HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

COMBINED SCIENCE — PHYSICS

(Sample Paper)

Time allowed: 1 hour 40 minutes
This paper must be answered in English

GENERAL INSTRUCTIONS

1. There are **TWO** sections, A and B, in this Paper. Section A consists of multiple-choice questions in this question book, while Section B contains conventional questions printed separately in Question-Answer Book B. You are advised to finish Section A in about 40 minutes.

2. Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book B. **The Answer Sheet for Section A and the Question-Answer Book for Section B must be handed in separately at the end of the examination.**

SECTION A (MULTIPLE-CHOICE QUESTIONS)

INSTRUCTIONS FOR SECTION A

1. Read carefully the instructions on the Answer Sheet. Stick a barcode label and insert the information required in the spaces provided.

2. When told to open this book, you should check that all the questions are there. Look for the words **'END OF SECTION A'** after the last question.

3. All questions carry equal marks.

4. **ANSWER ALL QUESTIONS.** You are advised to use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber.

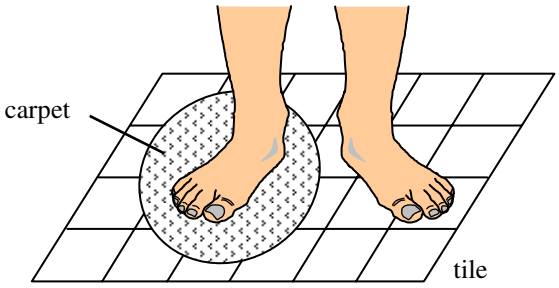
5. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.

6. No marks will be deducted for wrong answers.

Not to be taken away before the end of the examination session

There are 24 questions. The last page of this question paper contains a list of data, formul relationships which you may find useful.

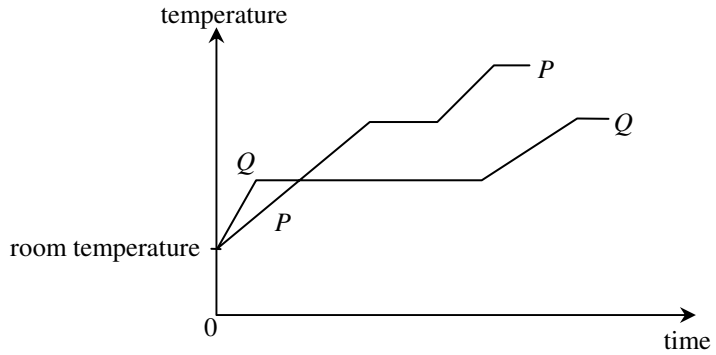
1.



Cynthia places a piece of carpet on a tiled floor. After a while, she stands in bare feet with one foot on the tiled floor and the other on the carpet as shown above. She feels that the tiled floor is colder than the carpet. Which of the following best explains this phenomenon ?

A. The tile is a better insulator of heat than the carpet.
B. The tile is at a lower temperature than the carpet.
C. The specific heat capacity of the tile is smaller than that of the carpet.
D. Energy transfers from Cynthia's foot to the tile at a greater rate than that to the carpet.

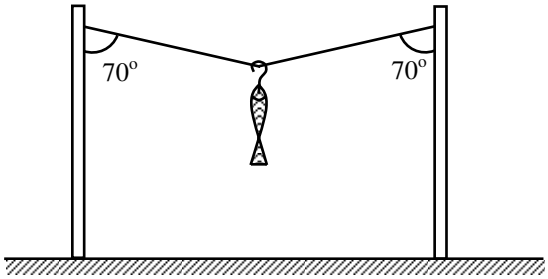
2.



The graph shows the variation in temperature of equal masses of two substances *P* and *Q* when they are separately heated by identical heaters. Which deduction is correct ?

A. The melting point of *P* is lower than that of *Q*.
B. The specific heat capacity of *P* in solid state is larger than that of *Q*.
C. The specific latent heat of fusion of *P* is larger than that of *Q*.
D. The energy required to raise the temperature of *P* from room temperature to boiling point is more than that of *Q*.

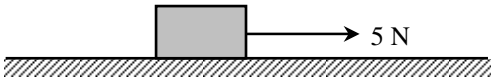
3.



