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London Examinations IGCSE

Physics (4220)

Exemplar candidate responses from the May 2005 examination session

March 2006

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Exemplar candidate responses

London Examinations IGCSE

Physics

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Paper 2H

Question 1

Leave blank

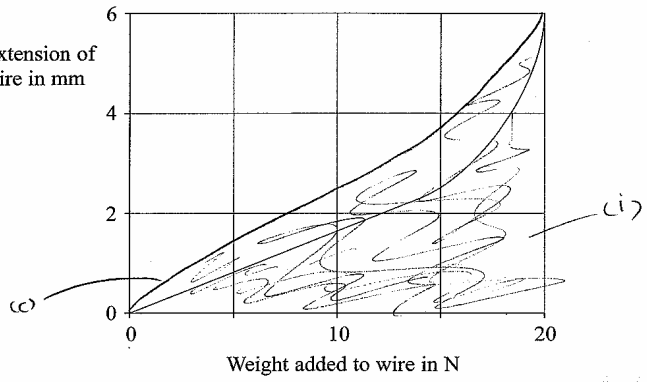
1. (a) A student wants to use metal wire as part of a model bridge that she is building. To test if a wire is suitable she hangs a mass of 0.5 kg from it and measures its extension. Calculate the weight in newtons of the 0.5 kg mass. 0.5 x 10 = 5 N

N = mg → 5 x 10 = 50 N

Weight = 50 N

(2)

(b) She continues to add masses to the end of the wire. The graph shows the results of her experiment.



(i) Indicate on the graph the region associated with Hooke's law.
extention ∝ $tretching force

(1)

(ii) Explain your answer.

the extention at this point is directly proportional to the strecking force

(1)

(c) The student thinks the wire is too weak and decides to replace it with a thicker wire of the same material and length. She tests it in the same way as before by hanging masses from its end.
Show her possible results on the axes above. → steeper line

(2)

Q1

(Total 6 marks)

Question 1 (out of 6)

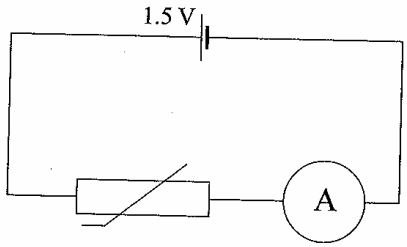
Calculation of the weight of a 0.5 kg mass gives rise to common errors such as 0.5 x 10 = 50 N and 5 x 10 = 50 N.
A mark was given for the use of W = m x g in (a). Identification of a Hooke's law region on a force-extension graph often causes problems even to those candidates who do know the answer. Using the axes to represent a material of different length and/or thickness proves difficult for most candidates.

Question 1 (score 2) **D standard**
5 x 10 = 50 N scores 1. Although the candidate knows that force is proportional to extension this is not indicated on the graph in (b)(i). Both marks are lost in (c) for a line above the original one.

Question 2

Leave blank

2. The circuit below contains a 1.5 V dry cell, an ammeter and a thermistor at room temperature.



(a) At room temperature, the resistance of the thermistor is 1000 Ω.
Calculate the current, in amps.

$\therefore R = \frac{V}{I} \therefore I = \frac{V}{R} \therefore I = \frac{1.5}{1000} = 1.5 \times 10^{-03}$

Current = 1.5×10^{-03} A

(3)

(b) What happens to the resistance of the thermistor as its temperature increases?

as the temperature increas the resistance increase

(1)

(c) What happens to the current as the temperature of the thermistor increases?

The current decrease ecf

(1)

Q2

(Total 5 marks)

4

Question 2 (out of 5)

Calculation of I given values of V and R. Recall that resistance of a thermistor decreases as temperature increases and that current increases as a result.

Question 2 (score 4) **C standard**
The effect of temperature on resistance has been reversed and is incorrect but the error is carried forward in (c). This still represents work at a high level for this section.

Question 3

Leave blank

3. The diagram represents the electromagnetic spectrum.

Gamma-rays	X-rays	Ultraviolet	Visible	Infra-red	Microwaves	Radio waves

(a) Which of X-rays and radio waves has the longer wavelength?

Radio waves ✓

(1)

(b) Which of X-rays and radio waves has the higher frequency?

X-rays ✓

(1)

(c) State one use of X-rays.

To see if there are stones in meat etc ✓

(1)

(d) State one property that all electromagnetic waves have in common.

They all travel in a straight line ✗

(1)

(e) State the law of reflection.

Angle of Incidence is equal to angle of Reflection ✓

(1)

(f) A teacher wants to demonstrate the law of reflection to his class.
Suggest two reasons why he should use visible light rather than X-rays.

1 X-rays will pass through the glass while visible light can ✓

2 X-rays can cause Sterility & ionisation of one cells.

– X rays have high penetrating power than light ✓

(2)

(Total 7 marks)

Q3 4

Question 3 (out of 7)

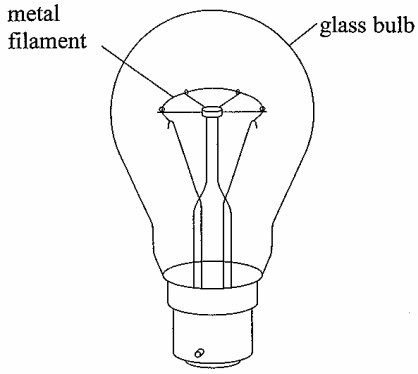
This question relies on the recall of properties of electromagnetic waves and reflection.

Question 3 (score 4) **C standard**
This candidate did not know a use for X-rays, a property common to all electromagnetic waves or a second reason for not using X-rays to demonstrate reflection.

Question 4

Leave blank

4.



(a) A metal filament lamp is switched on.
Complete the boxes to show the energy transfer that occurs.

Chemical energy → Electrical and light energy

(3)

(b) The lamp is rated at 100 W and is left on for 30 seconds.
How much energy, in joules, is transferred to the lamp?

P = work done / Time taken 100 = W.D / 30 ×30

Energy transferred = 3000.0 J

(2)

(c) The lamp is only 5% efficient. What does this mean?

The lamp has lost alot of energy and heat and mads why Efficiency is also not 100%

(2)

Q4

(Total 7 marks)

2

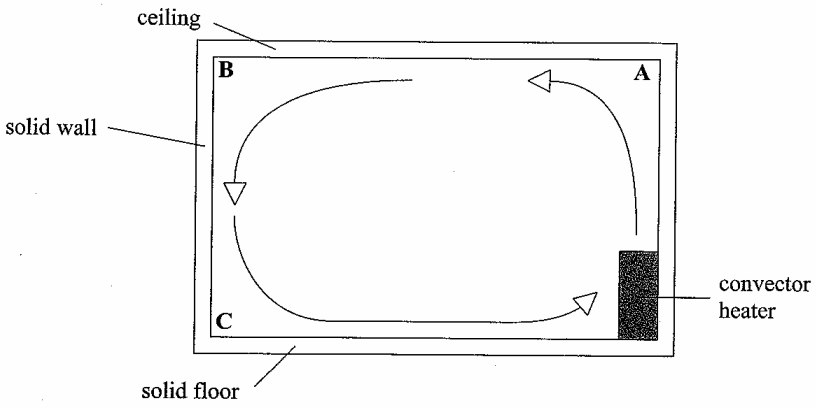
Question 4 (out of 7)

Show the energy transfer for a light bulb for 3 marks. Calculate the energy transferred to a 100W light bulb in 30s. Explain what is meant by 'the lamp is only 5% efficiency'.

Question 4 (score 2) **D standard**
'Chemical' energy has been used instead of 'electrical' energy in part (a). Also 1000 has been used instead of 100 in part (b). This error where different data is used for whatever reason (usually carelessness) will always be penalised. A mark cannot be scored for the formula because it is given on the inside front cover of the paper. A mark would have been awarded if the formula had needed to be transposed. The ideas presented on efficiency are not clear enough.

Question 5

5.



(a) The room shown is heated by a convector heater. The arrows show the direction of movement of the air within the room.
Is the highest temperature at **A** or **B** or **C**?

A

(1)

(b) The room has a floor area of 20 m^2. The height of the room is 3 m and it contains air of mass 72 kg.
Calculate the density, in kilograms per cubic metre, of the air in the room.

