pa

(b) Force $= P \times A$
$= (4.5 \times 10^4)(0.015) = 675$ N

(c) Work $= F \times d_{//}$
$= 550 \times 4 = 2200$ J

(d)



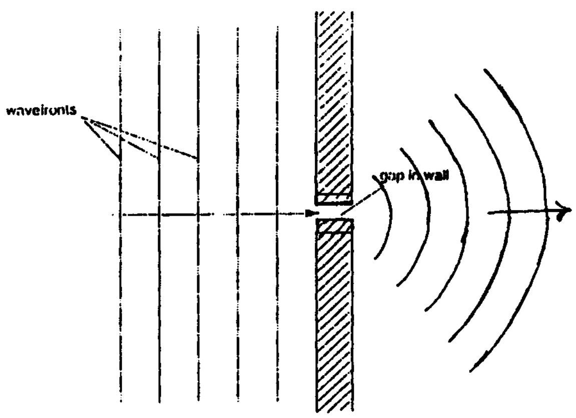
As the block rises through the water, the friction between the block and water molecules produces some heat. Also, the friction in the moving pulley produces some heat energy.

---

4. (a) $V = f \times \lambda$
$= 0.8 \times 1.6 = 128$ m/s

(b) wavelength $= 1.6$ m
frequency $= 0.80$ Hz

(c)



5. (a) Heat energy = m . c . θ

$$15.5\ \text{kJ} = 0.45 \times c \times 8.2$$

$$c = 4.2\ \text{kJ / kg °C}$$

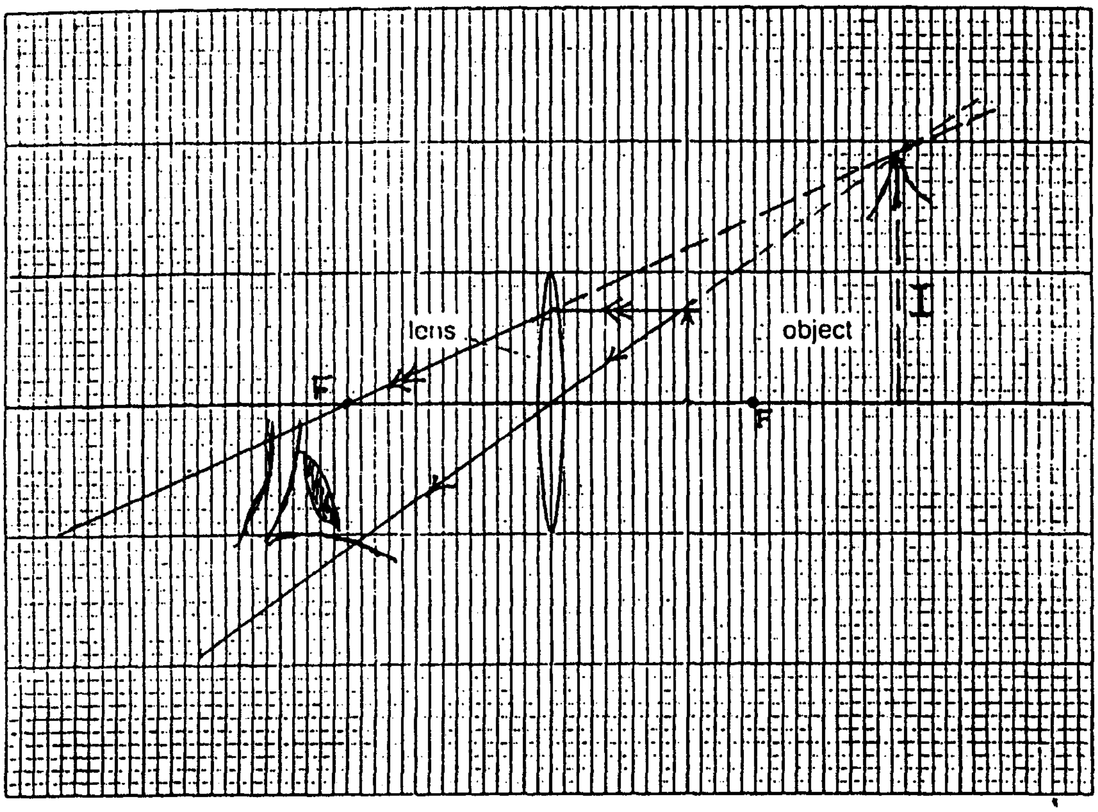
(b) (i) When the piston is moved into the cylinder, the volume of the gas decreases which produces an increase in gas pressure.

(ii) $V_1P_1 = V_2P_2$

$$0.0060 \times (2 \times 10^5) = V_2 \times (3.5 \times 10^5)$$

$$\therefore V_2 = 0.0034\ m^3$$

6. (a,b)



(c) The image is 2.5 times bigger.

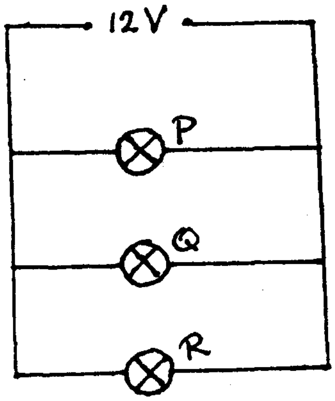
7. (a) $R = \dfrac{V}{I} = \dfrac{12}{2} = 6\Omega$

(b) combined $R = \left(\dfrac{6 \times 6}{6+6}\right) + 6 = 9\Omega$

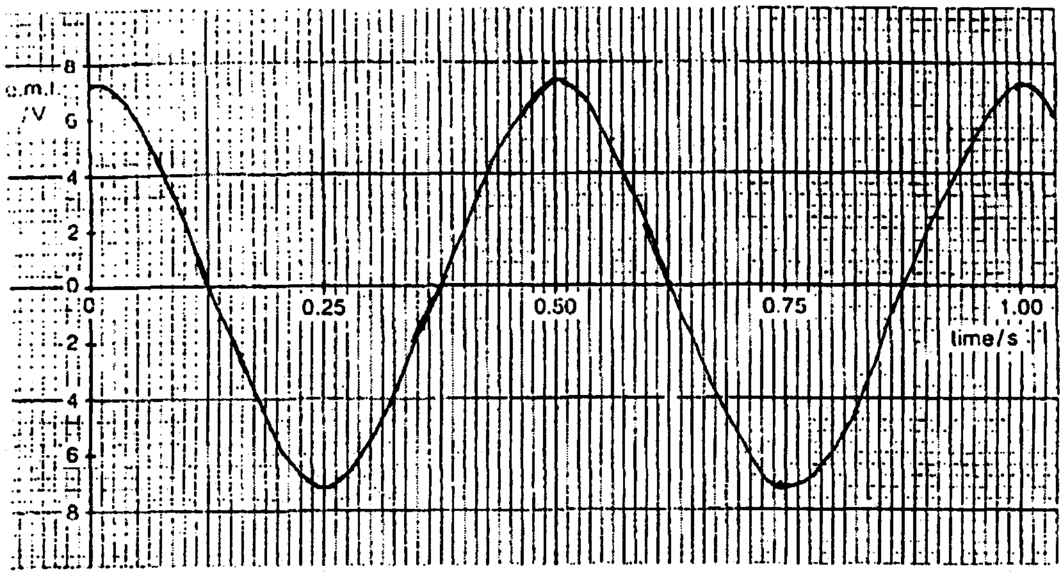
(c) $I = \dfrac{V}{R} = \dfrac{12}{9} = 1.33A$

(d) Lamp R is working with voltage equal to 8V and current 1.33 A, both voltage and current are less than the required values, so it is less bright than normal. Lamps P and Q each has 4V and 0.67 A, so they are equally very dim.

(e)



8. (a)



(b) (i) When the coil rotates inside the magnetic field of the permanent magnet, its wires cut the lines of the magnetic flux so an electric current is induced in the coil.

(ii) The induced e.m.f. is greatest when the plane of the coil is horizontal and cutting through the magnetic field lines most rapidly, while the emf is zero when the coil is vertical and its wires are moving parallel to field lines.
Also, the direction of motion of each wire is reversed each half cycle, which reverses the direction of induced emf in the coil each half cycle.

9. (a) (i) Some negative electrons are transferred from the duster to the polythene rod during rubbing.

(ii) 1. Bring the polythene rod near the metal plate.
2. Touch the metal plate by the finger (to remove the negative charge) then remove the finger away.
3. Remove the polythene rod away from the metal plate which would be positively charged.

(b) The alpha source ionizes the air to positive and negative ions. The negative ions are attracted towards the positive metal plate and neutralizes its charge.

---

10. (a) $^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y + {}^{0}_{-1}e$

(b) (i) As the thickness of paper increases, the absorption of beta particles by paper increases which decreases the detector reading (and vice versa).

(ii) 1. The counting rate is very sensitive to the thickness of paper when beta source is used. But the counting rate is not affected appreciably when gamma rays are used.

2. The range of gamma rays is very large, so its dangers can affect many workers, but the range of betas is much shorter and its dangers are less.

(c)

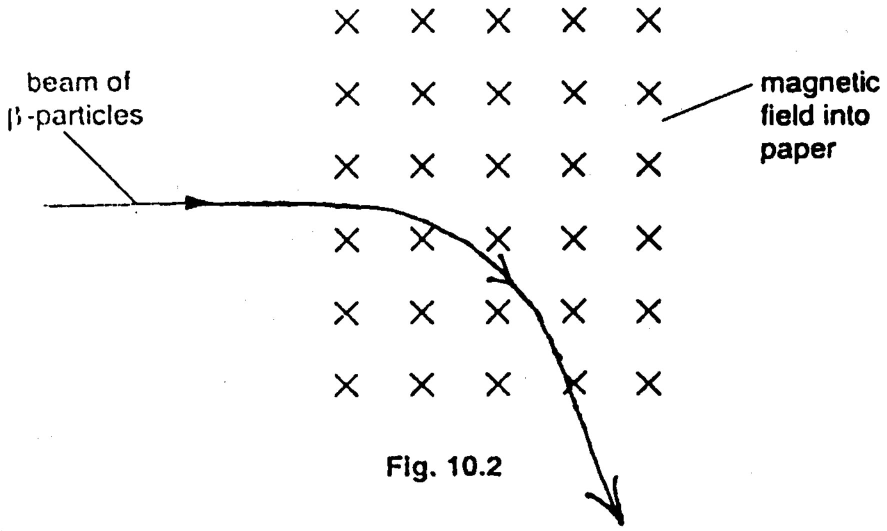


Fig. 10.2

November 2000

Paper 6

1. (a)

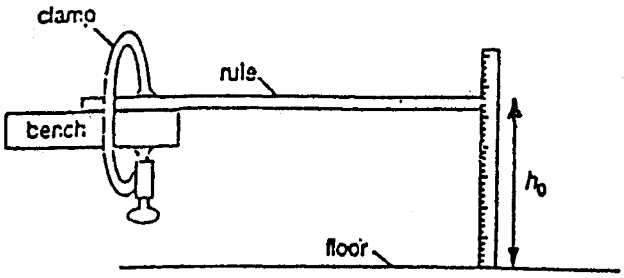
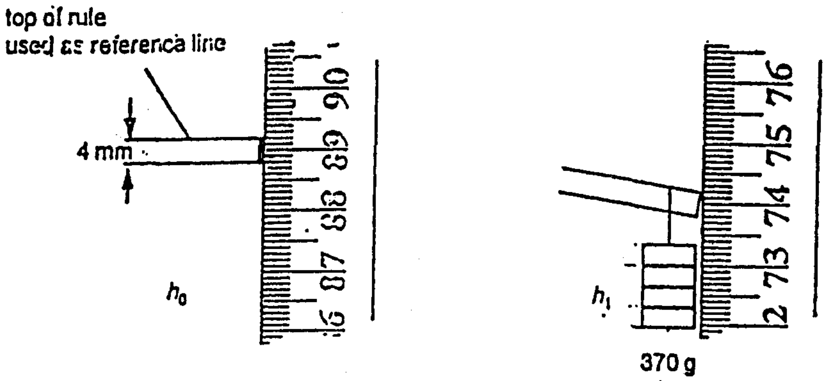


Fig. 1.1



1. Place another metre rule in a vertical position on the floor close to the end of the clamped metre rule.
2. Take the top of the clamped rule as a reference line, and take a reading for the height h_1 of the end of rule above the floor.
3. Remove the 50g mass from the free end of the clamped rule which takes horizontal direction, and determine the height h_0 of the end of the rule above the floor (using the same top reference line).
4. The depression, $x = h_0 - h_1$
5. Repeat the above steps several times to measure x several times then find the average value of x.

(b) 1. Bring a stop watch and set the loaded end of the metre rule into oscillation.
2. When the load reaches its highest point, press the stop watch to start counting the time. When the load goes down and reaches its highest point again this would complete one vibration.
3. Continue to count the number of oscillations until you count some 30 oscillations, then stop the stop watch and determine the time taken to make these 30 oscillations.
4. The time for one oscillation, $T = \frac{t}{30}$ sec

2. (a)

X / mm	W / mm	XW / mm^2
32	44	1408
57	27	1539
75	18	1350
103	9	927

(b) As the distance x increases, the width W decreases.

3. (a) To exclude heat energy of the hot water from affecting the experiment.

(b) 1. I reset the clock to zero.
2. I remove the 50g brass from the boiling water by one hand and press the clock to start with the other hand.
3. After a certain period of time t, I place the brass mass into the cold water while pressing the clock to stop with the other hand to find the recorded time, t.

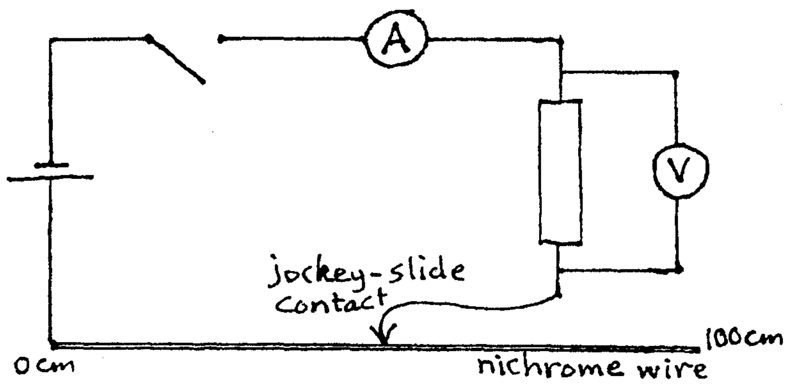
(c) Repeat the steps of (b) 1 &2. When the time reaches 60 seconds, immerse the brass mass into the cold water.

(d) (i) One can either replace the cold water with new amount at the same temperature; or wait for few minutes until the thermometer shows the same initial reading.
(ii) The volume of water can be measured accurately by using a pipette or a burette.

(e) to distribute heat evenly throughout the water before recording it temperature.

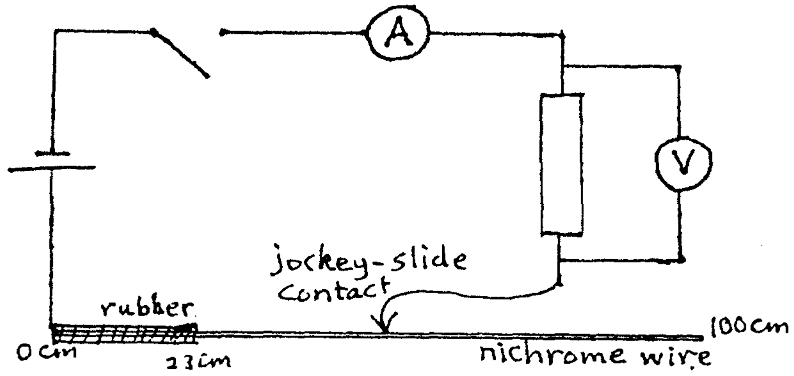
4. (a) (i) The minimum resistance is zero and it can be increased gradually until it reaches 10Ω.
(ii) .. in order to be able to get any value of resistance required.

(b) (i)



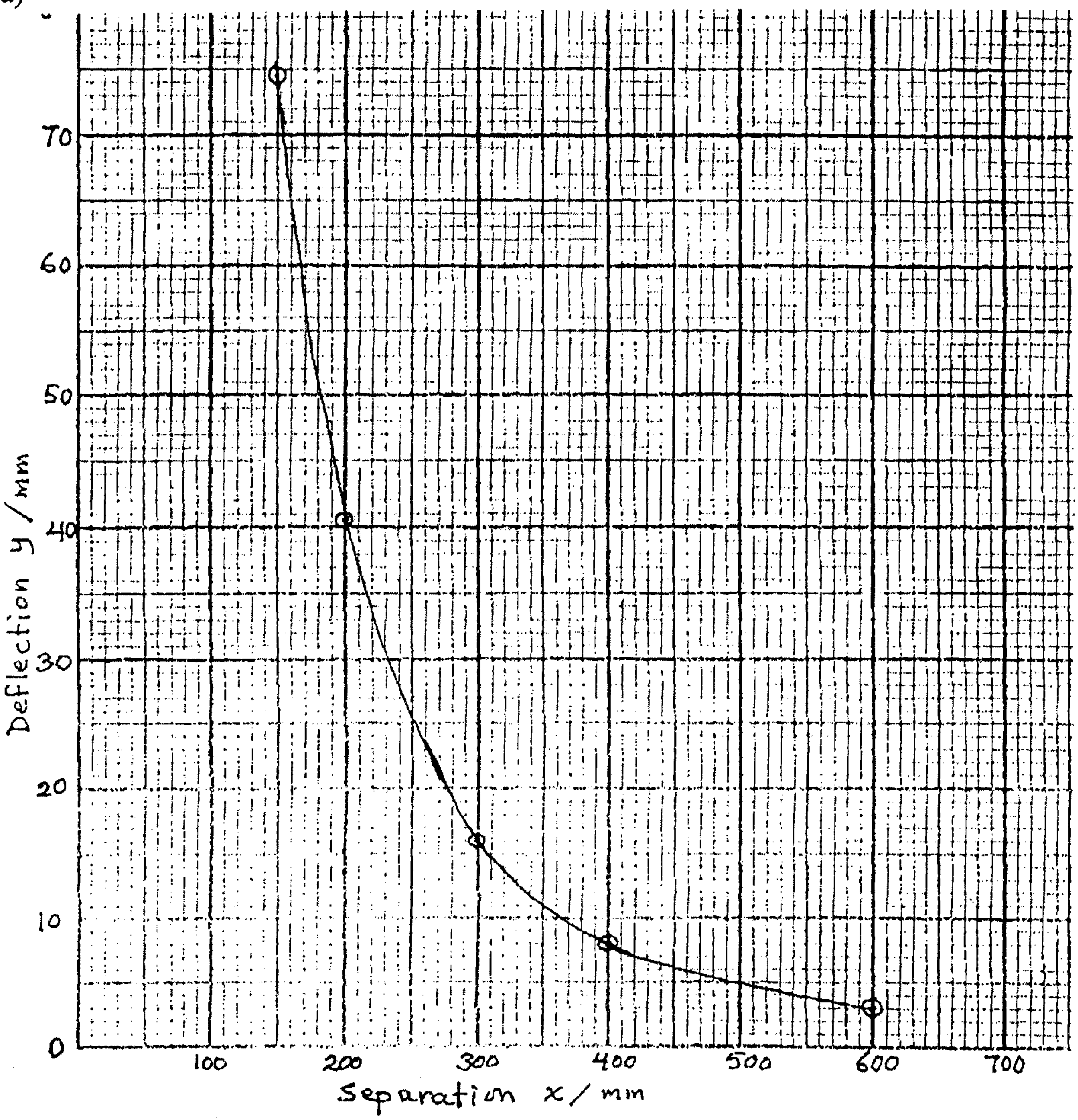
The wire should be bare and clean to ensure good electrical connection between the slide contact and the wire. By moving the slide contact gradually on the wire the value of the resistance changes smoothly to any desired value.

(ii)



Cover the first 23 cm of nichrome wire with plastic or rubber tubing to prevent using this part by anyone.

5. (a)



(b) (i)

x/mm		y/mm	
x_1	170	y_1	56
x_2	600	y_2	3
x_1/x_2	0.283	y_1/y_2	18.667

(ii) As the separation x decreases, the force between the magnets increases. The rate of force increase is greater than the ratio of the separation decrease.

June 2001

Paper 1

1	B	11	D	21	B	31	B
2	B	12	B	22	A	32	A
3	D	13	A	23	D	33	A
4	B	14	C	24	A	34	C
5	D	15	D	25	A	35	A
6	B	16	D	26	B	36	C
7	B	17	C	27	C	37	B
8	A	18	B	28	C	38	D
9	C	19	A	29	D	39	B
10	C	20	C	30	C	40	C

Paper 2

1. (a) 3.05
   (b) 3.35
   (c) 30 minutes
   (d) 6 minutes

---

2. (a) Moment of a force is the turning effect of a force about a fixed point (fulcrum).

   (b) (i) The two monents are equal.
   (ii)

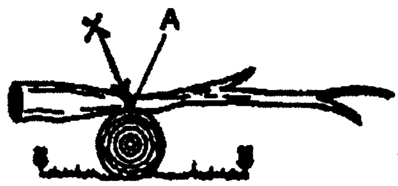


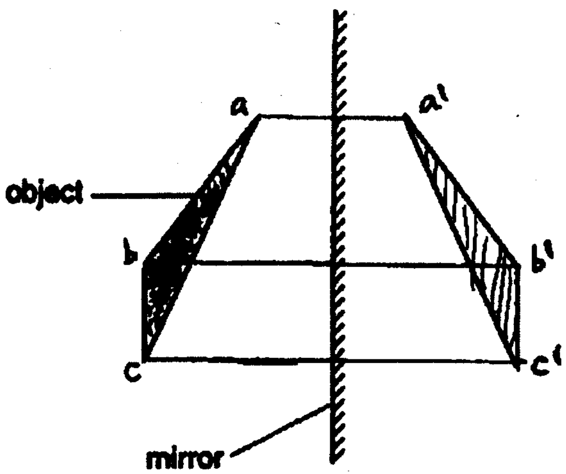
Fig. 2.1

---

3. (a) The air molecules have kinetic energy and they move randomly in all directions. When air molecules collide with the walls of the container, they rebound producing forces on the wall which produces pressure on the wall of the container.

   (b) (i) the average velocity of the air molecules increases
   (ii) * the pressure increases.
   * when the temperature increases, the molecules gain more energy and they move faster, so they collide with the walls harder and more frequently producing greater pressure.

4.



5. (a) (i) wavelength : between B and H (or between A and G).
(ii) amplitude : between B and C (or between E and F).

(b) frequency is the number of complete waves made in one second.

(c) $f = \frac{1}{T} = \frac{1}{0.2} = 5$ Hz

---

6. (a) the positive and the uncharged pieces are attracted to ebonite rod.

(b) Insulators are materials which do not allow the electric current to flow through them.

(c) glass , rubber , plastics , amber ....

---

7. (a) 0.1 A

(b) V = I R = 0.1 x 12 = 1.2 V

(c) Voltmeter

(d) e.m.f is larger than V_1

(e) combined R = 12 + 5 + 3 = 20 Ω

---

8. (a) It uses alternating current.

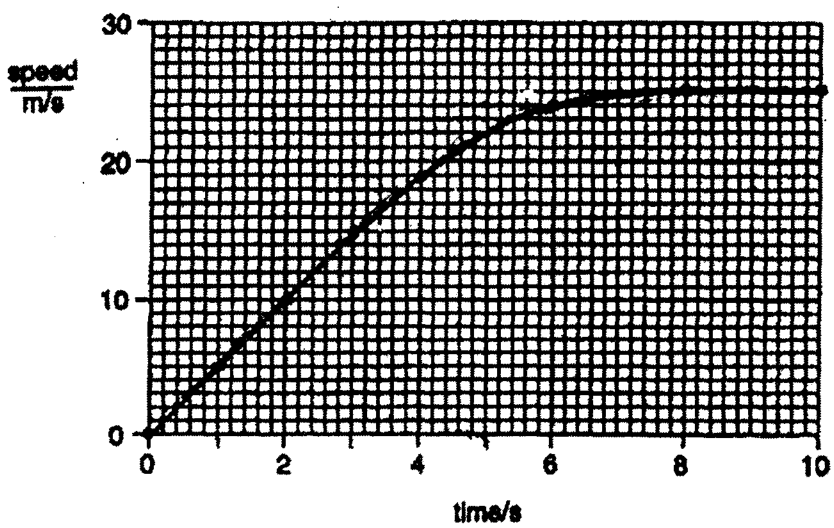
$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

The core is made of soft iron.

(b) (i) V_s = 6 V
(ii) V_s = 6 V
(iii) V_s = zero

---

9. (a)



(b) area under graph $= \frac{1}{2} \times 3 \times 15 = 22.5$ m

(c) 25 m / s

(d) distance = 3 x 25 = 75 m

---

10. (a) total work is the <u>same</u>.

(b) power of A is greater than power of B

(c) (i) chemical energy
(ii) obtained from food

(d) gravitational potential energy.

(e) As the box is falling, it potential energy is decreasing while its kinetic energy is increasing.
When it hits the ground, all its kinetic energy is converted to heat energy (in the box and in the ground) and also to sound energy.

---

11. (a) (i) Volume = 0.2 x 0.1 x 0.06 = 0.0012 m^3
(ii) mass = volume x density
= 0.0012 x 2400 = 2.88 kg
(iii) Total mass = 500 x 2.88 = 1440 kg

(b) (i) this mass is smaller
(ii) The mass of the brick filled with cement is greater than the original mass which indicates that the density of wet cement is greater than the density of brick (i.e., greater than 2400 kg / m^3).

---

12. (a) (i) When the cathode rays (electrons) hit the fluorescent screen, their kinetic energy is converted to light energy producing the bright line.
(ii) When the negative potential on the grid is reduced the number of electrons reaching the screen increases which increases the brightness.

(b) (i) to the y – input
(ii) 1. y – gain
2. time base
3. a vertical line in centre of screen.

June 2001

Paper 3

1. (a) (i) The body is accelerating.
   (ii) The body is moving at a constant speed.

   (b) It opens when the time is 20 seconds.

   (c)

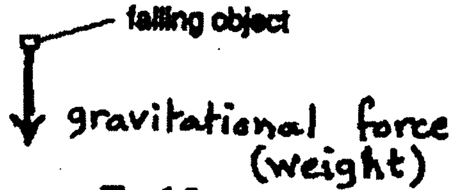
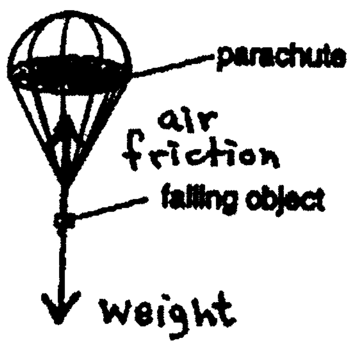


Fig. 1.2



   (d) (i) The gravitational force (weight) is acting vertically downwards.
   (ii) There is no resultant vertical force (because the two equal and opposite forces cancel each other).

   (e) Distance fallen = area under graph

$$= \frac{1}{2} \times 5 \times 47.5 = 118.8\,m$$

---

2. (a) Momentum = m . V = 800 x 20 = 16000 kg.m / s

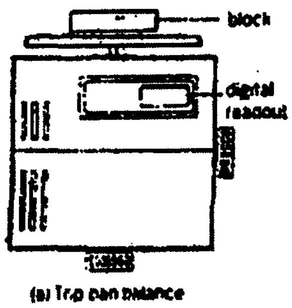
   (b) (i) $F = \dfrac{mv - mu}{t} = \dfrac{800(5-20)}{4} = -3000\,N$

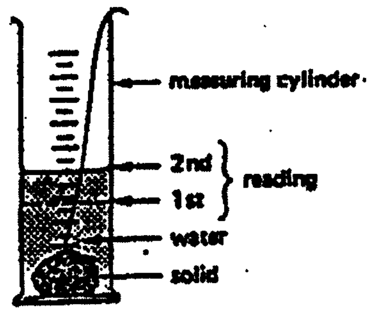
(ii) $a = \dfrac{v-u}{t} = \dfrac{5-20}{4} = -3.75 m/s^2$

average deceleration $= 3.75 \ m/s^2$

---

3. (a)





(b) mass of rock, m = g

initial volume of water, V_1 = cm^3

Volume of water and rock, V_2 = cm^3

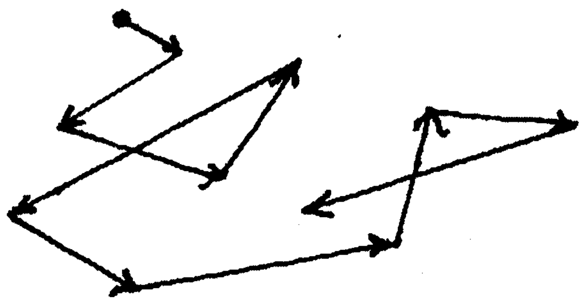
Volume of rock, $V = V_2 - V_1$ = cm^3

(c) density of rock material $= \dfrac{mass}{volume}$

$= \dfrac{m}{v}$ (g/cm^3)

---

4. (a)



(b) The dust particle is surrounded by much smaller and much faster air molecules which bombard the dust particle from different directions causing it to move in random (habhazard) direction which is called "Brownian motion".

(c) When the temperature increases, air molecules gain extra energy, so they move faster and they collide with the dust particle harder causing it to moe faster in random directions.

---

5. (a) P x t = m . c . θ

$$C = \frac{p \times t}{m \times \theta} = \frac{50 \times 600}{0.2 \times 45} = 3333 \text{ J / kg K}$$

(b) (i) During the experiment, some heat energy is lost to the container and to the surroundings, thus the temperature rise (θ) is smaller than it should, and the value obtained for "c" is higher than the actual value.

(ii) The apparatus should be lagged by a heat insulator material (like felt or expanded polystyrene) to reduce heat losses.

---

6. (a) (i) critical angle = 40°

(ii) If the angle of incidence of the blue light at P becomes smaller, the refracted ray into the glass will make an angle of incidence at Q greater than 40° thus producing total internal reflection in glass.

(b) refractive index $= \frac{1}{\sin(critical)} = \frac{1}{\sin 40}$

$= 1.56$

---

7. (a) direction of wave propagation.

(b) (i) the amplitudes of vibrations of particles.

(ii) a rarefaction at P

(iii) a compression at Q

(c) The air particle at R is moving to the left in a direction parallel to the direction of the wave motion.

(d) wavelength = 4 cm

---

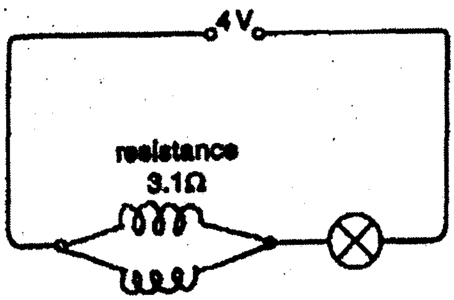
8. (a) (i) $I = \frac{P}{V} = \frac{0.6}{1.5} = 0.4A$

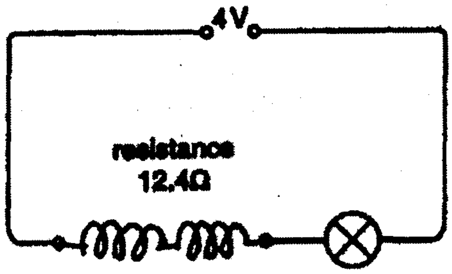
(ii) $R = \frac{V}{I} = \frac{4}{0.4} = 10\Omega$

(iii) Q = I t = 0.4 x 20 = 8 C

(b) (i) use two lengths of wire (each is 1 m long) connected in parallel to get 3.1 Ω

(ii) use two lengths of wire (each is 1m long) connected in series to get 12.4 Ω





(c) Energy $= I^2$ R t

$= (0.6)^2 \times 5 \times 20 = 36$ J

9\. (a) (i) When an alternating current passes through the primary coil, an <u>alternating</u> magnetic field is set up in the iron core of the transformer. This alternating magnetic field passes through the secondary coil and induces an alternating voltage in it.

(ii) If the primary coil is connected to a d.c. supply the magnetic field produced would be a <u>steady</u> magnetic field which does not change with time.

This steady field is constant and does not produce any induced voltage.

(b) (i) $\frac{V_1}{V_2} = \frac{N_1}{N_2}$

$\frac{240}{12} = \frac{N_1}{100}$ $\quad\quad\quad\quad \therefore N_1 = 2000$ turns

(ii) $I_1 V_1 = I_2 V_2$

$I_1 \times 240 = 4 \times 12$

$\therefore I_1 = 0.2$ A

10\. (a) mass no. = 4

charge = 2

ionization of gases : strong

deflection in magnetic field : at right angles

deflection in electric : towards negative

(b) (i) The mass of the nucleus of a metal atom is much greater than that of an α - particle, because the alpha particle scatters backward when it hits the nucleus.

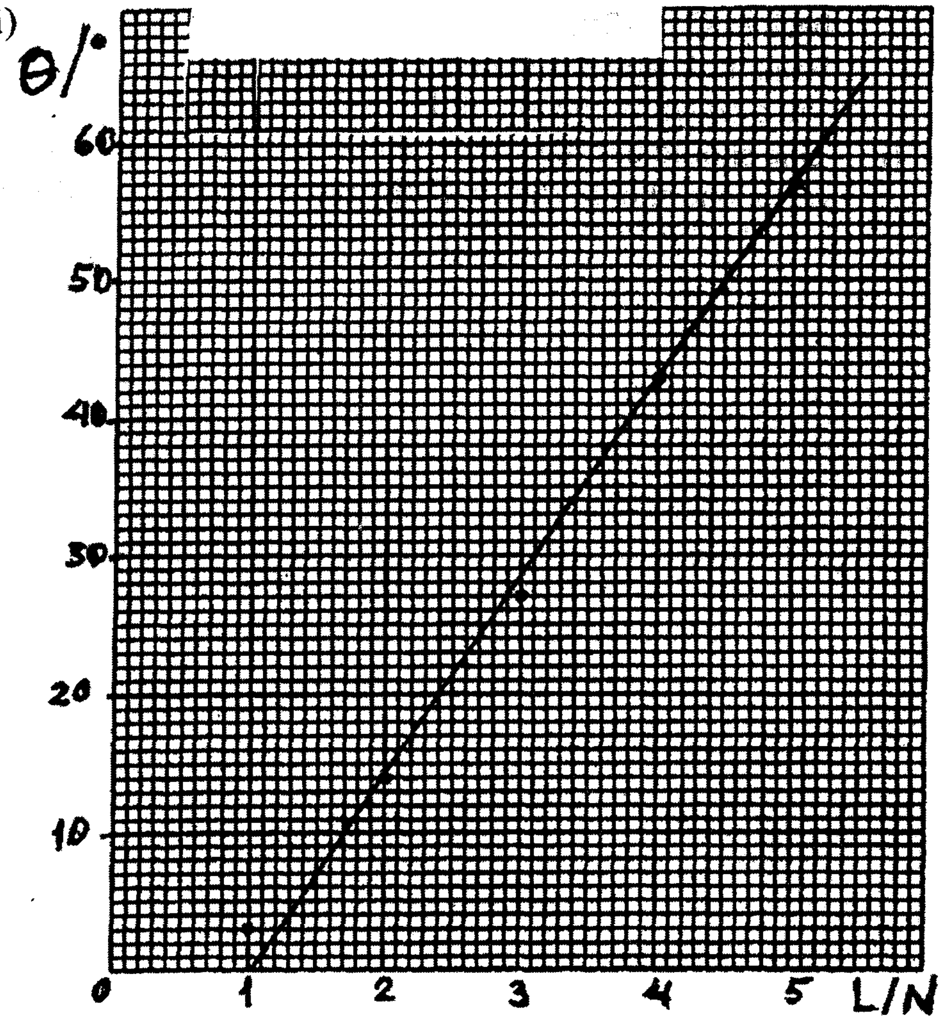
(ii) Since the alpha particle is positively charged and it repels away from the nucleus; then the charge of the nucleus must be also positive.

(iii) The volume of the metal atom must be much greater than that of its nucleus, because many alpha particles travel through the atom in straight lines as if traveling in empty space.

June 2001

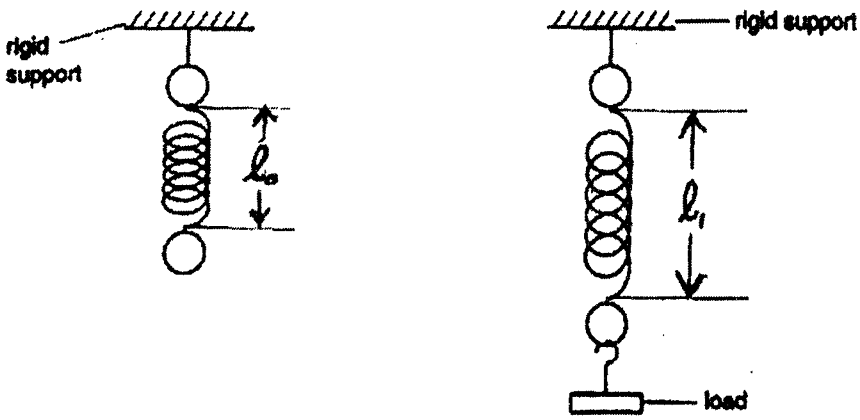
Paper 6

1. (a) (i)



(ii) .. because the load is not directly proportional to the angle of deflection.