$20 \times 3 = 60\ m^3$

$\rho = \frac{m}{V} = \frac{72}{60} = 1.2\ kg/m^3$

Density = 1.2 kg/m^3

(3)

(c) The density of air changes with temperature.
Is the density of air lowest at **A** or **B** or **C**?

C

(1)

(d) Some heat energy within the room is transferred through the solid floor.
Name the energy transfer process taking place.

Convention

(1)

(Total 6 marks)

blank

Q5

Question 5 (out of 6)

This shows the movement of air in a room heated by a convector heater. There is calculation of the density of air in the room and the regions of greatest temperature and lowest air density have to be located.

Question 5 (score 4) **C standard**
In part (c) there is a common error. The region of lowest air density is **A** being the same as the answer to part (a). Many candidates associated the term lowest in (c) with the lowest part of the room and answered **C** instead of **A**. This candidate has answered 'convention' meaning 'convection' but the correct answer is 'conduction'. It is always best to learn to use the correct term! An answer like 'convuction' would have been penalised even though it is also only one letter different from the correct answer.

Question 6

Leave blank

6. A technician measures the activity of a radioactive source.
The activity is 400 Bq. After 20 minutes the activity decreases to 100 Bq.

(a) Calculate the half-life, in minutes, of the radioactive source.

400 ÷ 20 = 20.0 400 → 100 20 mins

400 → 200 10 mins

Half-life = 10 minutes
(2)

(b) Why is this source unsuitable for dating archaeological specimens?

It decays too fast
(1)

(c) The technician continues measuring the activity from the source. The measured activity does not drop below a certain value due to background radiation.
Name two sources of background radiation.

1 Cosmic waves

2 radio active rocks
(2)

Q6

(Total 5 marks)

5

Question 6 (out of 5)

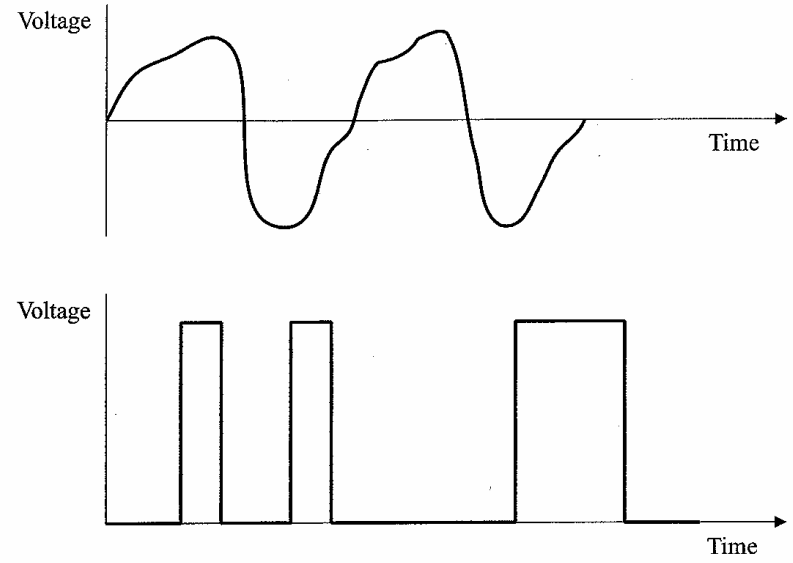
This involves a calculation of the half-life of a radioactive from two values of activity at different times. Reasons for the unsuitability of the source due to its short half-life are sought and two sources of background radiation are also asked for.

Question 6 (score 5) **C standard**
This is a very good answer. The idea that 20 minutes represents two half lives is understood. It is a good idea to state this because it is worth a mark by itself. Part (b) shows further understanding of what half life means. Part (c) is recall.

Question 7

Leave blank

7. The diagram shows an example of an analogue signal and an example of a digital signal.



Complete the sentences.

(a) The analogue signal varies ..... voltage ..... between a maximum and minimum value.

(1)

(b) The digital signal only has two values. These are 1 which corresponds to

..... on ..... and ..... off ..... which corresponds to ..... time .....

(3)

(Total 4 marks)

Q7

Question 7 (out of 4)

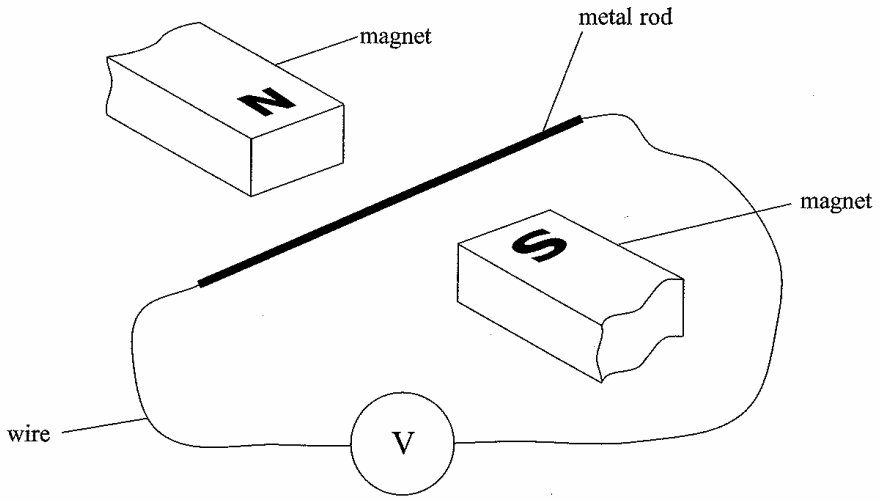
No candidates scored full marks on this question.

Question 7 (score 2) **C standard**
This shows a knowledge of ON and OFF but has filled the other two gaps with the labels of the graphs (voltage and time) given. This was a very common response.

Question 8

Leave blank

8. A physics teacher uses the apparatus shown in a demonstration to her class.



She moves the metal rod upwards and the voltmeter briefly shows a small reading.

(a) Why does the voltmeter show a reading?

Voltage is induced (in the wire because) when a conductor is moving in a magnetic field, it cuts through the magnetic fields and induces voltage.

(3)

(b) A boy standing at the back of the class complains that he cannot read the voltmeter. Suggest two ways in which the teacher could use the same apparatus to produce a bigger reading on the voltmeter.

1 By increasing the magnetic field

2 By moving the wire faster.

(2)

(Total 5 marks)

Q8

4

Question 8 (out of 5)

Candidates find the topic of electromagnetic induction difficult at all levels. The rod is a conductor and cuts magnetic field lines inducing a voltage. The term 'induce' is essential here and cannot be replaced with 'create' or 'produce'.

Question 8 (score 4) **C standard**
This shows an understanding of the topic and mentions the three important points in (a). In (b) the same apparatus must be used to increase the magnetic field. This is achieved by moving the magnets closer together. Stating that the magnetic field must be increased is insufficient.

Question 9

Leave blank

9. On a day when there is no wind, a rock falls from a very high cliff. It does not hit anything until it reaches the ground.

(a) Give the name and direction of each of the two forces, apart from upthrust, which act on the rock as it falls.

1 Gravity towards the earth

2 Air resistance against the rock

(2)

(b) One of the forces which acts on the rock changes significantly as the rock falls. Name the force and explain what happens.

Air resistance increases as the rock gains speed until the forces balance out and the terminal velocity is reached

(2)

(c) The mass of the rock is 450 kg. At one point in its fall the unbalanced force on the rock is 60 N.
Calculate the acceleration of the rock at this point and include its unit.

F = mass x acceleration 60 = 450 x a

$\frac{60}{450} = a$ 0.1333 or $\frac{2}{15}$

Acceleration = 0.1333 ms^{-2}

(3)

(d) After some time, the falling rock reaches its terminal velocity.

(i) Describe the motion of the rock when it is at terminal velocity.

The rock is falling at a constant speed

(1)

(ii) State the size of the unbalanced force on the rock as it falls at terminal velocity.

4500 N

(1)

Q9

(Total 9 marks)

Question 9 (out of 9)

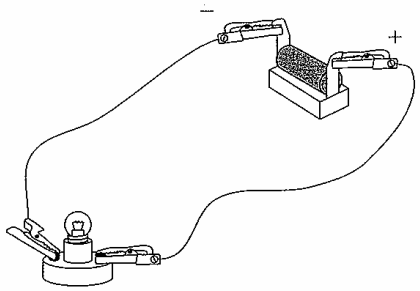
This is the first of the Higher Tier questions that test in the range B to A. With a total mark of 9 it requires a lot of descriptive work and a calculation. At this level candidates will be asked for units in their answers and may have to manipulate familiar equations to change the subject of the equation. Here a calculation is required from F = m x a.*

Question 9 (score 8) **A standard**
The last mark was lost for stating that the size of the unbalanced force at terminal velocity is equal to the weight of the body rather than zero.