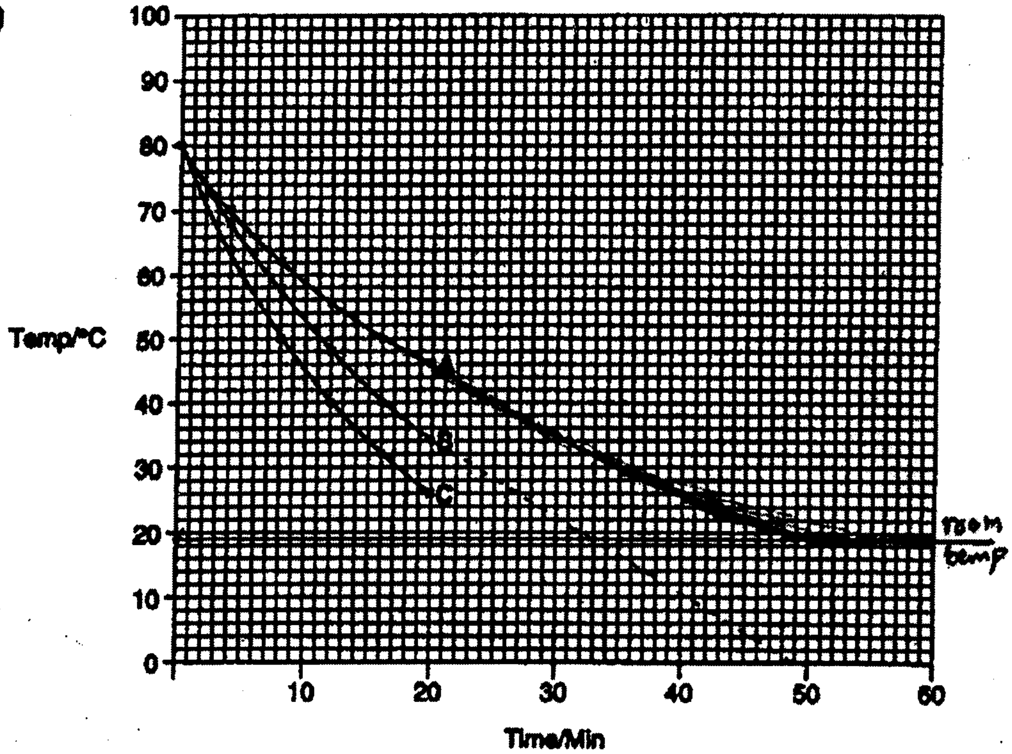
(b) (i,ii)



(iii) $e = l_1 - l_0$

2. (a) (i) beaker A : 7°C
beaker B : 16°C
beaker C : 12°C
Beaker A appears to be the best insulated.
(ii) Put a cover on the top of the beaker.
(iii) One should use the same volume of water in each beaker. (also, one should start with the same temperature of water in each beaker).

(b) (i) beaker A
(ii) because the temperature does not fall to zero, it rather falls to the room temp (19°C).
(iii)



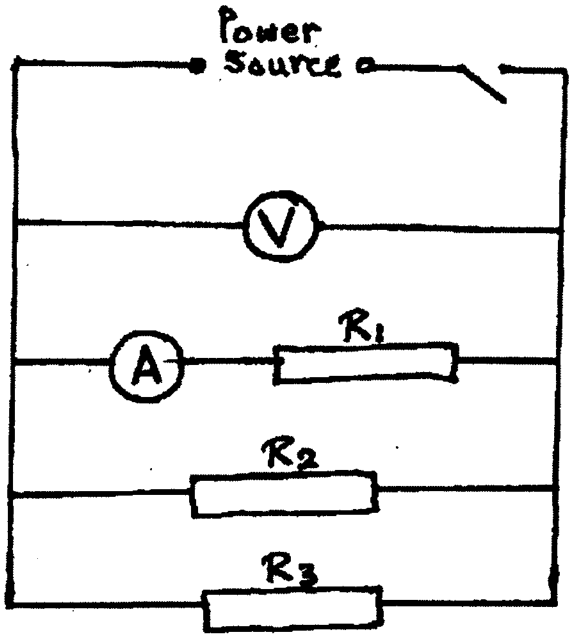
3. (a) (i)

Potential difference	V / V
V_1	0.94
V_2	0.35
V_3	0.48

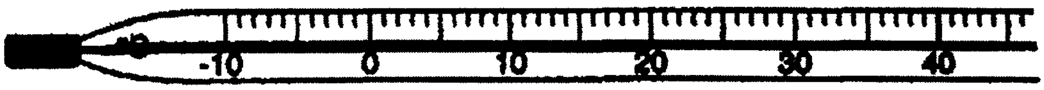
(ii) potential difference = 1.77 V

(iii) $R_1 = 2.69\Omega$ $R_2 = 1.00\Omega$ $R_3 = 1.37\Omega$

(b)



4. (a)



(b) to make sure that the glass stopper's temperature has reached 100°C.

(c) it is transferred quickly so that it loses as little amount of heat as possible.

(d) (i) temperature rise = 30.5 - 20.0
= 10.5°C.

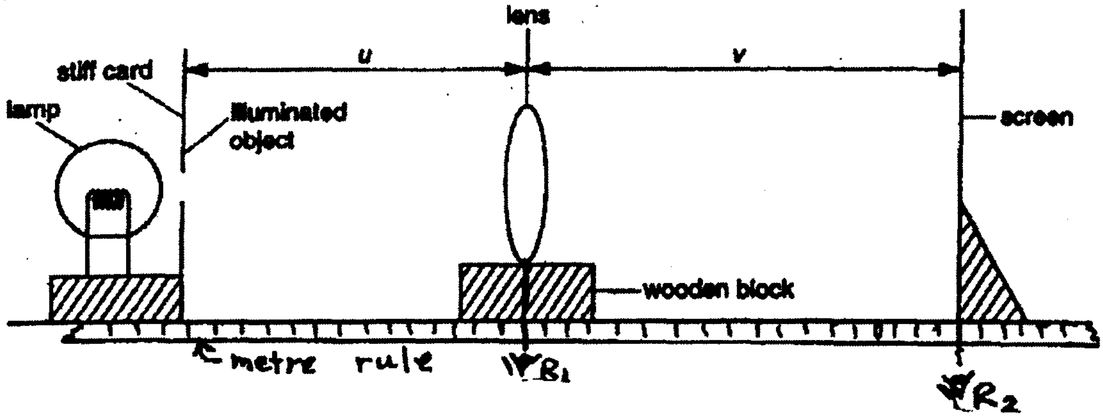
(ii) temp. fall of glass = 100.0 - 30.5
= 69.5°C.

(e) The heat capacity of the larger stopper is greater, thus a greater amount of heat energy is transferred to the water causing a greater temp rise.

5. (a)

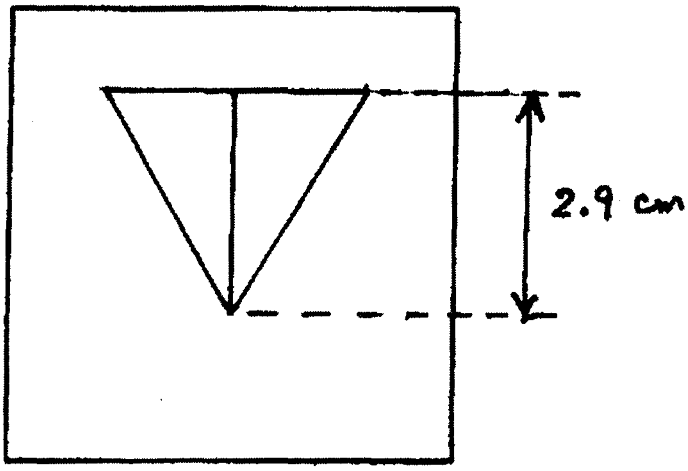
u / cm	v / cm	x / cm	y / cm	y / cm (by calculation)
15.0	30.0	1.5	2.9	3.0
20.0	19.6	1.5	1.6	1.5
25.0	16.8	1.5	1.1	1.0

(b)



1. Use the marker pen to draw a vertical line on the wooden block exactly at the poin where the lens touches the wooden block.
2. Place the metre rule on the table where it lightly touches the wooden block and the screen.
3. Take a reading R_1 on the metre rule at the vertical line of the wooden block; and another reading R_2 at the screen.
4. Now, $V = R_2 - R_1$

(c)



(d) The centers of the illuminated object, the lens and the screen should be lined up in a straight line.
(also, the screen should be perpendicular to this straight line).

November 2001

Paper 1

1	A	11	D	21	A	31	A
2	A	12	D	22	B	32	C
3	B	13	A	23	A	33	C
4	A	14	D	24	B	34	A
5	B	15	A	25	C	35	A
6	B	16	A	26	D	36	C
7	C	17	B	27	D	37	B
8	D	18	B	28	C	38	B
9	C	19	A	29	B	39	D
10	D	20	C	30	C	40	C

November 2001
Paper 2

1. (a) Length of string = 21 - 5 = 16 cm

(b) Circumference = 16 ÷ 8 = 2 cm

2. (i) Increase the area of base of jug.

(ii) Increase the mass of lower part of jug to lower its centre of gravity.

3. (a) by heating it (to raise its temperature).

(b) the spacing increases.

(c) a bimetallic strip in a thermostat (or in a flasher lamp, or in a fire alarm system).

(d) Gaps are left between sections of railway lines to avoid damage of rails as they expand in hot weather.

4. (a)

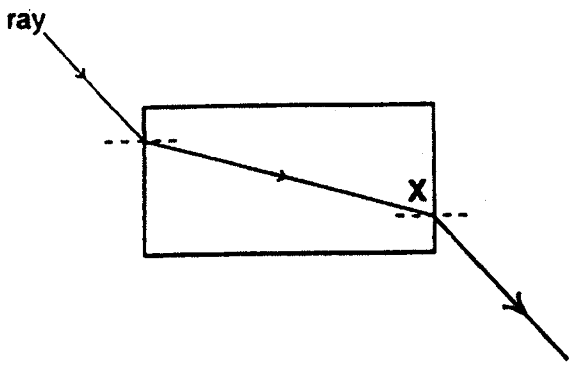


Fig. 4.1

(b) (i)

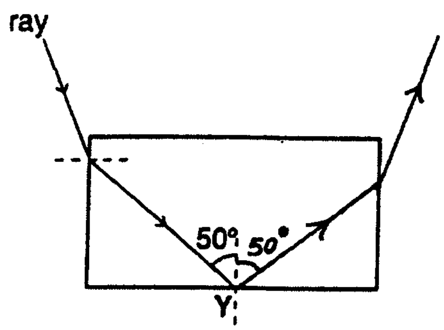


Fig. 4.2

(ii) When the angle of incidence in glass is greater than the critical angle, the ray experiences total internal reflection.

(c)

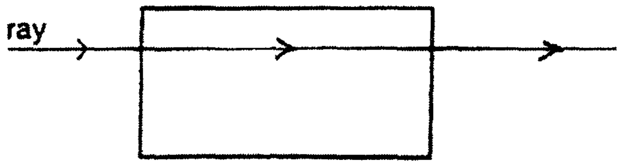


Fig. 4.3

5. (a) 1. Sun's rays should be refracted at first surface of prism.
2. Sun's rays should be dispersed at first surface of prism.

(b) (i) blackened-bulb thermometer (or a thermopile).
(ii) (above the red colour).

(c) 1. Gamma rays.
2. X – rays.
(also, ultra-violet and radio waves).

6. (a) (i) aluminium is not attracted to bar magnet.
(ii) unmagnetised iron is attracted to both poles of the bar magnet.
(iii) one end of permanent magnet is attracted to one pole of the bar magnet, while it is repelled with the other pole.

(b) (i) soft iron.
(ii) by an electric current flowing in its coil.
(iii) turn off the electric current.

7. (a) If a fault occurs, the current becomes excessive and the wires heat up causing damage of insulation and causing sparks which can start a fire.

(b) Water and steam can damage the insulation and conduct electricity which may cause electric shock to the user of the switch.

(c) a damaged cable may cause a short-circuit which produces excessive current and may cause a fire.

8. (a) The nucleus of the atom disintegrates by emission of some particle (alpha or beta) or some radiation (gamma).
A new nucleus (and thus a new element) can be formed.

(b) (i) half-life = 5 min.
(ii) no. of half-lives = 4
(iii) count rate = 25 counts /s

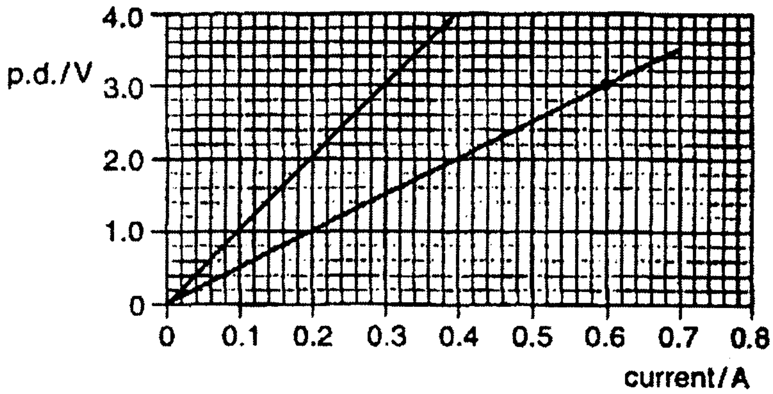
(c) alpha-particle : zero electrons ; two protons ; two neutrons.
beta-particle : one electron ; zero protons ; zero neurons.

9. (a) (i) ammeter.
(ii) A.
(iii) voltmeter.
(iv) V.

(b) (i) rheostat (variable resistor).
(ii) changing the current in the circuit (by changing its resistance).

(c) (i) the gradient of the graph equals resistance R.
(ii) $R = 3.0 \div 0.6 = 5.0$ ohms.

(d) (i) R becomes greater.
(ii)



10. (a) (i) Aluminium ; because the mass is directly proportional to the density (mass = volume x density) and aluminium has greatest density.
(ii) Aluminium block.
(iii) Aluminium block.

(b) position A, because the base area is smallest. (pressure is inversely proportional to base area).

(c) (i) because the pressure on sand is too large.
(ii) increase the base area by placing the chair on a large plate of wood.

11. (a) the temperature of water.
(b) mercury.
(c) 100° C
(d) reading on thermometer remains constant.
(e) Place the thermometer in pure melting ice contained in a funnel, and leave it for enough time.
If the scale is correct, the mercury reading should be at the zero mark exactly.

12. (a) (i) because the temperature difference between inside the room and outside the house is much greater.

(ii) because the thickness of window glass is much smaller (and its material is better conductor of heat).

(b) 4 150 000 J / hour.

(c) heat can be lost by "radiation" also.

November 2001
Paper 3

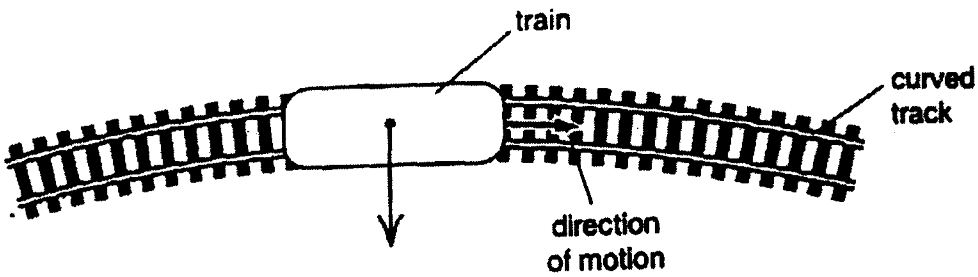
1. (a) (i) max speed = 10 m/s

(ii) time taken = 32 - 18 = 14 s

(iii) length of bend = v x t
= 10 x 14 = 140 m

(b) deceleration = $\frac{\Delta v}{t} = \frac{25-10}{18-10} = \frac{15}{8} = 1.9\, m/s^2$

(c) (i)



(ii) it causes the train to travel in a circular path.

(iii) it is provided due to the friction between the wheels of train and the rails of track.

---

2. (a) (i) momentum = m . v
= 90 x 45 = 4050 kg.m/s

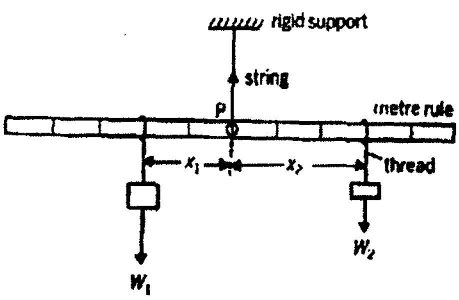
(ii) are force = momentum change ÷ time
= 4050 ÷ 1.2 = 3375 N

(b) Heat energy.

(c) energy = $\frac{1}{2}mv^2 = \frac{1}{2} \times 90 \times (45)^2$
= 91125 J

---

3. (a)



(b) 1. Position a weight W_1 tied to a loop of thread on the left of the rule.
2. Hang a second weight W_2 in the right of pivot, and move the loop holding W_2 until the rule is once again balanced horizontally.
3. Read and record the distances x_1 and x_2 from the rule itself.
4. Calculate $+ W_s x_1$ and $- W_2 x_2$ and show that the sum of moments, in equilibrium, is zeros.
5. Repeat above steps with two different weights.

(c)

W_1 / N	X_1 / cm	W_2 / N	X_2 / cm	$(W_1x_1 + W_2x_2)$ / N.cm
2	30	3	20	(60 - 60) = zero
5	40	20	10	(200 - 200) = zero

4. (a) As the molecule M is moving randomly, it collides with other molecules of air (and molecules of gas).
On each collision, it changes its direction in random way as shown.

(b) Because the molecule M changes its direction in forward and backward directions, it moves relatively short distance in the straight line direction. This explains why gas molecule move through air molecules rather slowly.

5. (a) <u>experiment 1:</u>

250 g of water raised 10°C needs 10 500 J

∴ 250 g of water raised 100°C needs 105 000 J

and 1 g of water raised 100°C needs $\frac{105000}{250} = 420$ J

<u>experiment 2:</u>

15 g of water evaporated at 100°C needs 33 900 J

1 g of water evaporated at $\frac{33900}{15} = 2260$ J

energy difference = 2260 - 420 = 1840 J

(b) Considerable heat energy is needed to force the molecules of water far apart from each other to change it to steam at same temperature. Steam molecules travel freely in random directions and their potential energy increases greatly.

(c) (i) sensitivity is the ability of a thermometer to detect small changes in temperature.