Question 10

Leave blank

10. (a) The drawing shows an electrical circuit containing a cell, a lamp and some insulated copper wire with clips.



(i) A direct current passes through the circuit.

Name the particles that flow.

electrons (charges in Coulombs) ✓

Why do the particles flow from the negative terminal to the positive terminal?

Because they are opposite charges ✓

(2)

(ii) The circuit has a 1.5 V cell.

Complete the sentence by adding the names of the two missing units.

A volt is a ~~.....~~ Q of volt per second ✗

(1)

(b) A student has a reading lantern. It contains a 1.5 V rechargeable battery. The lantern uses solar cells to charge its battery during the day. The student switches on the lantern at night to read.

Use the relationship $E = I \times V \times t$ to calculate the average current from the battery when it delivers 216 J in 2.0 hours.
Show how you get your answer and include the unit.

$216 = I \times 1.5 \times 2 \times 60 \times 60$ ✓

$216 = 16800\ I$ ✓

$I = 0.02$ Amp. Average current = 0.02 Amp ✓

(3)

Q10 5 ✓

(Total 6 marks)

Question 10 (out of 6)

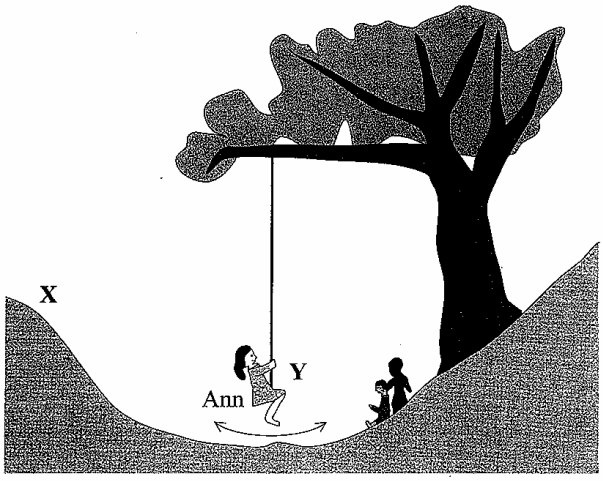
Recalling that electrons are negatively charged and flow from negative to positive and recalling the definition of the volt as a joule per coulomb.

Question10 (score 5) **A standard**
The definition of the volt is not well known. A mark has been missed in (a)(i) for not mentioning that electrons are negatively charged.`

Question 11

Leave blank

11. Some children are playing on a swing.



(a) Ann has a mass of 32 kg. At **Y** her kinetic energy is 784 J. Calculate her speed in m/s.

$g = 10 m/s^2$

Kinetic Energy = $\frac{1}{2}$ mass x velocity^2 = $E_k = \frac{1}{2} m v^2$

$784 = \frac{1}{2} 32 \times v^2$ 7 m/s

$\frac{784}{16} = v^2$ $49 = v^2$ $7 = v$

Speed = 7 m/s

(2)

✓✓2

(b) (i) Ann started her swing at **X**. How much more gravitational potential energy did Ann have at **X** than at **Y**?

E_p gained = E_p lost 784 J

(1)

✓1

(ii) State two assumptions which you made.

1 no energy is loss against frictional forces

✓

2 there is no air resistance

✓

(2)

✓2

(Total 5 marks)

Q11 5

5

Question 11 (out of 5)

Calculation of speed from a given value of kinetic energy is as difficult as it gets numerically. Always look out for situations where an amount of kinetic energy transfers to the same amount of gravitational energy and vice versa.

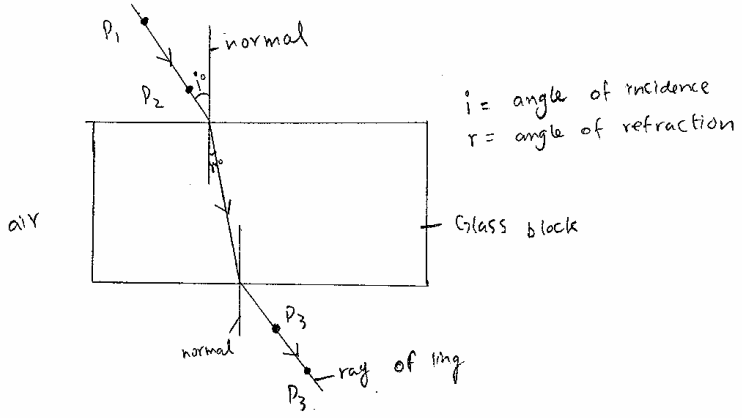
Question 11 (score 5) **A* standard**

A very good answer. There are many responses that can be awarded marks in (b)(ii).

Question 12

12. (a) A student uses a rectangular glass block to determine the refractive index of the glass.

(i) Describe the experiment. Draw a diagram to illustrate your answer.



Shine a ray of light through the glass block using a ray box and place two pins on the ray on the paper before the light enters the glass. And place two pins (remove the block) (joining the pins) after the ray leaves the block. Draw straight lines and measure the angles of incidence and refraction. Calculate the refractive index using this equation: $n = \frac{\sin i}{\sin r}$ **(4)**

(ii) The student finds that when the angle of incidence in the air is 68° the angle of refraction in the glass is 38°.

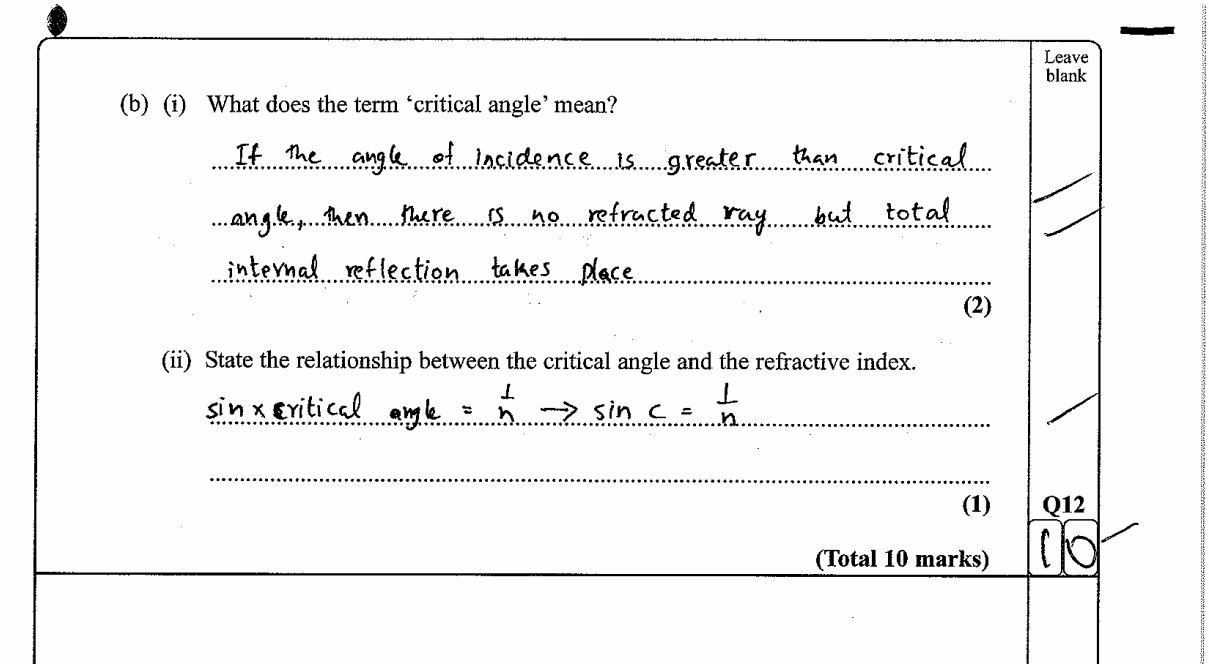
The table contains information about the two angles.

Angle	Cosine	Sine	Tangent
38°	0.79	0.62	0.78
68°	0.37	0.93	2.48

Calculate the refractive index of the glass.