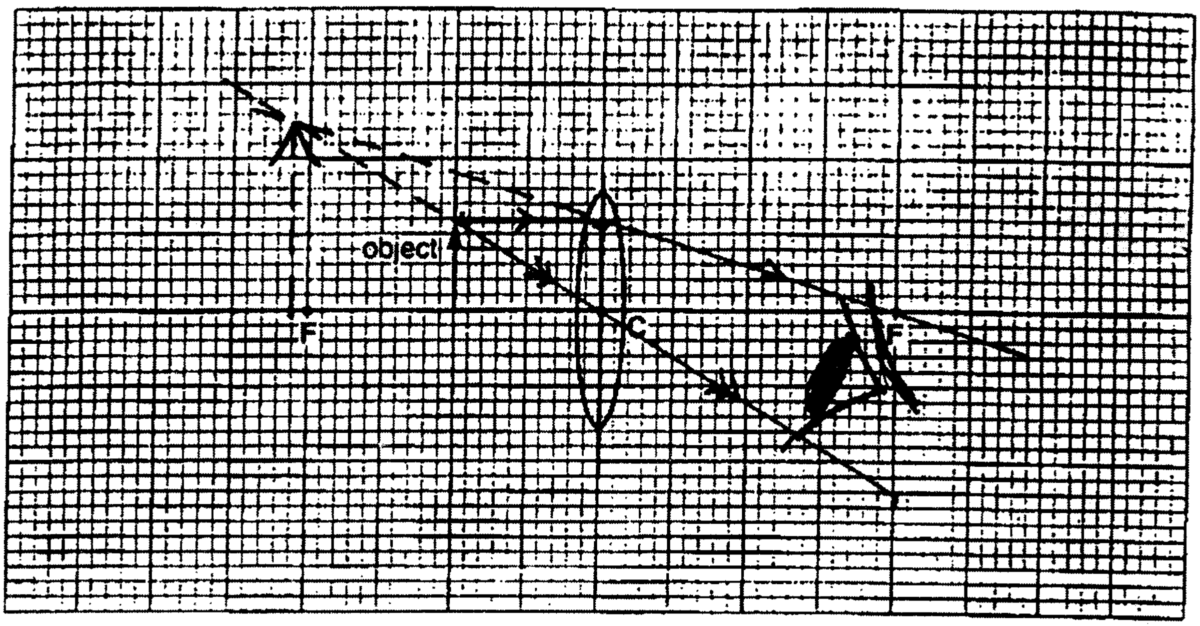
(ii) range is the maximum number of temperature degrees which can be measured by the thermometer.

(iii) linear scale means that the length of each degree on the scale is the same at low and high temperatures.

6. (a)

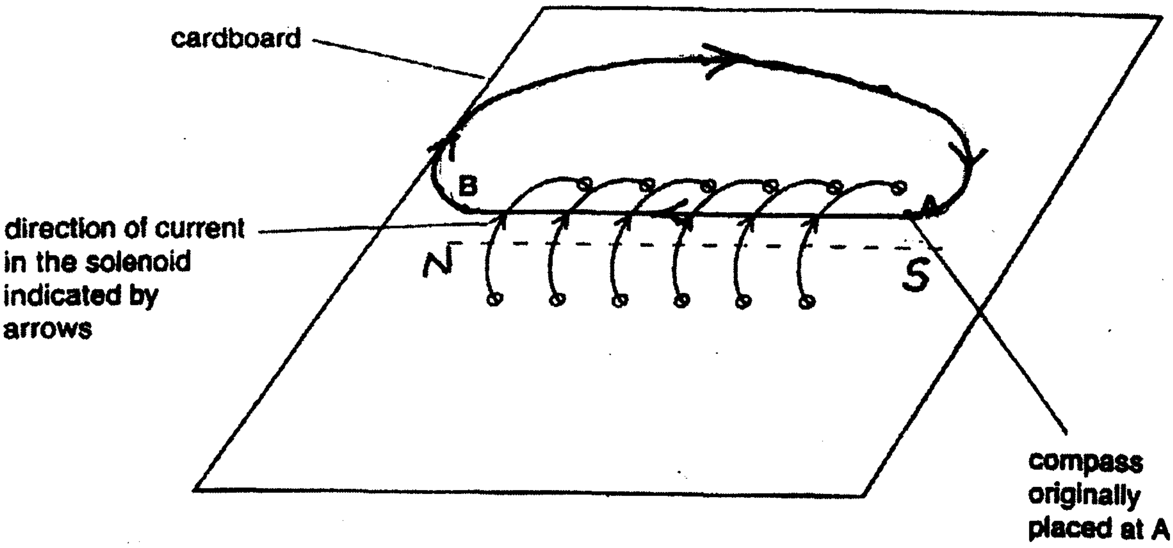
	Fig. 6.1	Fig. 6.2
name of the effect shown	**refraction**	**diffraction**
wavelength change, if any	λ **decreases**	**no change**
frequency change, if any	**no change**	**no change**

(b)

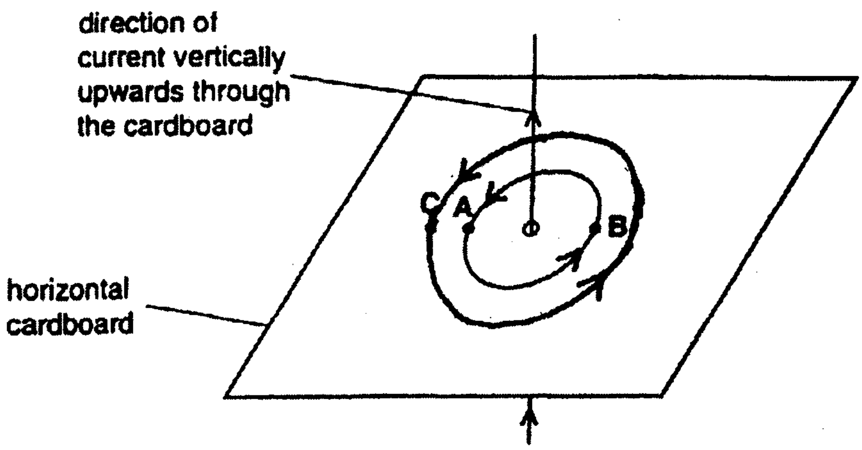


(i) number of times bigger = 2
(ii) it can be used as a "magnifying glass".

7. (a)



(b) (i)



(ii) The lines from C and from B are concentric circles, so they cannot intersect.

(iii) 1. strength : same - direction : reversed
2. strength : increases - direction : same

8. (a) current at X $= \dfrac{P}{V} = \dfrac{600}{240} = 2.5$ A

current at Y $= \dfrac{300}{240} = 1.25$ A

current at Z $= 2.5 + 1.25 = 3.75$ A

(b) $R = \dfrac{R_1 R_2}{R_1 + R_2} = \dfrac{96 \times 192}{96 + 192} = 64\Omega$

(c) (i) $R = R_1 + R_2 = 96 + 192 = 288\ \Omega$

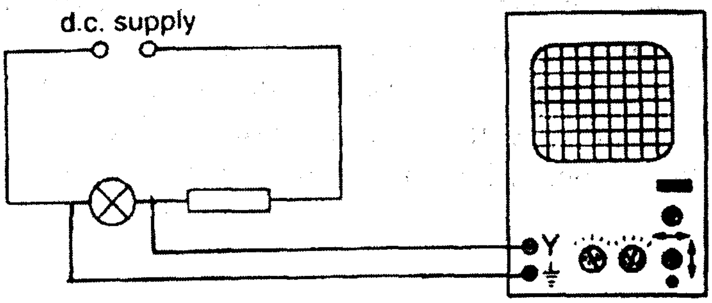
current at P $= \dfrac{V}{R} = \dfrac{240}{288} = 0.833$ A

(ii) p.d. across A = IR_1 = 0.833 x 96 = 80 V
p.d. across B = IR_2 = 0.833 x 192 = 160 V

(d) (i) In Fig. 8.1, connection in parallel is better :
because the current in each lamp is greater,
and the potential difference in each lamp is greater,
due to smaller total resistance in the circuit.

(ii) If a switch is placed at the point X and at the point Y in Fig. 8.1, each lamp can be switched on and off independently.

9. (a)

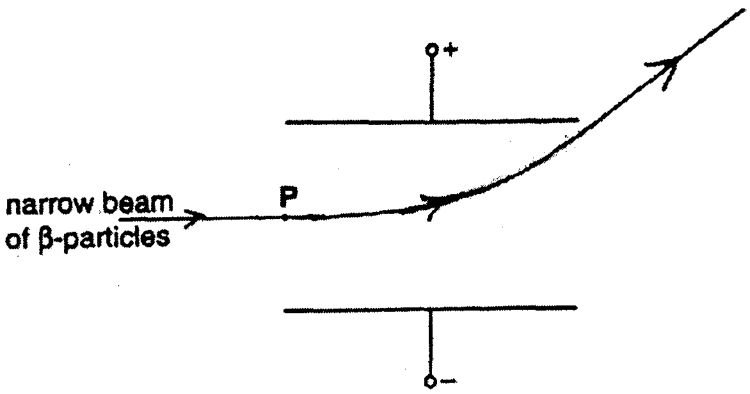


(b) Potential difference = no. of divisions x voltage per division
= 3.5 x 0.4 = 1.4 V

(c) C.R.O can measure p.d. without knowing which side is positive and which is negative.
Also, we can change its sensitivity over a large range of voltages.

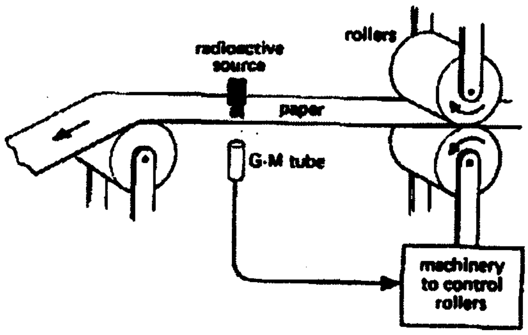
10. (a) $^{24}_{11}Na \rightarrow ^{24}_{12}Mg + ^{0}_{-1}e$

(b) (i)



(ii) The negatively charged beta-particles are deflected strongly towards the positive plate. When they come out of the electric field, they contiune in a straight line.

(c) (i)

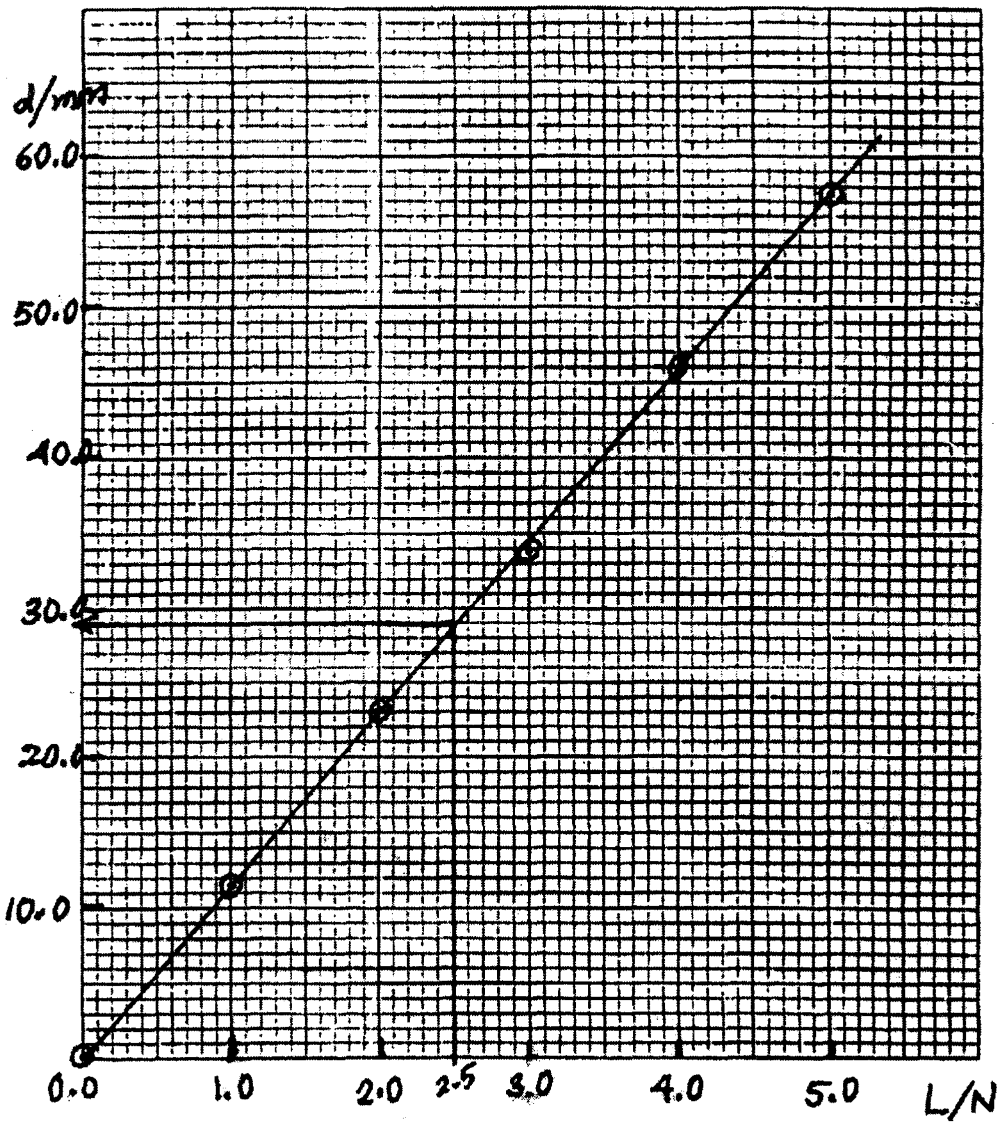


(ii) The count-rate of beta-particles reaching the G-M counter is recorded as the paper roll passes under the radioactive source.

1. A constant count-rate indicates constant thickness,
2. a decreasing count-rate indicates increasing thickness,
3. an increasing count-rate indicates decreasing thickness.

November 2001
Paper 6

1. (a) (i)



(ii) depression = 29 mm

(b)

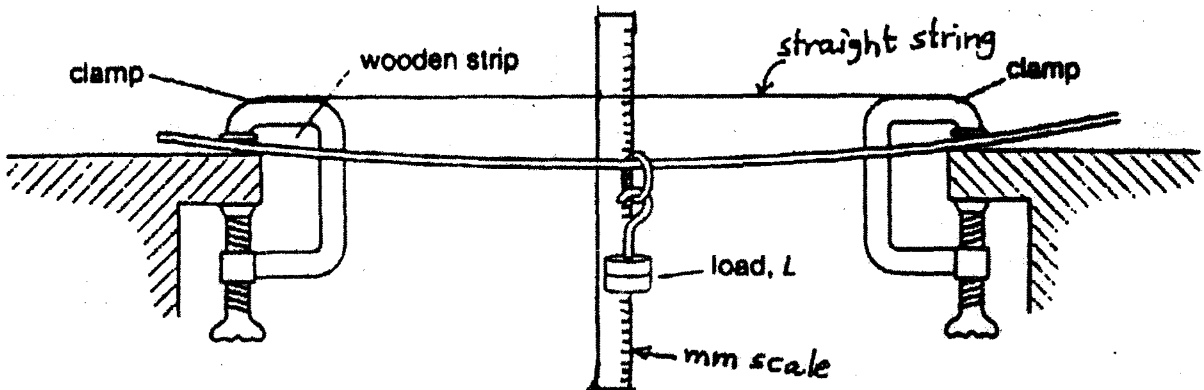


Fig. 1.1

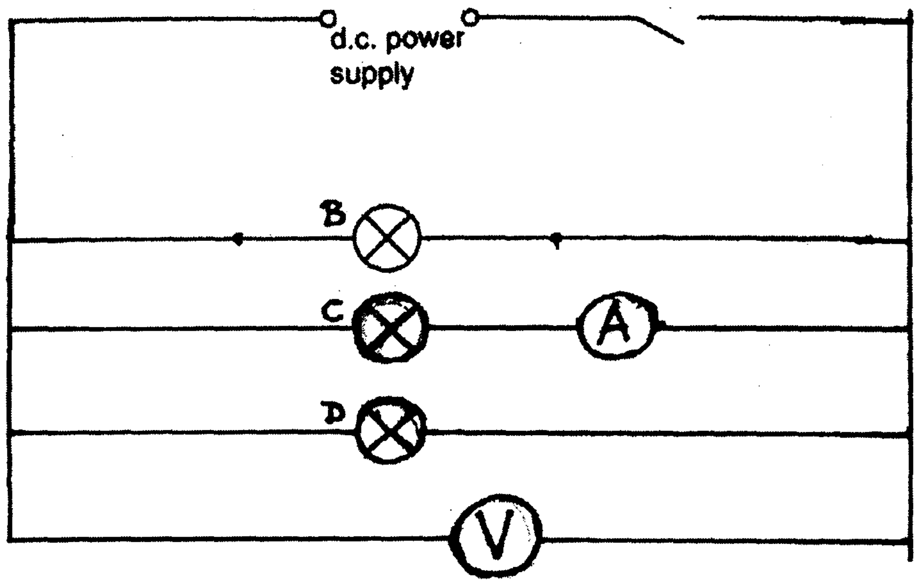
2. (a) (i)

lamp	V / V	I / A
B	2.0	**0.22**
C	2.1	**0.23**
D	1.9	**0.175**

(ii) Using the values in the table and the equation $R = V / I$, calculate the resistance each lamp.

resistance of lamp B = 9.09 Ω
resistance of lamp C = 9.13 Ω
resistance of lamp D = 10.86 Ω

(b)



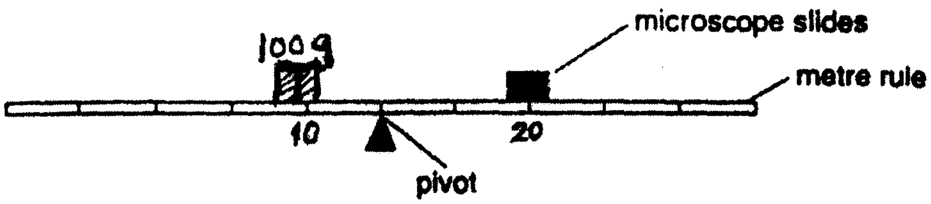
3. (a) (i) h = 18 mm

(ii) t = 1.2 mm

(iii) V = 1440 mm^3

(iv) $d = \frac{3.7}{1440} = 0.0026\ g / mm^3$

(b)



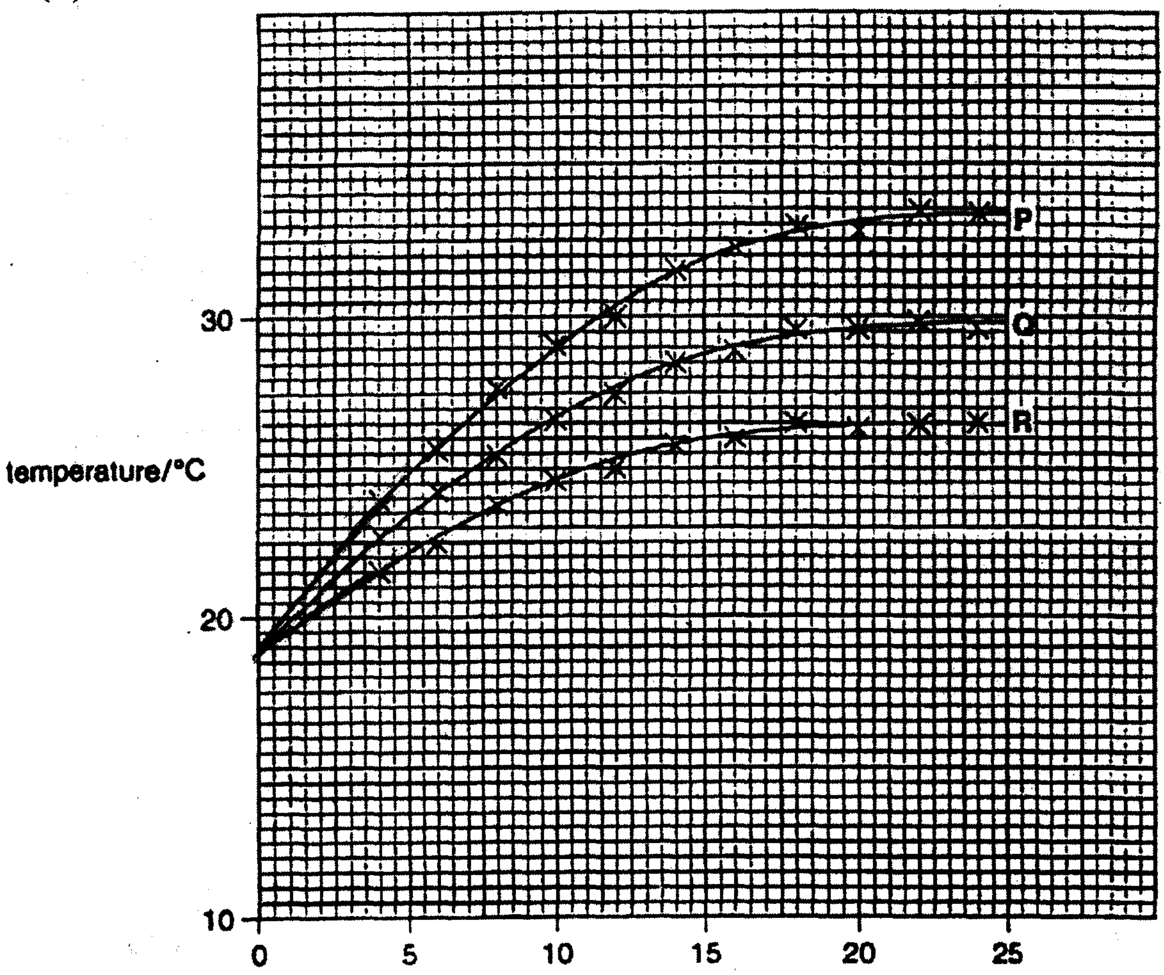
4. (a) (i)

can	initial water temperature/°C	final water temperature /°C	heating time / min	temperature change /°C
A	20	55	20	**35**
B	20	43	23	**23**
C	20	52	18	**32**

(ii) 1. All cans should have same shape and size.
2. All cans should contain equal masses of water.

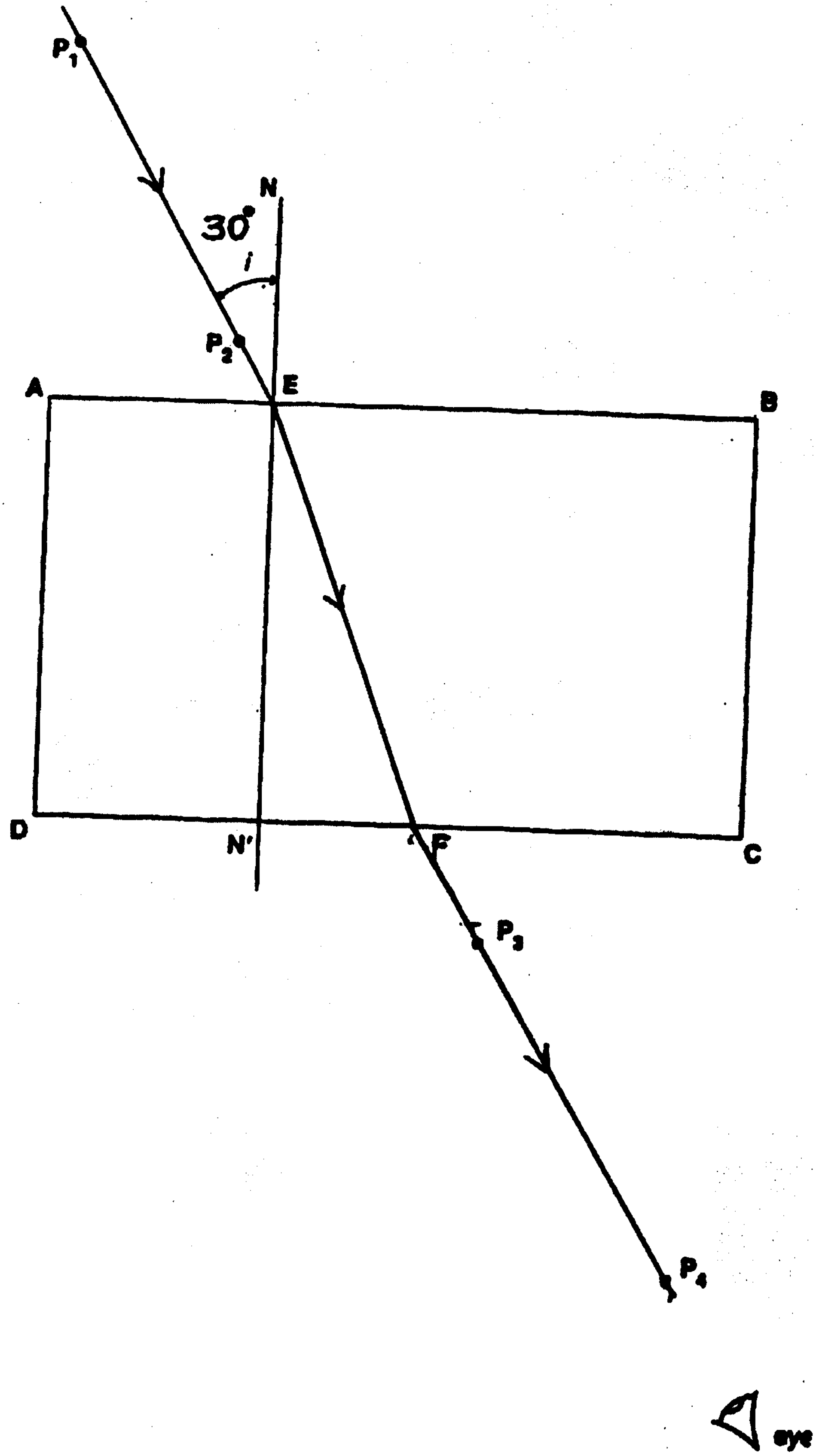
(b) (i) R

(ii)



temperature = 18°C

5. (a) (i)



(ii) angle i = 30°

(b) 1. The pin should be stuck in the mat in vertical position.

2. Look through the block at images of P_1 & P_2 and move the eye until image of P_2 exactly covers that of P_1 ; then stick P_3 such that it covers the images and the three pins appear as one (the three are linsed up).

The forth pin P_4 should bse stuck to cover the three and all should be lined up to appear as one pin.

(c) (i) $N'F = 2.4$ cm

(ii) $EF = 6.9$ cm

(iii) $n = 1.44$

June 2002

Paper 1

1	B	11	B	21	A	31	A
2	A	12	A	22	D	32	C
3	A	13	C	23	B	33	A
4	D	14	A	24	B	34	D
5	B	15	C	25	A	35	C
6	B	16	C	26	C	36	D
7	C	17	B	27	C	37	B
8	B	18	D	28	C	38	B
9	A	19	B	29	C	39	A
10	C	20	C	30	A	40	B

June 2002

Paper 2

1. (a) The weight is not measured in kg, it should be measured in newtons (1 kg equals 10 newtons).

(b) The mass is different from the weight.
The mass of an object is the amount of matter contained in the object.
The weight of an object is the force of gravity on that object.

---

2. (a) (i) a property that increases regularly with temp.

(b) (i) 70°C.
(ii) the thread will contract below 0°C.

---

3. (a) (i) number of puffs = 25
(ii) frequency = no. of revolutions per sec. x no. of holes
= 40 x 25
= 1000 Hz

(b) (i) it is the echo due to the reflection of sound on the building.
(ii) 1000 Hz
(iii) less than original sound.

---

4. (a)

particle	found in the nucleus	found in an orbit
proton	✓	
neutron	✓	
electron		✓

(b) (i) atomic no. = 15
(ii) nucleon no. = 15 + 16 = 31
(iii) ${}^{31}_{15}P$

---

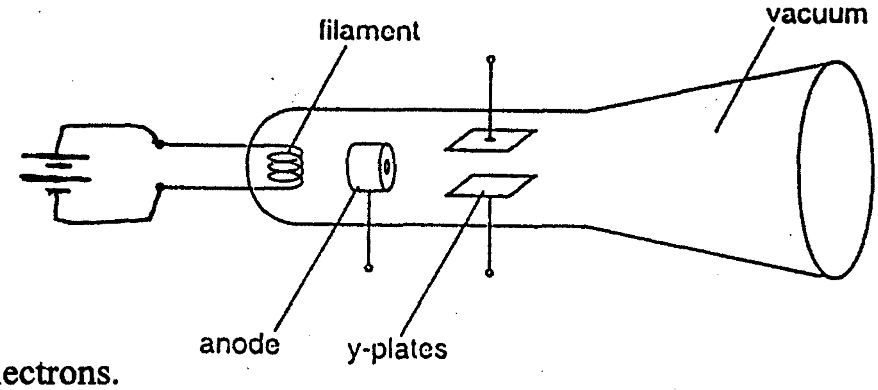
5. (a) Place the steel rod inside a long solenoid carrying a d.c. current for several minutes, the steel rod becomes magnetized.

(b) What to do ? Bring one end of magnetized rod near a freely suspended magnet from both ends.
What results ? the freely suspended magnet will be attracted to the rod from one end, and will be repelled from the other end.

(c) <u>What happens</u> ? magnet B will fall down (and vibrates several times) them stops away from (and above) magnet A.
<u>explanation</u> : magnet B will stop at the point where its downward force due to gravity (its weight) equals the upward repulsive force between the like poles of magnets.

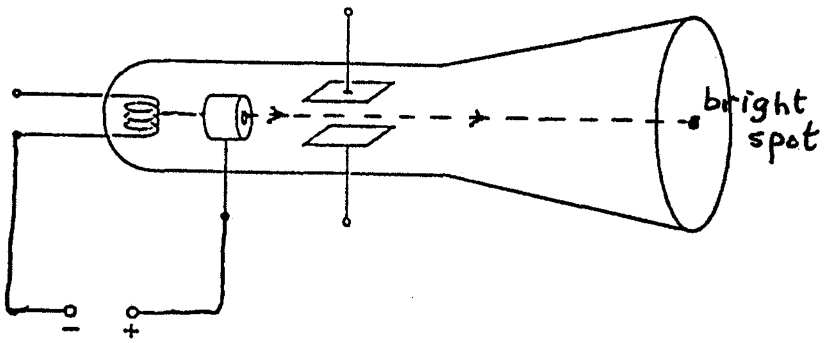
---

6. (a) (i)



(ii) electrons.

(b) (i),(ii)

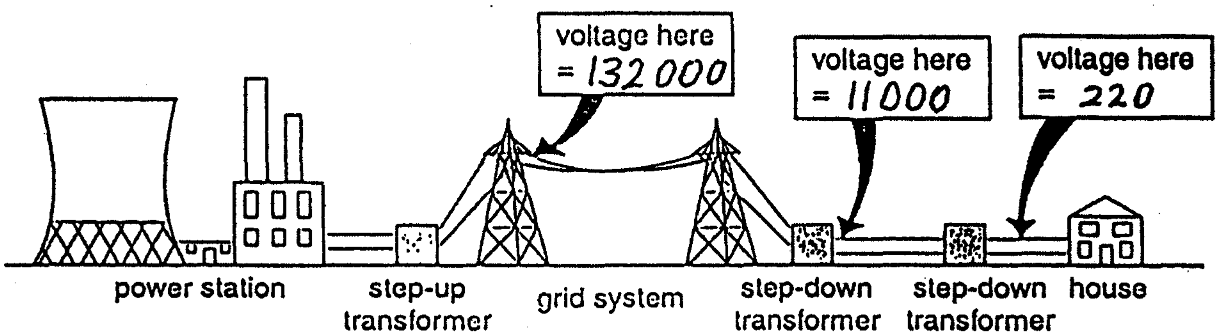


(iii) cathode rays produce a bright spot at the centre of the fluorescent screen.

(c) between point T (positive) and point S (negative).

---

7. (a)



(b) to reduce the electric power lost in the transmission wires.

---

8. (a) 1. To keep radioactive materials as far as possible from the body to reduce the amount of radiations reaching the body.
   2. To avoid touching the radioactive materials by hands (or gloves) and avoid any contamination.

(b) To avoid contamination of food by dangerous radioactive materials.

(c) To make sure that hands are clean and avoid contamination.

(d) To make sure that radioactive sources would be handled by authorized persons only.

---

9. (a) (i) R $= 40\ \Omega$

(ii) A_2 reads 0.2 A

A_3 reads 0.2 A

(b) (i) $10\ \Omega$

(ii) A_2 reads less than 0.8 A

A_3 reads 0.8 A

---

10. (a) (i) pressure of car $= \dfrac{10000}{4a}$

pressure of person $= \dfrac{500}{2a}$

$$\therefore \frac{\text{P of car}}{\text{P of person}} = \frac{10000}{4a} \times \frac{2a}{500} = \frac{10}{1}$$

(ii) When pressure of air in tyres is reduced, the area of tyres in contact with the road increases, thus the pressure of car on the ground decreases and it is less likely to sink in soft sand or snow.

(b) (i) liquid levels X and Y are the same, because both sides are exposed to the same atmospheric pressure.

(ii) level X moves down

level Y moves up

(iii) measure the difference in height between the levels of X and Y ; then add it to the atmospheric pressure.

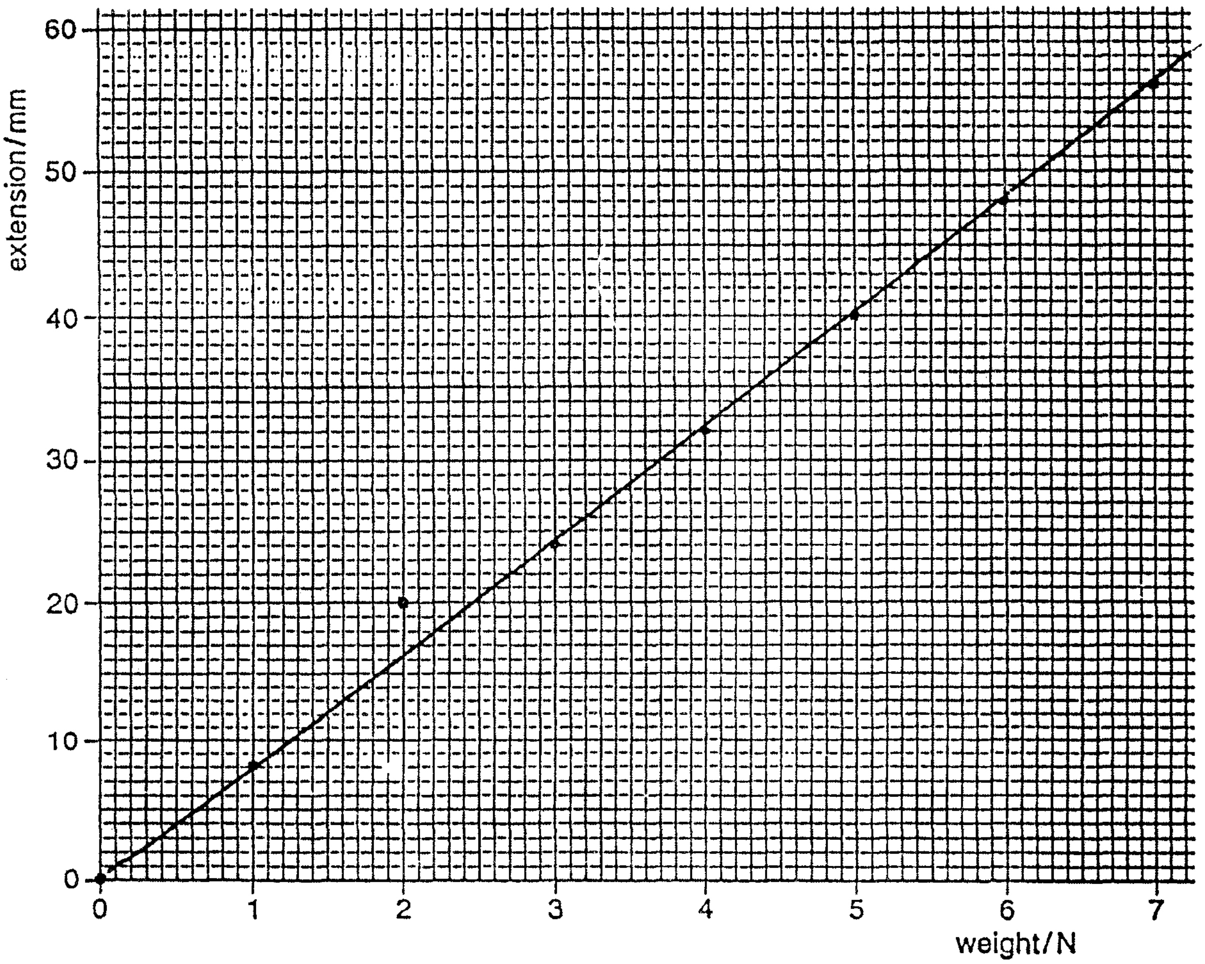
---

11. (a) length of unstretched spring = 40 mm

(b)

weight/N	0	1	2	3	4	5	6	7
length/mm	40	48	60	64	72	80	88	96
extension/mm	0	8	20	24	32	40	48	56

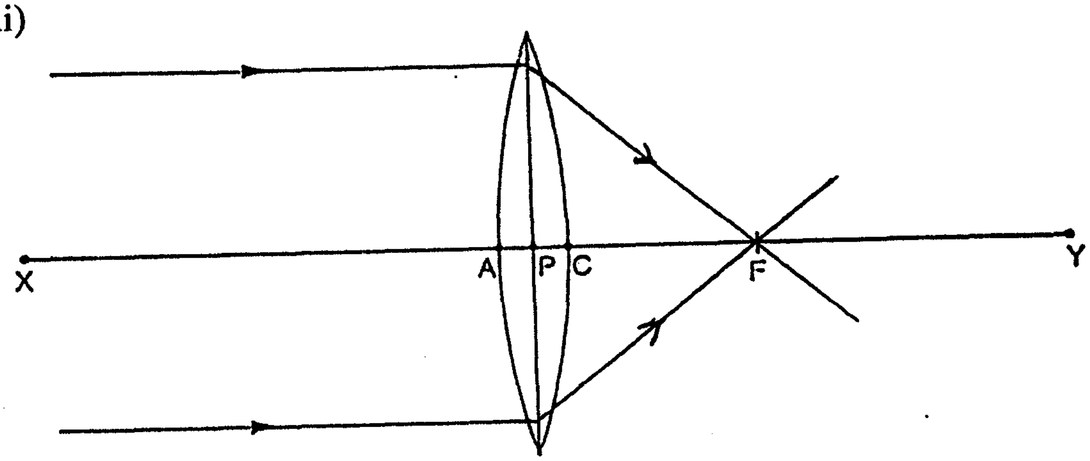
(c) (i), (ii)



(iii) 1. length 60 mm is incorrect.
2. correct length should be 56 mm

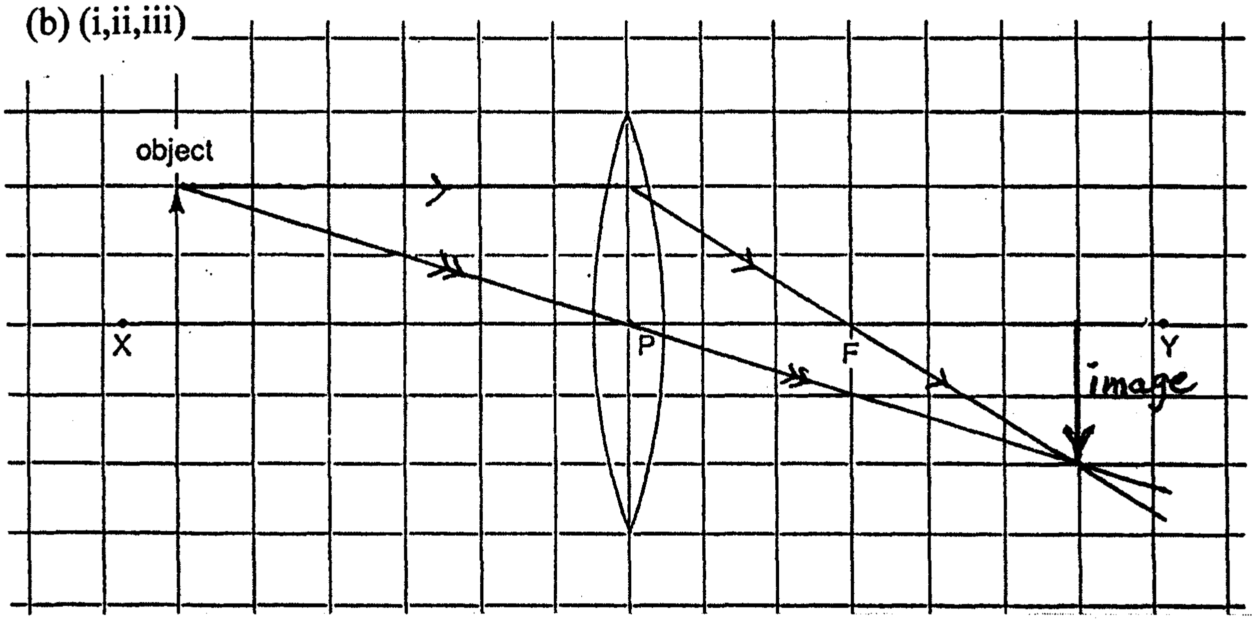
(d) (i) extension = 28 mm
(ii) force = 3.5 N
(iii) force of friction = 3.5 N

12. (a) (i) converge
(ii)



(iii) focal length is the distance between point P and point F.