$n = \frac{\sin i}{\sin r} = \frac{0.93}{0.62} = 1.5$

Refractive index = 1.5 **(3)**



(b) (i) What does the term 'critical angle' mean?

If the angle of incidence is greater than critical angle, then there is no refracted ray but total internal reflection takes place

(2)

(ii) State the relationship between the critical angle and the refractive index.

$\sin \times$ critical angle $= \frac{1}{n} \rightarrow \sin C = \frac{1}{n}$

(1)

(Total 10 marks)

Leave blank

Q12

10

Question 12 (out of 10)

This is one of several situations where a description of an experiment is required on the theory paper. Here it is refractive index. The others are speed of sound and density. A list of apparatus and a method are required. Learn them!

Question 12 (score 10) **A* standard**
A very good answer. The description in (a)(i) is very clear and the diagram is suitably labelled.

Question 13

13. A temperature of zero kelvin is sometimes described as absolute zero. It is equivalent to –273 °C and is the lowest possible temperature.

(a) Explain, in terms of particles, why absolute zero is the lowest possible temperature.

At absolute zero the particles stop moving, they have no kinetic energy.

(1)

(b) Calculate the kelvin temperature which is equivalent to 22 °C.

K = 0 °C = -273 K = 273 + 22

273 + 22 = 295

Kelvin temperature = 295 K

(1)

(c) There was a large fire at a factory. In one part of the factory a sealed gas cylinder exploded due to the high temperature. This cylinder was designed to withstand a pressure of 2000 kPa. Before the fire the pressure in the cylinder was 500 kPa at 22 °C.
Investigators concluded that the temperature in that part of the factory must have been over 900 °C.

Use the relationship $\frac{p_1}{T_1} = \frac{p_2}{T_2}$ to show whether or not the conclusion was correct.

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\frac{500}{22} = 22.7$ $22.7 = \frac{2000}{x}$

$\frac{2000}{22.7} = 88.1$ conclusion incorrect

The temperature would have only had to be over 88.1° for explosion.

(2)

(d) The average kinetic energy of the molecules of a sample of gas is doubled. What effect, if any, does this have on the kelvin temperature of the gas?

The kelvin temperature would also double

(1)

(Total 5 marks)

Q13

3

Question 13 (out of 5)

The topic of gas laws cause problems when the ideas of absolute zero and Kelvin temperature are not understood.

Question 13 (score 3) **B standard**
Temperature has not been converted to Kelvin even though candidates are led into it in part (b).

Question 14

Leave blank

14. (a) A family has a diesel generator. The output from the generator is 120 V a.c. They also have a transformer which will reduce the voltage from the generator to 6 V a.c.

(i) What do the letters a.c. stand for?

alternate current

(1)

(ii) Describe a.c.

A.C is the current moving and is constanly changing with respect to the time. *is used in the houses. **(1)**

(b) (i) Calculate the value of the output current, in amps, when the input current to the transformer is 1.5 A.

~~120~~ 120 × ~~x~~ 1.5 ⇒ $\frac{120 \times 1.5}{6} = 30$

~~6~~ 6

Current = 30 A

(2)

(ii) What assumption have you made?

~~The~~ When the voltage was 6 v mean the current is 1.5 A we want to find the 120 v so it is 30 A.

→ Ohm's law.

(1)

(Total 5 marks)

Q14

3

Question 14 (out of 5)

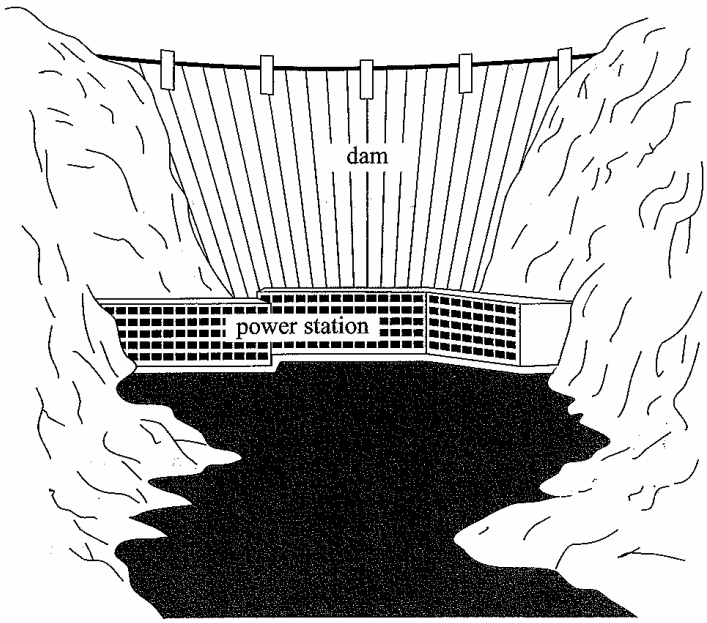
As with electromagnetic induction, the topic of transformers and a.c. is not well understood.

Question14 (score 3) **B standard**

'Alternate current' has been accepted as an answer instead of 'alternating current' but the correct term should always be given. The description of a.c. is inadequate (moving and constantly changing). This requires a reference to change of direction. This can also be answered successfully with a suitably labelled sinusoidal graph. The assumption behind this transformer calculation that it is 100% is not known. Instead the candidate thinks that it depends on Ohm's Law.

Question 15

15. The drawing shows a dam and a hydroelectric power station. Water from near the top of the dam flows through pipes to turbines in the power station.



(a) The dam wall needs to be thicker at the bottom than at the top.
Explain why.

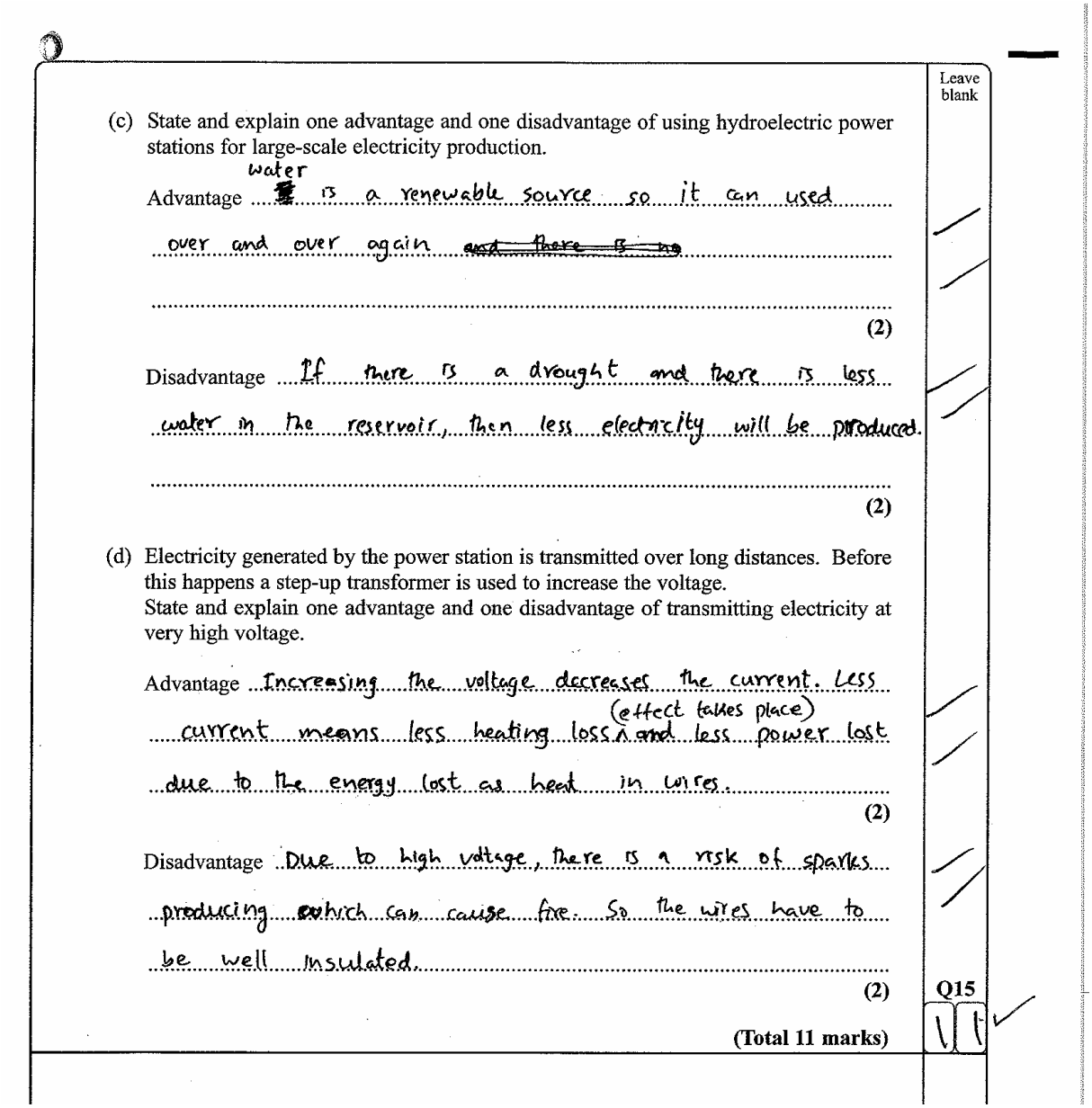
Pressure of a liquid (or fluid) increases with depth so a stronger wall is needed to withstand the higher pressure at the bottom of the dam.