(b) (i,ii,iii)



(iv) 1. height of image is the same as height of object.
2. distance of image is the same as the distance of object.
(v) The image is inverted with respect to the object.

June 2002

Paper 3

1.(a) 1. Mass of student who runs up the stairs (in kg)
2. Number of stairs he is climbing.
3. Height of each stair (in metres)
(use a mm scale to measure height accurately).
4. Time taken to run up the stairs (in seconds)
(use large no. of stairs to increase the time period to measure the time accurately using a stop-watch).

(b) Work done = mass of student (kg) x acceleration due to gravity (m / s^2) x total height of stairs (m).

$$\text{Power} = \frac{\text{work done (J)}}{\text{time taken (s)}}$$

(c) (i) gravitational potential energy.
(ii) some of student's power is dissipated as heat.

---

2. (a) (i) Part AB : The ball is falling down with increasing velocity, it is accelerating downwards due to the force of gravity.
(ii) Part DE : The ball is moving upwards with decreasing velocity, it is decelerating because force of gravity is opposing its upward motion. It velocity reaches zero at E at its maximum height.

(b) When the ball hits the ground it stops rapidly and its speed goes to zero (from B to C). The kinetic energy of the ball changes to strain potential energy in the elastic rubber. This potential energy is converted to kinetic energy and the speed of the ball increase rapidly from C to D in the opposite direction.

(c) (i) change in speed = 8 - 9.5 = -1.5 m / s
(ii) change in velocity = 8 - (-9.5) = 17.5 m / s

(d) The speed is a scalar quantity which has no direction.
Velocity is a vector quantity which has both magnitude and direction.

(e) Distance traveled = area under graph

$$= \frac{1}{2} \times 0.6 \times 8$$

$$= 2.4 \text{ m}$$

(f) $$a = \frac{v-u}{t} = \frac{0-8}{0.6} = -13.3 \text{ m} / s^2$$

deceleration = 13.3 m / s^2

---

3. (a) Because only few water molecules have high kinetic energies and are very near the surface of water can overcome binding energies with neighbouring molecules and can escape from water surface.

(b) 1. increasing the area of water surface,
2. raising the temperature of water.

(c) There are attractive forces between the molecules of the liquid. A molecule at the surface of liquid needs enough energy to overcome the binding energy with other molecules to liberate itself and move freely in air above the liquid.

---

4. (a) $V_1P_1 = V_2P_2$

$(80\text{ a})(1 \times 10^5) = (\ell\text{ a})(3.8 \times 10^5)$

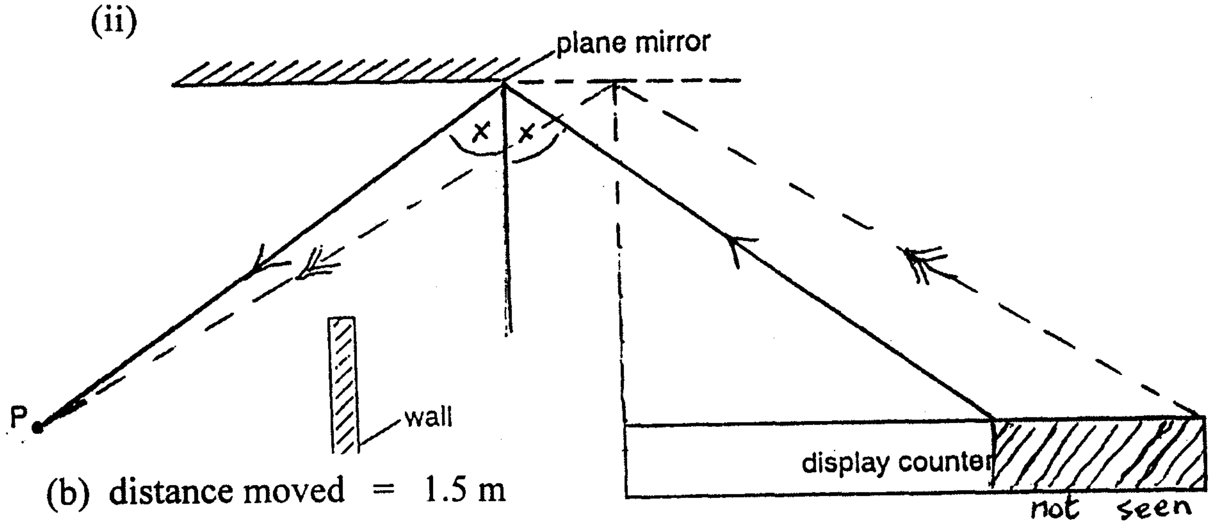
new length = 21 mm

(b) (i) 1. Place the cylinder in a large beaker containing pure melting ice for a long time, until the volume of air settles at a minimum value and mark the scale point 0°C at the inner edge of piston.
2. Place the cylinder in steam above pure boiling water for a long time until volume of air reaches its maximum value and mark the scale point 100°C at the inner edge of piston.

(ii) 1. Divide the distance between the two fixed points into 100 equal divions to make a temp. scale.
2. Place the cylinder into the water of the beaker for several minutes until the piston stops then read the temperature at the inner edge of piston.

---

5. (a) (i) the angle of reflection equals the angle of incidence.
(ii)



(b) distance moved = 1.5 m

(c) 1. virtual. 2. upright.
3. same size as the object.
4. at same distance behind the mirror.
5. laterally inverted.

---

6. (a) $v = f \times \lambda$

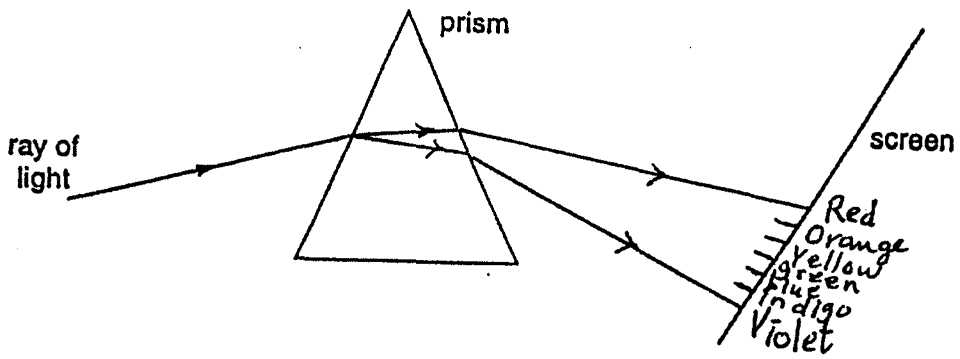
$$f = \frac{v}{\lambda} = \frac{3\times10^{8}}{5\times10^{-7}} = 6 \times 10^{14}\ \text{Hz}$$

(b) (i) distance $= v \times t$

$= 340 \times 3.6 = 1224\ \text{m}$

(ii) The speed of light is very great, so the time taken by to reach the observer is very very small and can be neglected.

(c)



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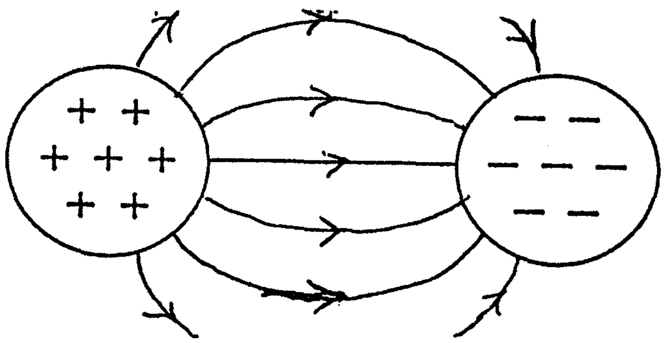
7. (a) During rubbing, some electrons are transferred from one sphere to the other. The sphere which loses negative electrons becomes positively charged, while the sphere which gains negative electrons becomes negatively charged.

(b)



(c) (i) Total charge $=$ no. $\times$ single charge

$= (2 \times 10^{10})(1.6 \times 10^{-19})$

$= 3.2 \times 10^{-9}\ \text{C}$

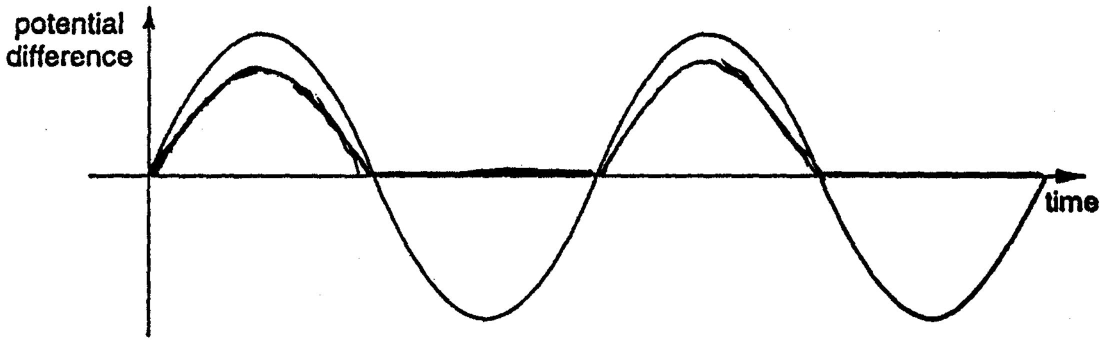
(ii) current $I = \frac{Q}{t} = \frac{3.2\times10^{-9}}{1\times10^{-3}} = 3.2 \times 10^{-6}\ \text{A}$

---

8. (a) 240 : 15
16 : 1

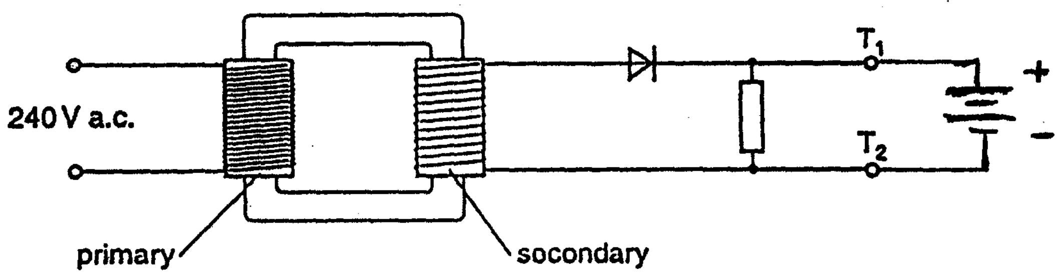
turns ratio = 16 : 1

(b)



(c) The diode plugged in the circuit allows the current to pass in one direction only, so it changes the a.c. current to d.c. current.

(d)



(e) (i) $P = V.I = 12 \times 2 = 24$ W

(ii) $E = P.t = 24(1.08 \times 10^5)$

$= 2.6 \times 10^6$ J

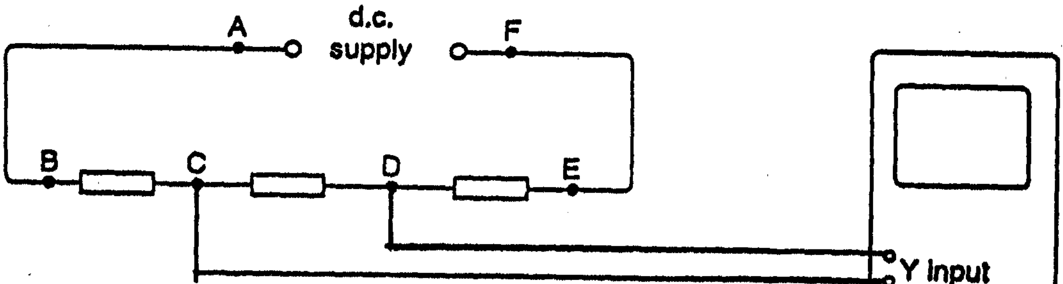
$= 2.6$ MJ

---

9. (a) 1. Turn on the c.r.o. and notice the place of the bright straight line in center of screen.
2. Connect the terminals of the d.c. supply to the Y – input of c.r.o. and measure the distance, y, which the bright straight line is displaced.
3. Now use the calibration :

y cm on screen = 1 Volt

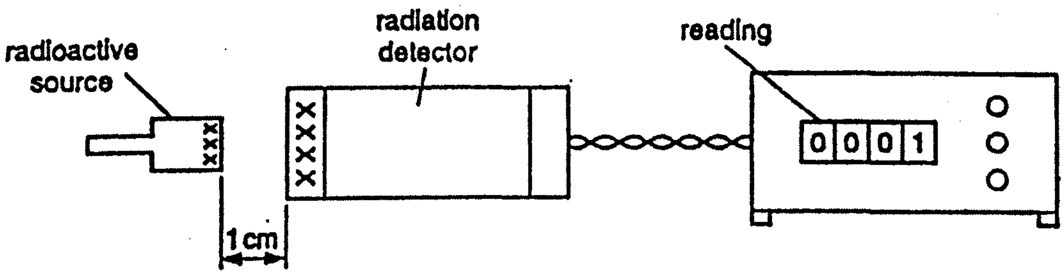
(b)



(c) Pd between A & F = (pd between B & C + pd between C & D + pd between D & E).

---

10. (a)



(b) 1. First, record the average background count rate.
2. Place the radioactive sample very close to the detector and record the gross count rate.
3. The net count rate of the sample is the difference between count rates in steps (1) and (2).

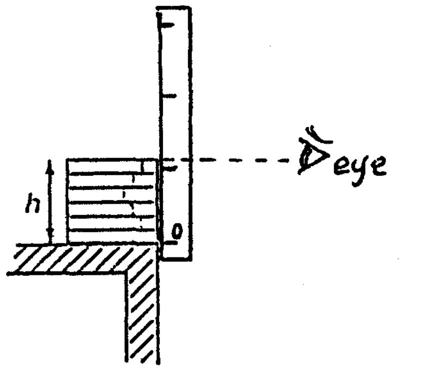
Note : if the sample is very close to the detector, only half its radiation goes to the detector and the other half travels in the opposite direction.

(c) precaution 1 : Radioactive sample should only be picked up using long-handled tools and should be kept as far as possible from the body.
Precaution 2 : The technician should wear rubber gloves and should wash his hands after the sample is put away safely, to avoid any contamination.

June 2002

Paper 6

1. (a)

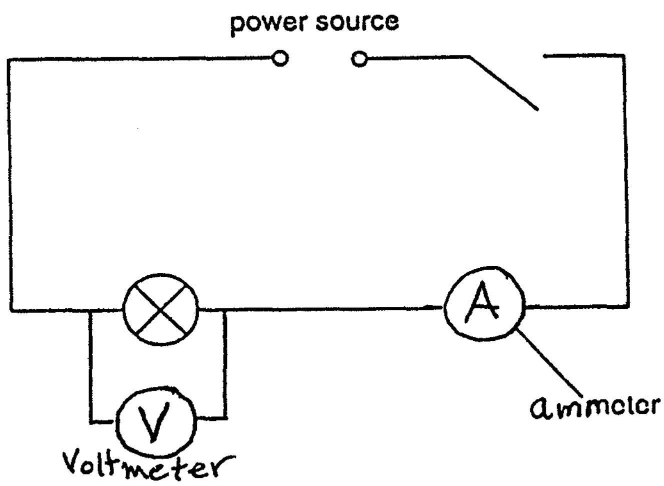


(b) (i) h = 12 mm

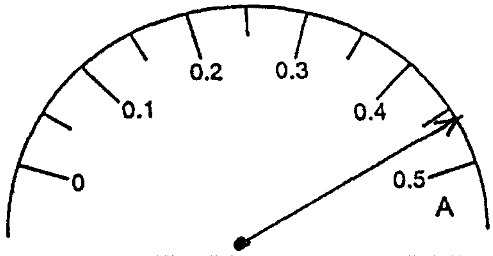
(ii) $t = \frac{120}{6} = 20$ mm

---

2. (a)



(b) (i)



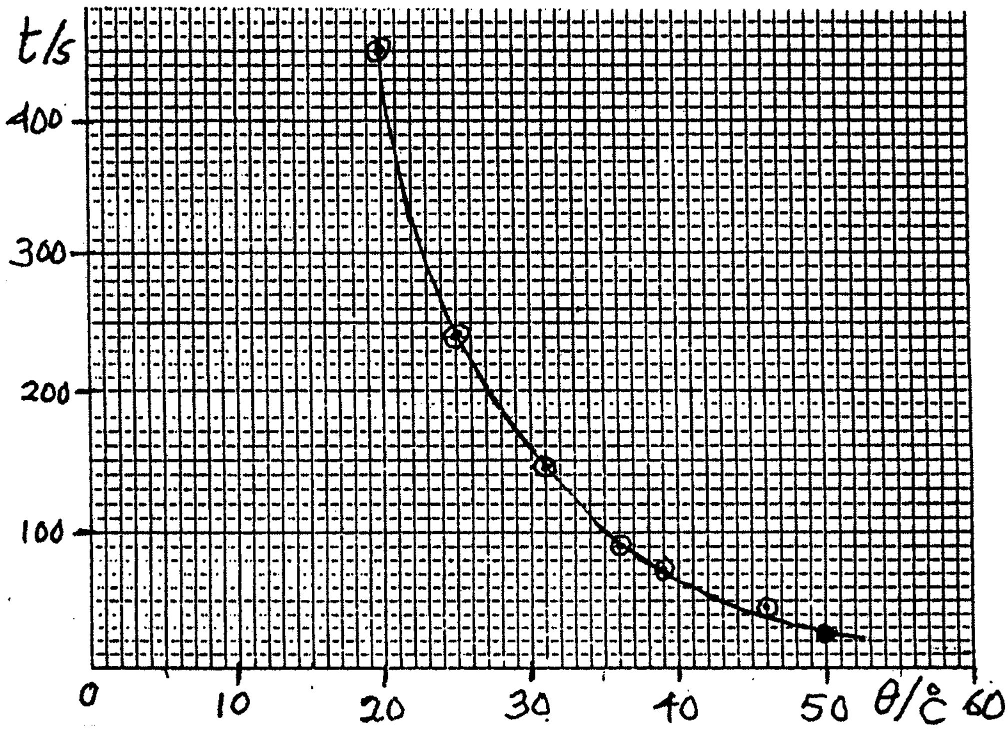
(ii) The range = 0.5 A

(c) $R = \frac{V}{I} = \frac{6.0}{0.46} = 13\ \Omega$

---

3. (a) 1. Use the same mass of sugar in each test.
2. Use the same mass of water in each test.
3. Keep the room temperature constant during the experiment.

(b)



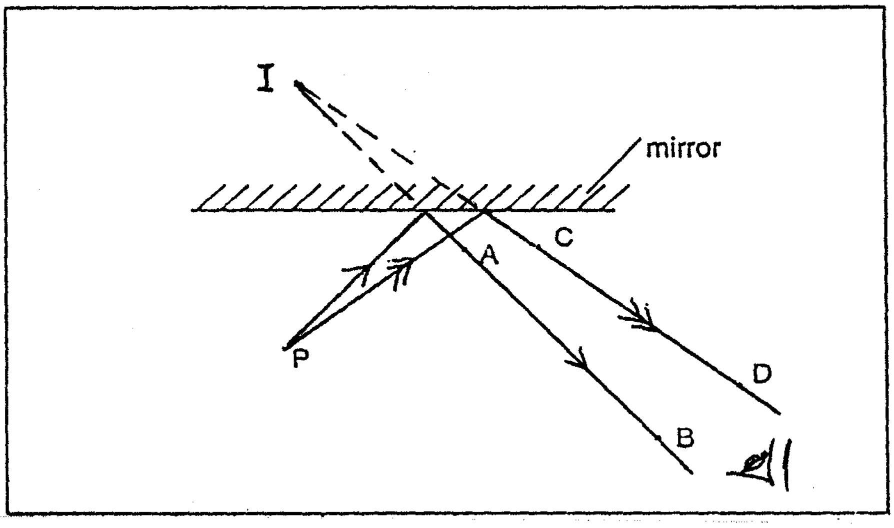
(c) (i) When the temperature is increased, the time needed is decreased.

(ii) $$\frac{\text{dissolving time at } 20°C}{\text{dissolving time at } 30°C} = \frac{450}{158} = 2.85$$

$$\frac{\text{dissolving time at } 40°C}{\text{dissolving time at } 50°C} = \frac{65}{24} = 2.7$$

(iii) ratio is about 2

4.(a)



(b) The image is virtual.
The light rays reflected from the mirror to the eye are diverging, the real rays do not produce an image ; the extensions of the rays meet and produce a virtual image behind the mirror.

---

5. (a) volume reading = 24 cm^3

(b) ... to get the average value of the constant using several readings from the graph.
The average value is more accurate.

(c) (i) 1. p = 200 kPa   V = 22 cm^3
pV = 4400

2. V = 37 cm^3 P = 120 kPa
pV = 4440

(ii) average pV = 4420
$\therefore$ 4420 = p x 18
p = 246 kPa

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Paper 1

1	C	11	A	21	A	31	D
2	B	12	C	22	B	32	A
3	D	13	C	23	A	33	D
4	C	14	C	24	C	34	A
5	C	15	D	25	D	35	A
6	B	16	A	26	A	36	A
7	D	17	A	27	B	37	C
8	B	18	C	28	C	38	B
9	B	19	D	29	B	39	A
10	D	20	C	30	C	40	A

November 2002

Paper 2

1. (a) (i)

The total energy is greater in B than in A.	☑
The total energy is the same in B and in A.	☐
The total energy is less in B than in A.	☐

(ii) The suitcase at B gains gravitational potential energy because it higher than that at A.

(b) (i)

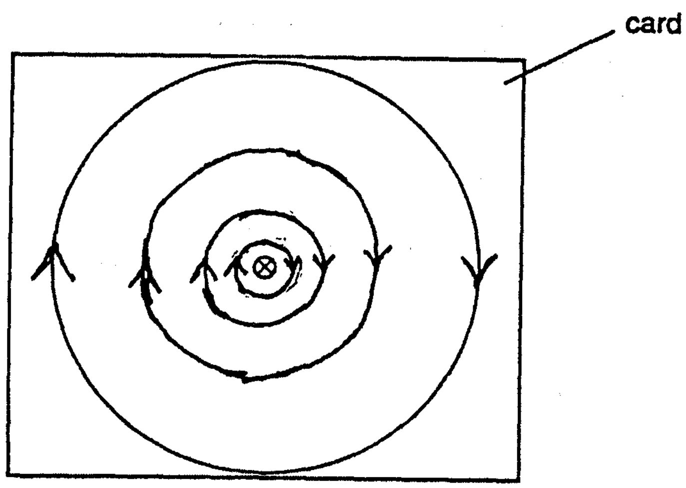
The total energy is greater in C than in B.	☑
The total energy is the same in C and B.	☐
The total energy is less in C than in B.	☐

(ii) At C, it has some extra kinetic energy due to its motion on the belt.

---

2. (a) insulator.
(b) radiation.
(c) conductor.
(d) convection.

3.



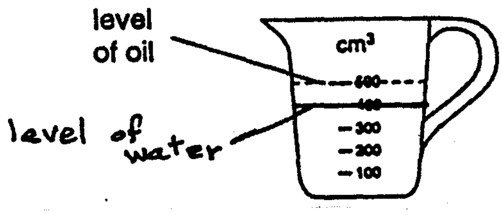
---

4. (a) (i) mass of oil $= 1020 - 610 = 410$ g

(ii) density of oil $= \dfrac{m}{v} = \dfrac{410}{500} = 0.82 \text{ g} / cm^3$

(iii) by using a narrow measuring cylinder, having smaller scale divisions.

(b)



---

5. (a) The number of protons and neutrons in the nucleus may change. Also, the energy of the nucleus may change.

(b) It takes two half-lives
Time $= 2 \times 28$ years $= 56$ years.

---

6. (a) The melting point is the temperature at which the substance changes from the solid state to the liquid state.

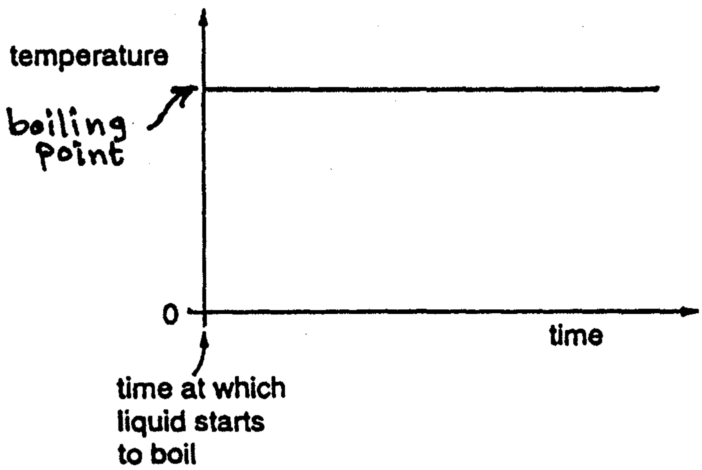
(b)

boiling point of iron ☐

freezing (solidifying) point of iron ☑

melting point of iron ☑

(c)



---

7. (a) Rub the polythene rod with the dry cotton cloth.
   (b) The charged rod can attract light objects like dust or fluff.
   (c) The electric field is the region where an electric charge experiences a force.
   (d) (i) It is repelled away.
       (ii) Like charges repel each other.
   (e) The produced charge escapes from the conducting copper rod to the hand then to the earth.

---

8. (a) in Volts.
   (b) potential difference = current x resistance.

$$V = I \, . \, R$$

   (c) $V = 0.5 \times 4.7 = 2.35 \text{ V}$
   (d) (i) increases
       (ii) decreases
   (e) R of variable resistor $= 10.0 - 4.7 = 5.3 \ \Omega$

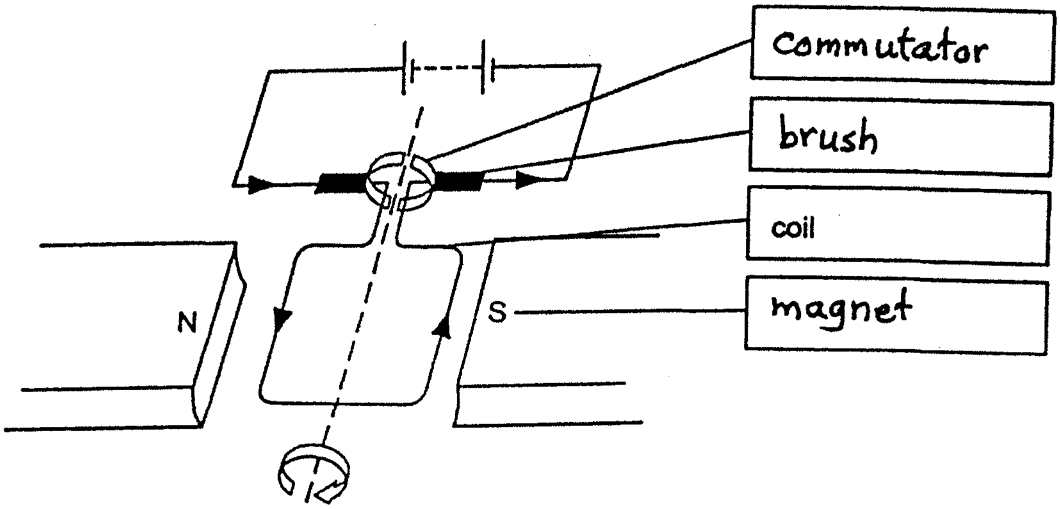
---

9. (a) to avoid any reflection of sound wave on surfaces of buildings.
   (b) so that the time would be long enough to be measured accurately.
   (c) long measuring tapes.
   (d) because the speed of sound is much smaller than the speed of light.
   (e) speed $= \dfrac{\text{distance travelled}}{\text{time taken}} = \dfrac{238}{0.7} = 340 \text{ m / s}$
   (f) to avoid the effect of air speed (wind) on the speed of sound measured.

---

10. (a) (i) The hanging rod moves (swings) to the left towards the inside of the magnet.
        (ii) The electric current in the copper rod is perpendicular to the magnetic field of the magnet, this produces a force which is perpendicular to both the current and the magnetic field which pushes the rod inwards according to Fleming's left-hand rule.
        (iii) The rod swing in the opposite direction (away from the magnet).

(b) (i)



(ii) The commutator

(iii) This reverses the direction of rotation.

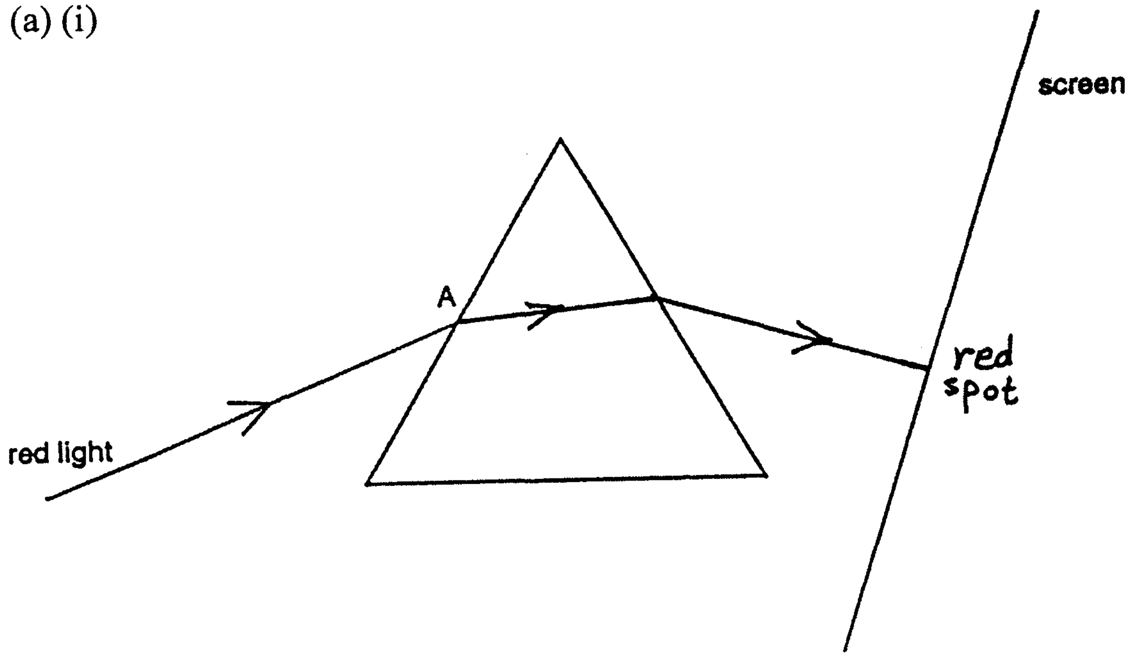
---

11. (a) When S is closed the current in the solenoid creates a magnetic field which magnetises the iron reed producing unlike poles at their close ends causing them to attract each other and touch each other.

(b) When the temperature rises, the resistance of thermistor decreases and the current increases in the soleniod producing a large magnetic field which magnetises the reeds and closes the circuit of the warning lamp so it lights.

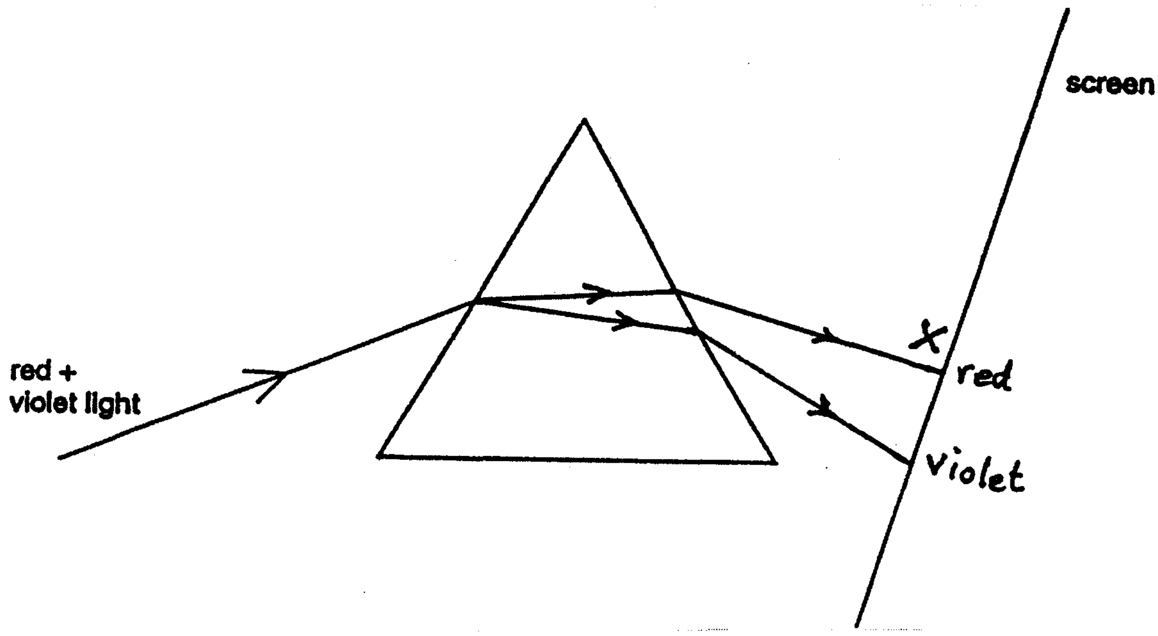
---

12. (a) (i)



(ii) refraction.

(b)



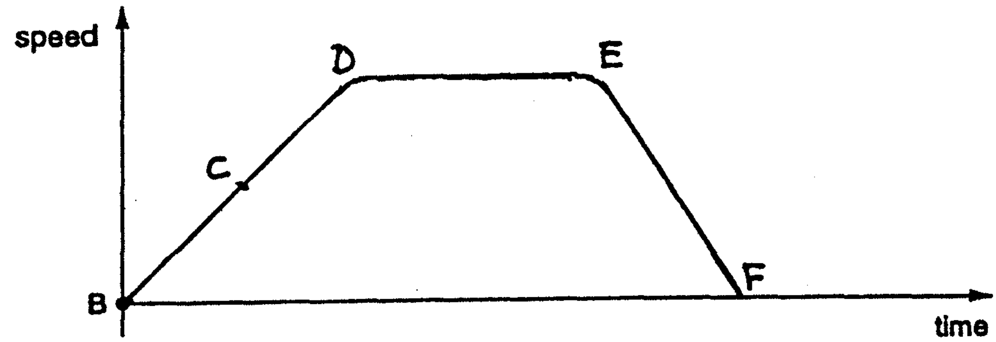
(c) Seven colours are seen on the screen :
red - orange - yellow - green - blue - indigo & violet.

(d) (ii) infra-red rays are invisible rays.
(iii) They can be detected by a "thermopile" or by a blackened-bulb thermometer.