(2)

(b) As water begins to flow through the pipes from near the top of the dam, a useful energy transfer takes place. Complete the boxes to show this energy transfer.

potential energy → kinetic energy

(1)



Leave blank

(c) State and explain one advantage and one disadvantage of using hydroelectric power stations for large-scale electricity production.

Advantage water is a renewable source so it can used over and over again ~~and there is no~~

(2)

Disadvantage If there is a drought and there is less water in the reservoir, then less electricity will be produced.

(2)

(d) Electricity generated by the power station is transmitted over long distances. Before this happens a step-up transformer is used to increase the voltage.
State and explain one advantage and one disadvantage of transmitting electricity at very high voltage.

Advantage Increasing the voltage decreases the current. Less current means less heating loss (effect takes place) and less power lost due to the energy lost as heat in wires.

(2)

Disadvantage Due to high voltage, there is a risk of sparks producing which can cause fire. So the wires have to be well insulated.

(2)

Q15

(Total 11 marks)

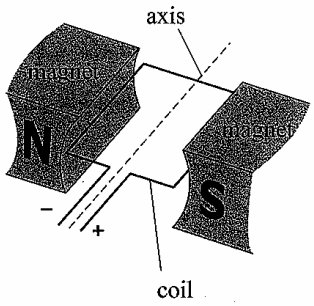
Question 15 (out of 11)

Detailed questions on renewable energy sources are not well answered, in particular their disadvantages.

Question 15 (score 11) **A* standard**
A very good answer. Not many candidates made the point that not only is the pressure of the water greatest at the bottom but that is where the wall must be at its strongest. In (c) and (d) most candidates found it difficult to propose two advantages and two disadvantages of using hydroelectric power and also two advantages and disadvantages of transmitting electricity at very high voltages.

Question 16

16. The diagram shows part of a simple electric motor.



The motor is connected to a d.c. power supply.

(a) A student predicts that, when the motor is switched on, the coil will turn in a clockwise direction.

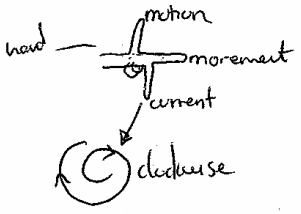
(i) Name the rule which the student could use to make this prediction.

flemings ~~left~~ right hand rule

(1)

(ii) Explain how the rule shows that the coil will turn in a clockwise direction.
You may add to the diagram or draw another diagram to help you explain.

with this rule the direction of the current is shown with the 2nd finger ∴ it turns clockwise.



(2)

(iii) Suggest one change which would make the coil turn faster.

add more turns to the coil

(1)

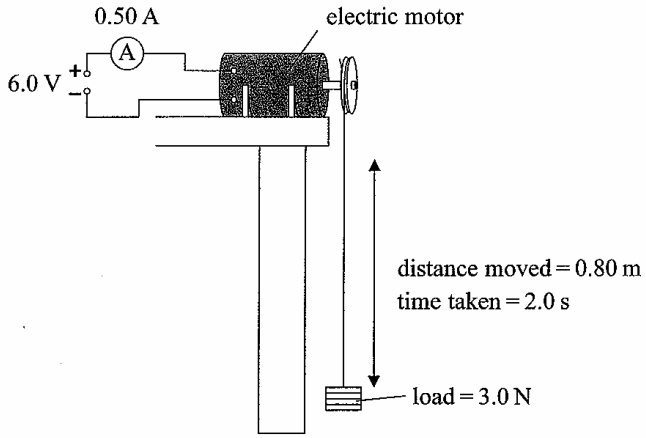
(iv) Suggest one change which would make the coil turn in the opposite direction.

reverse the polarity of the magnet

(1)

Leave blank

(b) The diagram shows an electric motor lifting a load.



Use information from the diagram to answer the following questions.

(i) Calculate the useful work done in lifting the load 0.80 m, and include the unit.

(S)
work done = distance x force

→ 3 x 0.80 = 2.4 Joules(S)

Work done = 2.4 S

(3)

(ii) How much useful energy was transferred to lift the load?

energy transferred = current x voltage x time

E = 6 x 0.5 = 3(J) 0.50 x 6.0 x 2 = 6(J)

(1)

(iii) The total energy transferred by the electric motor was 6.0 J.
Suggest two reasons for the difference between this value and your answer to (ii).

1 the useful energy is less than the total because it may be converted to something else

2 heat loss

(2)

(Total 11 marks)

Q16

Question 16 (out of 11)

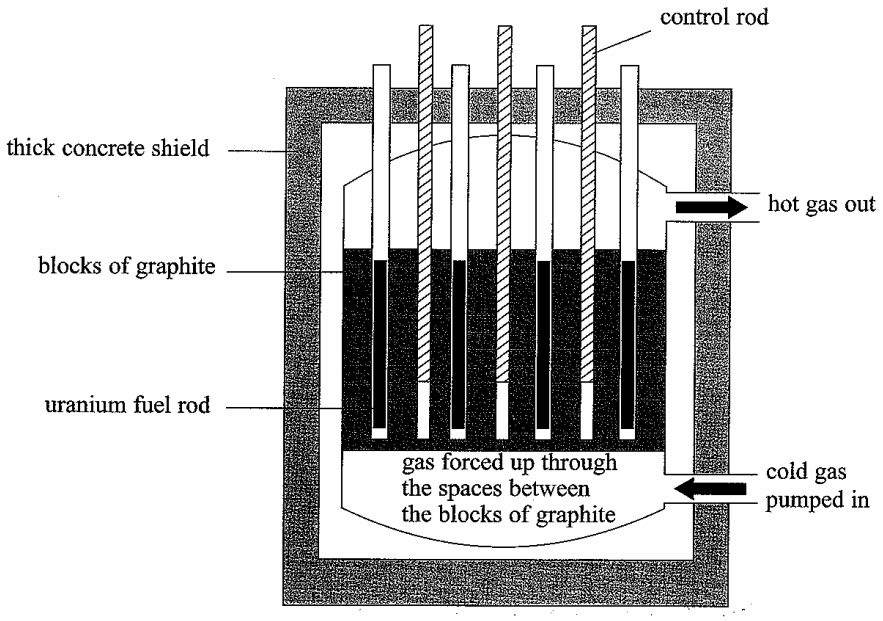
This asks for the left hand rule as the principle of the electric motor and its demonstration in a particular situation. The question provides a lot of data to enable the calculation of the work done by a motor in lifting a load.

Question16 (score 7) **C standard**
The right hand rule is wrongly given but the calculation is correct. This is a good example of knowing enough physics to merit a safe grade C.

Question 17

Leave blank

17. The diagram shows the inside of a gas-cooled nuclear reactor.



(a) What is the form of the main energy output from the reactor?

Thermal energy

(1)

(b) Complete the sentence.

The nuclear reaction which takes place in the reactor is an example of a

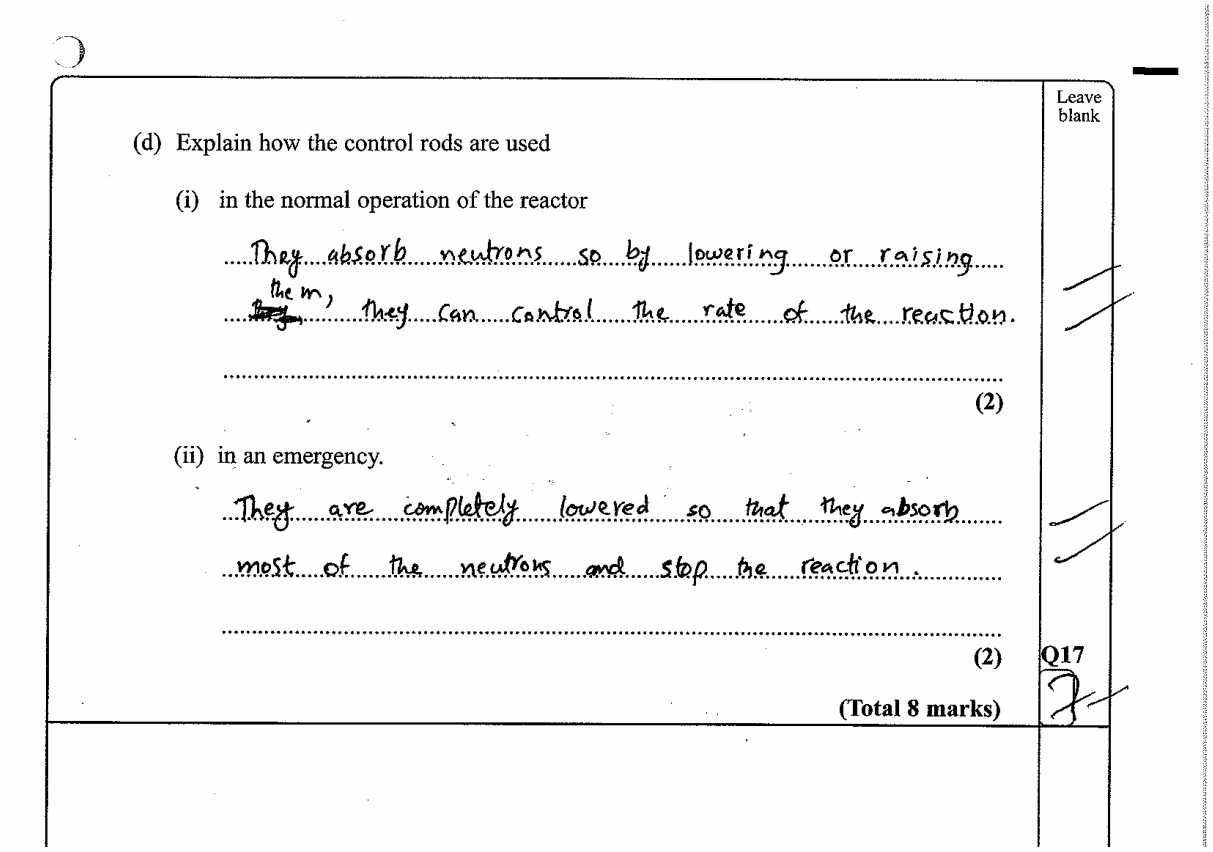
Fission reaction.

(1)

(c) Explain why the blocks are made of graphite.

They absorb neutrons and slow them down so that not a lot of neutrons are absorbed by uranium. ∴ the control the reaction and keep it safe.

(2)



Leave blank

(d) Explain how the control rods are used

(i) in the normal operation of the reactor

They absorb neutrons so by lowering or raising them, they can control the rate of the reaction.

(2)

(ii) in an emergency.

They are completely lowered so that they absorb most of the neutrons and stop the reaction.

(2)

Q17

7

(Total 8 marks)

Question 17 (out of 8)

A descriptive question on a nuclear reactor requiring some knowledge of the function of the moderator and the control rods.

Question 17 (score 7) **A* standard**
A good answer. One mark was lost in (a) for why the blocks in a diagram of a nuclear reactor are made of graphite. They slow down neutrons (scores 1) so that not a lot are absorbed by uranium is incorrect and contradictory. Few high marks were seen for this question.

Question 18

Leave blank

18. (a) All living things contain carbon atoms. All materials such as leather or wood, which come from living things, also contain carbon atoms.
Of all these carbon atoms, a tiny proportion is carbon-14.

The nuclear equation for the radioactive decay of carbon-14 is

$$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e$$

Beta particles are emitted in this decay. How can you tell this from the equation?

A neutron has been changed into a proton and an electron (0,e)

(2)

(b) There are three forms of carbon: carbon-12, carbon-13 and carbon-14.
Complete the sentence.

These three forms are Isotopes of carbon.

(1)

(c) Radium-226 is a radioactive metal which decays by alpha emission to radon-222 which is a radioactive gas.

Complete the nuclear equation for this decay.

$$^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + {}^{4}_{2}He$$

(2) Q18

(Total 5 marks)

TOTAL FOR PAPER: 120 MARKS

END

Question 18 (out of 5)

This question was well answered with candidates knowing how to complete a nuclear equation showing alpha decay. The term 'isotope' needed to be known and also how beta particles could be identified from a beta decay equation.

Question18 (score 4) **B standard**
Only one property of a beta particle was given.

Paper 3

Question 1

Leave blank

1. A student is asked to investigate the properties of three different cups.
The cups are all of the same size and shape but made from different materials.
These cups keep drinks hot for as long as possible.

She has the following apparatus.


thin metal


thin plastic


thick plastic

(a) Describe how the student would use the apparatus to determine which cup keeps the liquid hottest.

method:

1. First the student should take the kettle and fill it up with water from the tap.

2. Once she has collected the water she should heat the water in the kettle until it boils.

3. Then she should take the measuring cylinder, and pour ~~approxima~~ the hot water into it. The amount of hot water taken should be 130 ~~cm³~~ ml

4. Then the student should pour the hot water measured

Leave blank

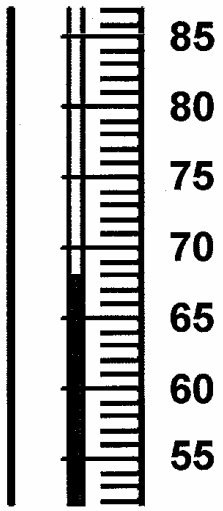
accurately into one of the cups. (e.g. thin metal cup)
5. Each cup should contain a thermometer.
6. Then the student should repeat steps 3 and 4. But this time, the hot water measured should be poured into another cup. (e.g. the thin plastic cup)
7. This cup should contain the thermometer as well.
8. Repeat steps 3 and 4 again for the last cup (the thick plastic cup).
9. Start the stop watch.
10. After 3 minutes, take the stirring rod and stir the water in the three cups.
11. Wait for a while and then note down the temperature of the water in all three cups.
12. Note which temperature has dropped the least. the cup that contained this water keeps the liquid hottest. (8)

(b) List two things that she should keep constant when comparing cups in this investigation.

1 The volume of hot water in each cup.

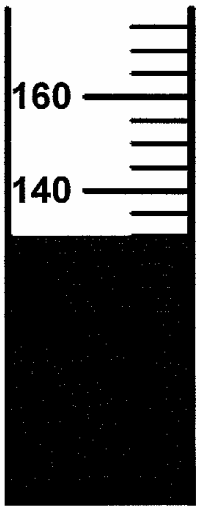
2 the time between pouring the hot water into the cups and measuring the temperature. (2)

(c) During the investigation she takes readings from the measuring cylinder and the thermometer.
Record her readings.