November 2002

Paper 3

1. (a)



(b) (i) Work done $= m\ g\ h$

$= 0.2 \times 10 \times 0.6 = 1.2$ J

(ii) kinetic energy $= \frac{1}{2} mv^2$

$= \frac{1}{2} \times 0.2 \times (2.5)^2$

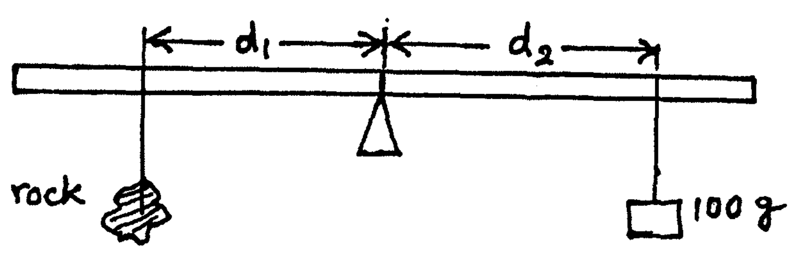
$= 0.625$ J

(c) The speed is a scalar value, it did not change at D because its value remained constant. But velocity is a vector quantity which depends on the value and the direction, therefore the velocity changes at D because the direction has changed.

(d) As the block moves from E to F, it loses some energy as heat due to friction on the rough surface E F, thus the block cannot reach the same level of B because of energy lost.

---

2. (a) (i)



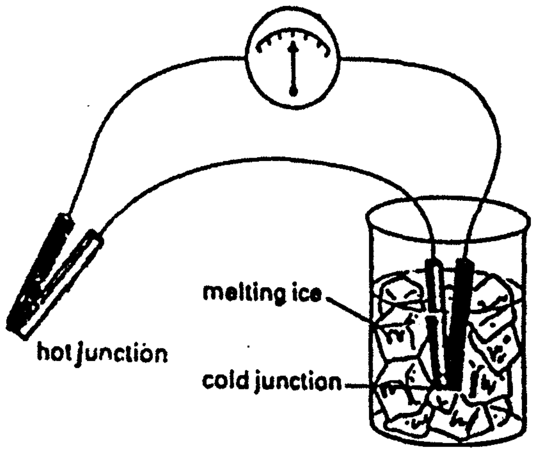
(ii) The distance from rock to pivot (d_1 cm)
The distance from 100 g mass pivot (d_2 cm)
m (rock) x d_1 = 100 g x d_2

(b) 1. Place the measuring cylinder on a horizontal surface,
2. Fill half the cylinder with water and record its value V_1,
3. Lower the rock gently in the water (using a piece of cotton string) and record the new volume of water V_2
4. The volume of rock V = V_2 - V_1

(c) density of rock $= \frac{m}{V} = \frac{88}{24} = 3.67\ g/cm^3$

---

3. (a)



(b) (i) Place one junction of thermocouple in pure melting ice (0° C) and place the other junction touching the inner wall of the pottery kiln. Record the value given by the milli-voltmeter and use a calibration curve to determine the temperature of the wall.
(ii) The difference in temperature, between the two junctions of the thermocouple, produces an electric potential difference V which is proportional to temperature difference.

(c) 1. When measuring very high (or very low) temperatures.
2. When temperature measured is rapidly changing.

---

4. (a) (i) V I t = (m_1 - m_2) L

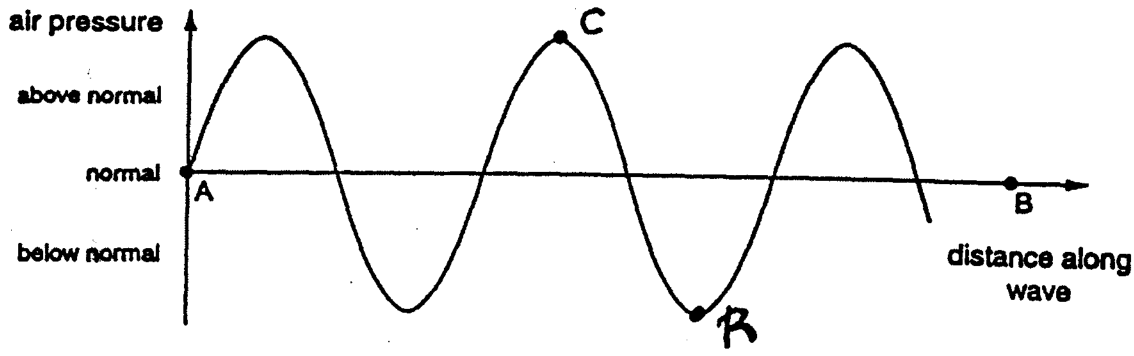
(ii) $L = \frac{VIt}{(m_1 - m_2)} = \frac{12 \times 2 \times 3750}{(0.120 - 0.080)}$

Specific latent neat = 3 x 10^6 J / kg

(b) The specific latent heat of water has a high value sufficient to overcome all the bonds between each particle all its neighbours and to move the molecules farther apart forming a gas state.

---

5. (a) (i)



(ii) it equals <u>half</u> a wavelength.

(b) $V = f \times \lambda$

$$f = \frac{V}{\lambda} = \frac{340}{1.3} = 261.5 \text{ Hz}$$

---

6. (a) (i) critical angle $= 43°$

(ii) critical angle of light in glass is the angle of incidence of light in glass which has an angle of refraction in air equal to $90°$. (The refracted ray is tangent to the surface of the two media).

(b) (i) speed $= 3.0 \times 10^8$ m / s

(ii) refractive index $= \dfrac{\text{speed of light in air}}{\text{speed of light in glass}}$

$$= \frac{3.0\times10^8}{2.0\times10^8} = 1.5$$

(iii) because the ray QY is perpendicular to the surface of glass at Y.

(iv) its speed increases as it goes into air.

---

7. (a) (i) Steel

(ii) Place the steel bar inside (along) the cardboard tube and switch on the circuit. Use the rheostat to increase the current to a suitable value. After few minutes, switch off the circuit and remove the steel bar which has been magnetized permanently.

(iii) The variable resister is set to its maximum value before we switch on the circuit. When circuit is on, reduce the resistance of rheostat gradually while watching the current on the ammeter until you get the suitable value desired.

(b) (i) resistance $= \frac{V}{I} = \frac{12}{4} = 3\ \Omega$

(ii) Power $=$ VI $= 12 \times 4 = 48$ W

(iii) Energy $=$ VIt $= 12 \times 4 \times 5 = 240$ J

(c) (i) p.d. $= 12 - 7 = 5$ V

(ii) Total voltage of power supply (e.m.f) equals the sum of potential differences of all components in the circuit.

$$\text{emf} = V_1 + V_2 + \ldots..$$

---

8. (a) from N to S (to the right)

(b) (i) it moves in downward direction.

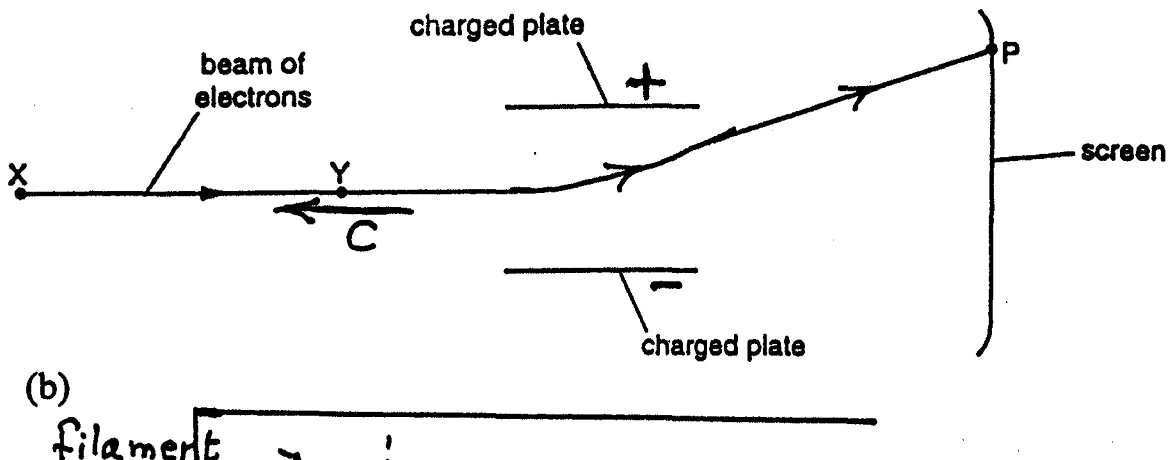
(ii) By using Fleming's left-hand rule :

1. Forefinger points in direction of magnetic field,
2. Second finger points in direction of current, then
3. Thumb points in direction of Force (motion).

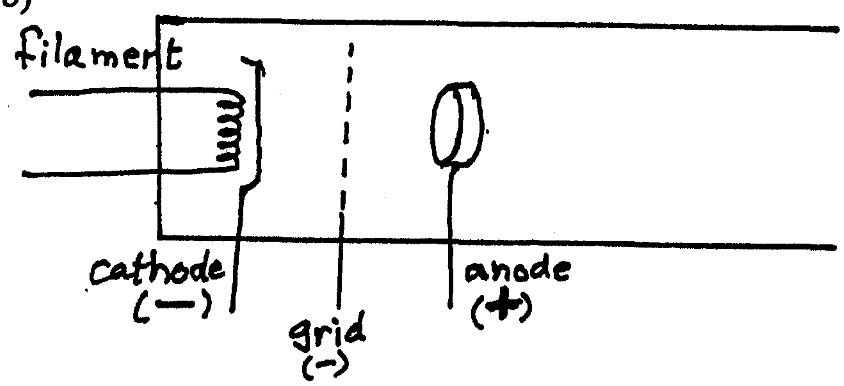
(c) change 1 : The wire should take the shape of a rectangular coil,
change 2 : the two ends of the coil should be connected to a commutator.

---

9. (a)

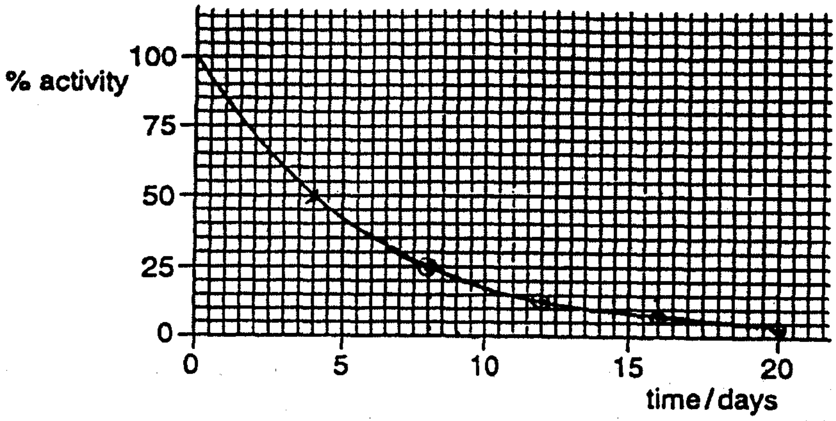


(b)



10. (a) half-life = 4 days

(b)



at 8 days, the activity is 25 %
at 12 days, the activity is 12.5 %
at 16 days, the activity is 6.2 %
at 20 days, the activity is 3.1 %

(c) After 1 day the activity of source is 85 %
After 20 days the activity of source is 3.1 % which much smaller and thus much safer.

(d) ${}^{A}_{Z}X \rightarrow {}^{0}_{-1}e + {}^{A}_{Z+1}Y$

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Paper 6

1. (a) (i) 6.0 cm

(ii) $d = \dfrac{6.0}{12} = 0.5$ cm

(iii) $V = \dfrac{\pi(0.5)^3}{6} = 0.065\ cm^3$

(b) (i) $V_1 = 80\ cm^3$

$V_2 = 96\ cm^3$

(ii) $V = V_2 - V_1$

$= 96 - 80 = 16\ cm^3$

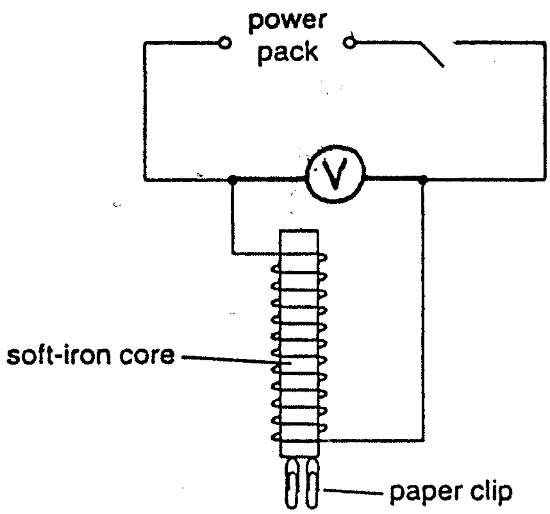
Volume $= 16\ cm^3$

(iii) $V = \dfrac{16}{225} = 0.071\ cm^3$

(c) Method 2 gives more accurate result, because it gives the average volume of one glass bead from the volume of a very large number of beads.

---

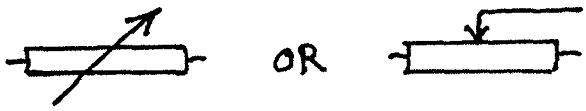
2. (a)



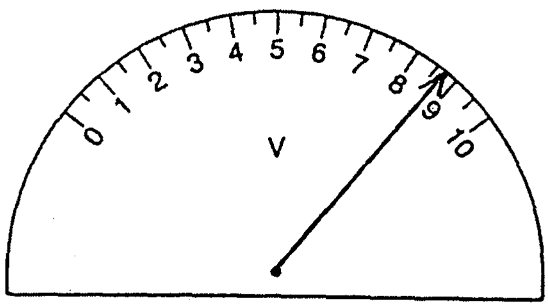
(b) (i) student B ✓

(ii) The poteutial difference (V) was measured more accurately by student B, he used an extra decimal figure.

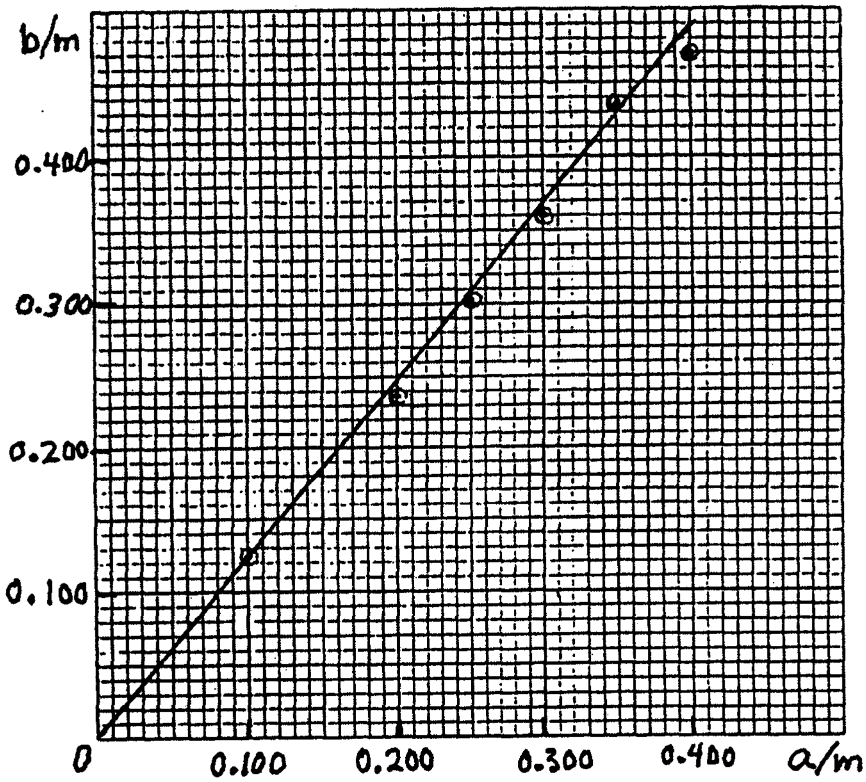
(c)



(d)



3. (a) (i,ii)



(iii) $G = \dfrac{0.360}{0.300} = 1.2$

(iv) $W = XG = 5.0 \times 1.2 = 6.0$ N

(v) If a = 0.450 m, the value needed for b would be more than 0.500 m which is available for b using a metre rule.

(b) He can stick a small piece of plaslicine on the left side of the rule (mear the zero mark) to allow the unloaded rule to balance at the 0.5 m mark.

---

4. (a) (i) heat loss during experiment.
   (ii) 1. use a thermal insulator like felt or expanded polystyrene around the beaker to reduce thermal loss,
   2. Calculate the amount of heat gained by the beaker itself.

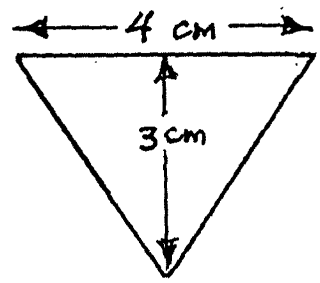
(b) 38° C

(c) P = V I = 12.0 x 5.5 = 66.0 W

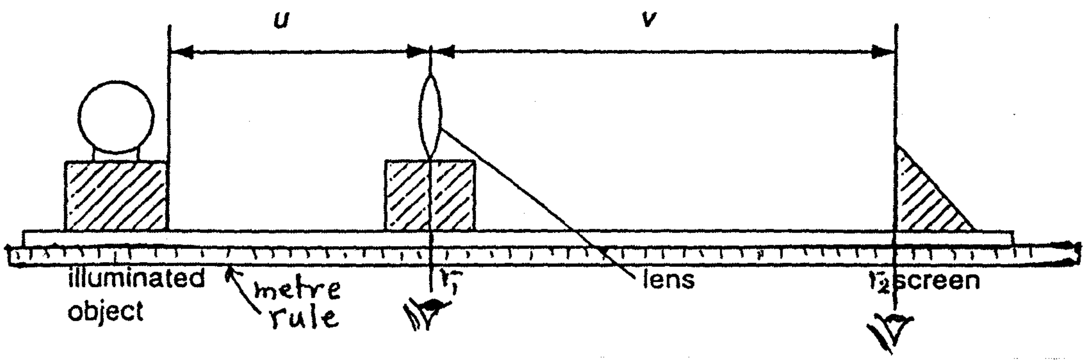
---

5. (a) (i) $m = \frac{v}{u} = \frac{72.3}{35.0} = 2.1$

(ii)



(b)



Place a metre rule close to the base apparatus and take a reading, r_1, at the centre of the lens and another reading, r_2, at the surface of the screen, then v = (r_2 - r_1).

CORRECTIONS

* **Page 28 :** Problem 3. (a)
add, (missing frequency) = 200

* **Page 214 :** Problem 4. (e)

(i) $\frac{V_1}{V_2} = \frac{N_1}{N_2}$, $\frac{400}{33000} = \frac{500}{N_2}$

$N_2 = 41250$ turns

(ii) The power output should be less than 275 KW due to the Power loss in the transformer. Some of the electric energy is converted to heat energy in the coils and core of the transformer.

* **Page 239 :** Problem 6. (b)

(b) Inverted in the vertical direction.
(and upright in the horizontal direction)

* **Page 246 :** Problem 3. (a) (iii)

(iii) The distance the storm moved in 4 min = 408 m

$$\text{speed of storm} = \frac{408}{4} = 102 \text{ m/min.}$$

$$= 102 \times \frac{60}{1000} = 6.12 \text{ Km/h}$$

* **Paper 1 :** **Page 119 :** Nov. 93, answer no. 19 is C.
Page 188 : Nov. 95, answer no. 32 is D.