thermometer

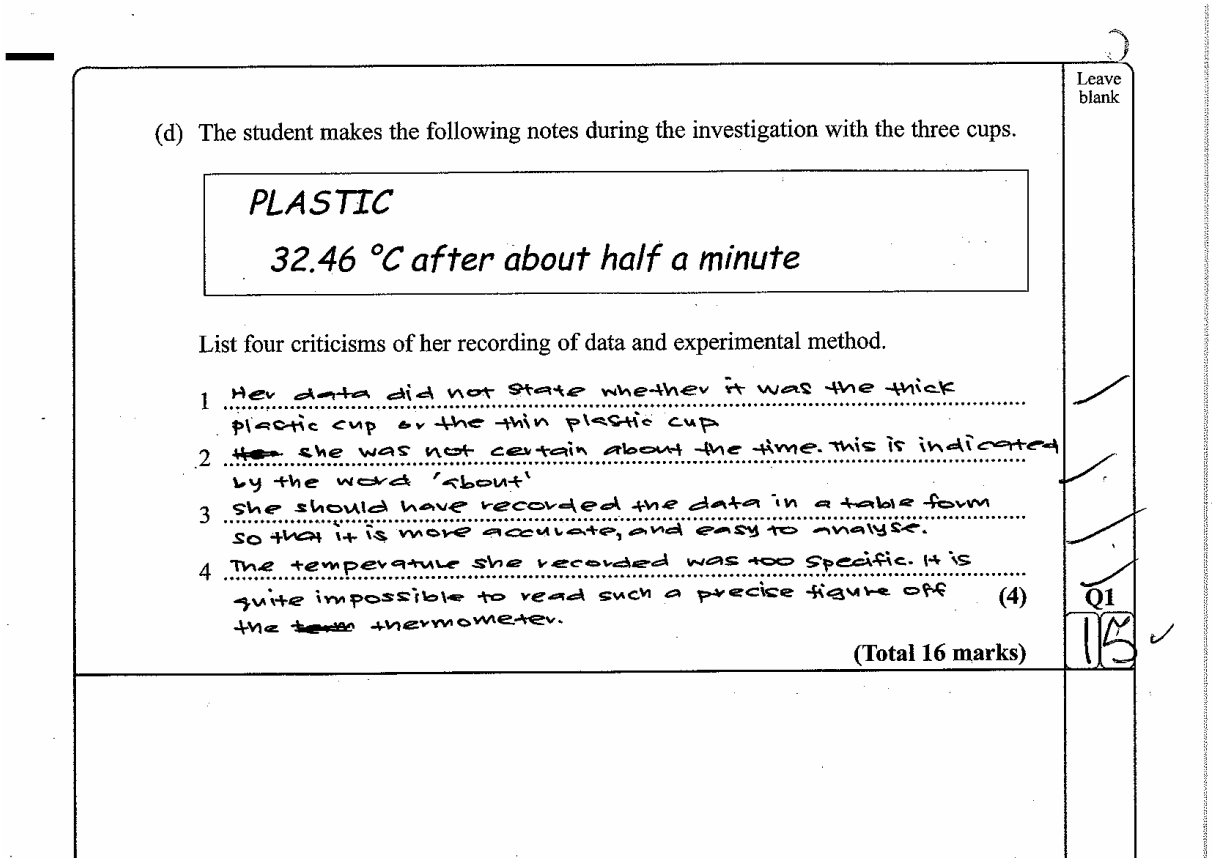
68 °C



measuring cylinder

130 ml

(2)



Leave blank

(d) The student makes the following notes during the investigation with the three cups.

PLASTIC

32.46 °C after about half a minute

List four criticisms of her recording of data and experimental method.

1 Her data did not state whether it was the thick plastic cup or the thin plastic cup

2 ~~the~~ she was not certain about the time. this is indicated by the word 'about'

3 She should have recorded the data in a table form so that it is more accurate, and easy to analyse.

4 The temperature she recorded was too specific. It is quite impossible to read such a precise figure off the ~~temp~~ thermometer. (4)

(Total 16 marks)

Q1

15

Question 1 (out of 16)

This question scored well with 8 marks for planning a cooling exercise, 2 marks for listing two things that should be kept constant, 2 marks for observations from a thermometer and a measuring cylinder and 4 marks for criticism of the recording of some data.

Question 1 (score 15) **A* standard**
One mark was lost in (b) for suggesting that the time between pouring the hot water into the cups and measuring temperature should be kept constant. It is the starting temperature that should be kept constant.

Full marks were scored in (d) where the mark scheme allows four points for the following:

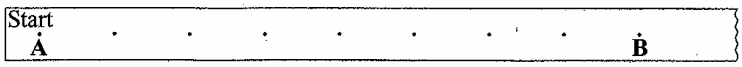
Which plastic is being referred to — thick or thin?
1) The thermometer cannot be read to this accuracy.
2) The time recorded is too vague. It is not specified well enough.
3) The starting temperature must have been too low.
4) There is no tabulation of this data.
5) It is not clear if it refers to a temperature or a temperature fall.

This answer included 1, 3, 4 & 5.

Question 2

Leave blank

2. A teacher attaches a tape to a trolley. The tape passes through a ticker-timer which makes a dot on the tape every 0.020 seconds. He sets the trolley in motion. Part of the tape from the experiment is shown below.



(a) (i) Count the number of spaces between dot **A** and dot **B**.

8 dot spaces.

(1)

(ii) Calculate the time, in seconds, that the trolley takes to travel the distance **AB**.

8 x 0·02

Time = 0·16 s

(2)

(b) How can you tell from the tape that the trolley is travelling at constant speed?

The dot spaces are equal in length.

(1)

(c) Measure the distance **AB** in mm.

Distance = 114 mm

(1)

(d) (i) Use your values of time and distance to determine the average speed of the trolley. Give your answer to an appropriate number of significant figures and include a suitable unit.

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

Average speed = $\frac{114\text{ mm}}{0{\cdot}16\text{ s}}$

Speed = 712·5 mm/s

(3)

(ii) Justify the number of significant figures for your calculated value of speed.

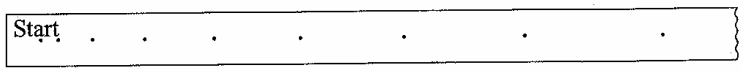
3 significant figures.

712·5 → 713 mm/s

(2)

Leave blank

(e) In a different experiment the student marks every tenth dot. These marked dots are shown below.



(i) Measure the smallest gap between two neighbouring dots.

Smallest gap = 3 mm

(1)

(ii) Measure the largest gap between two neighbouring dots.

Largest gap = 24 mm

(1)

(iii) Describe the motion represented by this tape.

Acceleration.

(1)

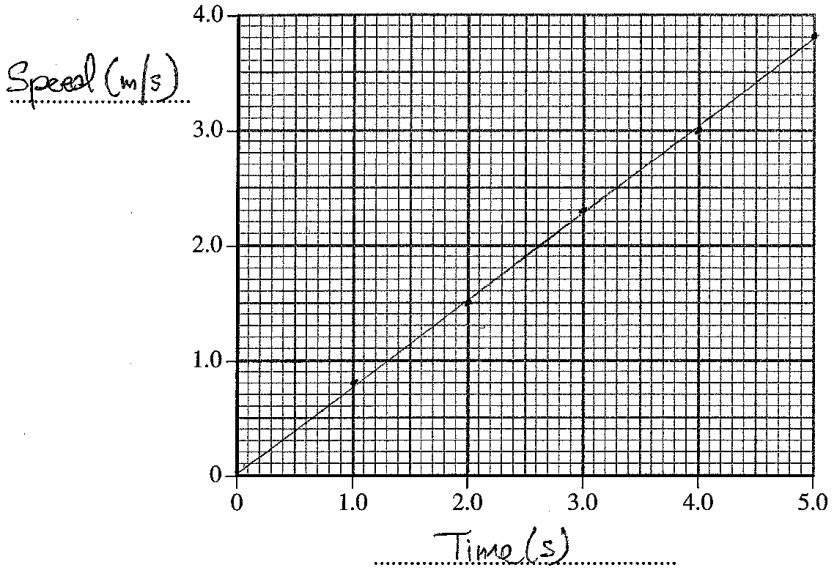
(f) Using a tape the student is able to determine the speed of a trolley at different times.

His experiment produces the following data.

Speed (m/s)	Time (s)
0.8	1.0
1.5	2.0
2.3	3.0
3.0	4.0
3.8	5.0

Leave blank

(i) On the grid, plot a graph of speed (y-axis) against time (x-axis).
Draw the best straight line through your plotted points.
Label the axes of your graph on the dotted lines.



(4)

(ii) Give ~~two~~ One reason why the tape in (e) could be part of the student's experiment.

1 The tape can help mark down the distance the trolley has travelled in intervals of each 10th dot.

2 .....

.....

(2)

(Total 19 marks)

Q2

Question 2 (out of 18)

This question scored well with measurements taken from a tape showing constant speed having passed through a ticker-timer. Average speed was calculated from a given formula and issues about significant figures accounted for 2 marks. The measurements, calculations and graphical work were well done. Candidates were not clear about significant figures in part (d). The scheme in (d) was:

(d)(i)
substitution of measured values from (a)(ii) and (c) *1*
correct calculation *1*
significant figures *1*
appropriate unit *1*

(d)(ii)
time to 2 s.f. *1*
distance to 3 s.f.
therefore speed to 2 s.f.

OR any sensible comment about significant figures

Question 2 (score 14) **B/A standard**
This candidate recorded 114 mm instead of 104 mm l (c). There was an error carried forward in (d)(i) but the 3rd mark was lost for giving 4 significant figures. No relevant comment was seen in (d)(ii). The mark in (f)(ii) was not scored. This mark is awarded in the scheme for stating that the tape showed acceleration.

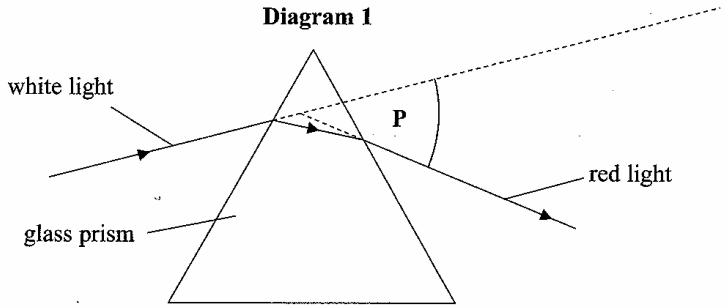
Question 3

Leave blank

3. On entering a glass prism, white light splits up into many colours.

(a) Diagram 1 shows white light entering a glass prism. The path of the red light is shown passing through the prism and emerging after refraction. The angle **P** is called the angle of deviation for red light. It is the angle between the direction of the white light entering the prism and the red light emerging from the prism.

Diagram 1

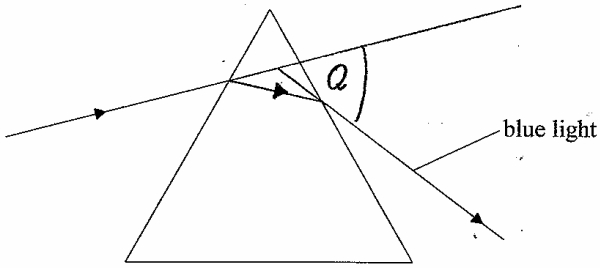


Measure the angle **P**. ..... 36° .....

(1)

(b) Diagram 2 shows white light entering the glass prism as before. Blue light is shown emerging from the prism.

Diagram 2



(i) Draw the path of the blue light as it passes through the prism.

(1)

(ii) Draw two more lines on diagram 2 to show the angle of deviation for blue light. Label this angle **Q**.

(3)

(iii) Measure the angle **Q**. ..... 52° .....

(1)

(c) Suggest a value for the angle of deviation for green light.

..... 52 - 36 = 16° .....

(2)

(Total 8 marks)

Q3

6

Question 3 (out of 8)

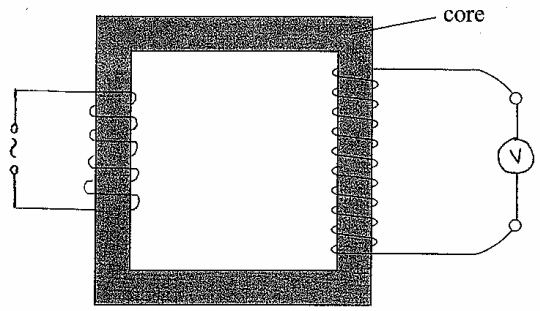
This question was very well answered. Candidates competently measured angles and drew light rays as instructed in a slightly unfamiliar situation. The final mark was often not scored where the range for the deviation of green light had to be narrowed down.

Question 3 (score 6) **A standard**
Having successfully measured the deviations for red and blue light as 36º and 52º, the value for green light has been given as 52º - 36º = 16º instead of a value in between these two values. This loses the final two marks.

Question 4

Leave blank

4. The diagram shows part of a transformer. There are 10 turns of insulated wire wrapped around the right side of the core.



(a) Draw 5 turns of wire around the left side of the core.

(1)

(b) Below are the symbols for an alternating current (a.c.) supply and a 0–10 V a.c. voltmeter.

Add these to the diagram to represent a step-up transformer from which the output voltage can be measured.

(2)

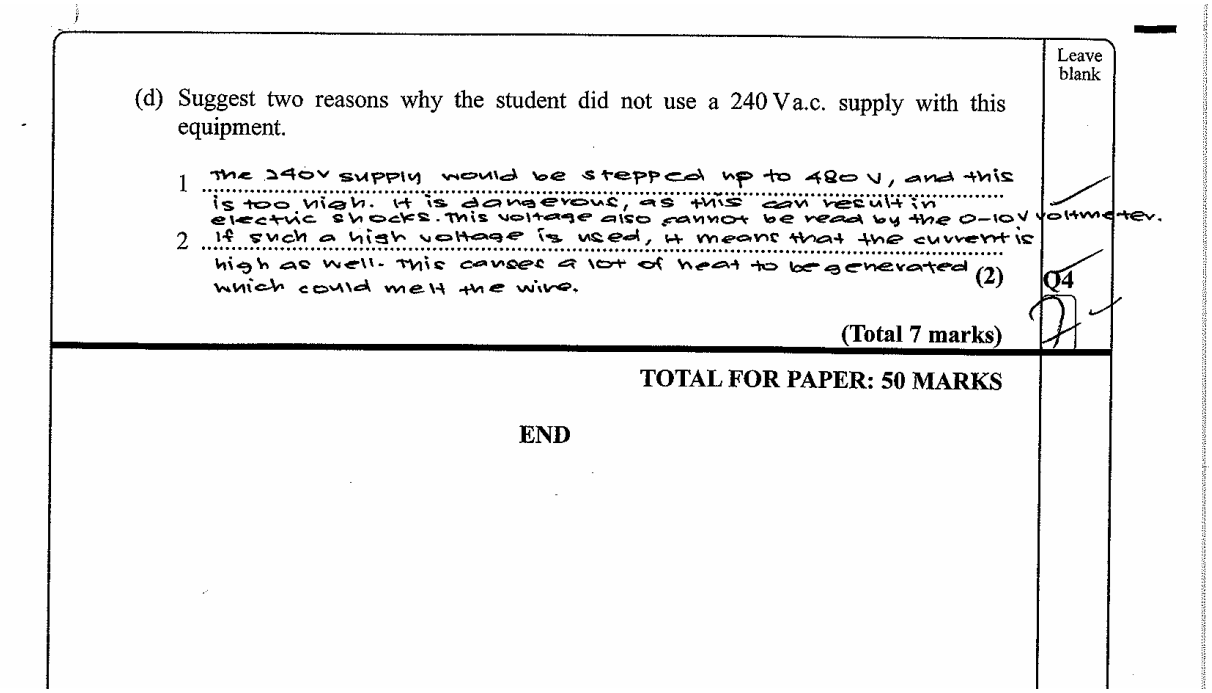
(c) When a student uses the apparatus as a step-up transformer he gets the following readings.

Supply voltage (V)	Voltmeter reading (V)
2.4	4.8
3.7	7.4
6.2	

There is a gap in the table of readings. Explain why the student could not get a reading to fill this gap.

The student could not get the reading because the voltmeter was a 0-10V a.c voltmeter. This means that the voltmeter was only capable of measuring voltages up to 10V. The stepped up voltage reading for the one above however exceeded 10V. The voltmeter reading would have been 12.4 V

(2)



(d) Suggest two reasons why the student did not use a 240 V a.c. supply with this equipment.

Leave blank

1 the 240V supply would be stepped up to 480 V, and this is too high. It is dangerous, as this can result in electric shocks. This voltage also cannot be read by the 0–10V voltmeter.

2 If such a high voltage is used, it means that the current is high as well. This causes a lot of heat to be generated which could melt the wire. **(2)**

Q4

(Total 7 marks)

TOTAL FOR PAPER: 50 MARKS

END

Question 4 (out of 7)

This question was the least well-answered on the paper. Candidates almost always successfully drew five turns of wire on the core of a transformer but were unsure about connecting an a.c. supply and an a.c. voltmeter to make a step-up transformer.

Question 4 (score 7) **A* standard**
This is a good answer. In (c) the appearance of 12.4 V shows that the candidate is thinking about the step-up process. This leads on to the range of the voltmeter being inadequate. In (d) two separate safety ideas are presented. It is easy to say the same thing twice and only merit one mark. Furthermore 'dangerous' is linked to 'electric shock'.

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