A fish is hung on a light string as shown above. The tension in the string is 10 N. Find the total weight of the fish and the hook.

A. 20 sin 70° N
B. 20 cos 70° N
C. 10 sin 70° N
D. 10 cos 70° N

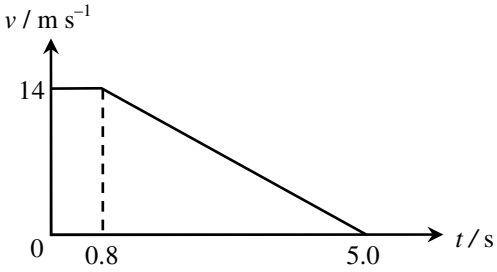
4.



A 1 kg block is pulled by a horizontal force of 5 N and moves with an acceleration of 2 m s^{-2} on a rough horizontal plane. Find the frictional force acting on the block.

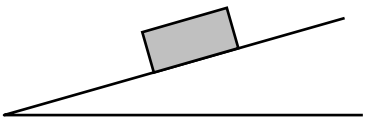
A. zero
B. 2 N
C. 3 N
D. 7 N

5. Patrick is driving along a straight horizontal road. At time t = 0, he observes that an accident has happened. He then applies the brakes to stop his car with uniform deceleration. The graph shows the variation of the speed of the car with time.



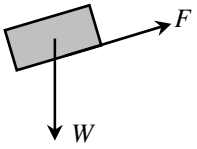
Find the distance travelled by the car from time t = 0 to 5.0 s.

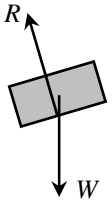
A. 29.4 m
B. 40.6 m
C. 46.2 m
D. 81.2 m

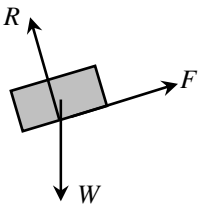
6. 

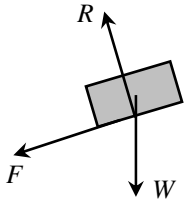
A block remains at rest on a rough inclined plane. Which diagram shows all the forces acting on the block ?

Note : W = gravitational force acting on the block,
R = normal reaction exerted by the inclined plane on the block, and
F = friction acting on the block.

A. 

B. 

C. 

D. 

7. Kelvin is standing on a balance inside a lift. The table shows the readings of the balance in three situations.

Motion of the lift	Reading of the balance
moving upwards with a uniform speed	R_1
moving downwards with a uniform speed	R_2
moving upwards with an acceleration	R_3

Which relationship is correct ?

A. $R_1 = R_2 > R_3$
B. $R_3 > R_1 = R_2$
C. $R_1 > R_2 > R_3$
D. $R_3 > R_1 > R_2$

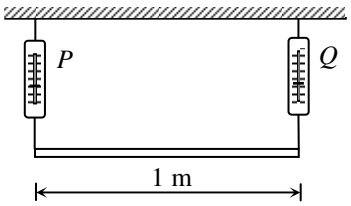
8. 

Figure (a)

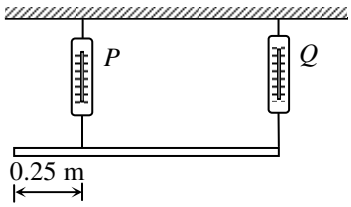


Figure (b)

Figure (a) shows a uniform plank supported by two spring balances P and Q. The readings of the two balances are both 150 N. P is now moved 0.25 m towards Q (see Figure (b)). Find the new readings of P and Q.

	Reading of P/N	**Reading of Q/N**
A.	100	200
B.	150	150
C.	200	100
D.	200	150

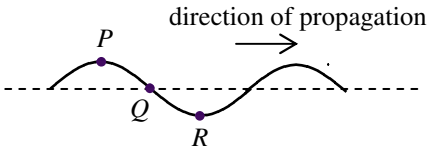
9. Two small identical objects P and Q are released from rest from the top of a building 80 m above ground. Q is released 1 s after P. Neglecting air resistance, what is the maximum vertical separation between P and Q in the air ?

A. 5 m
B. 10 m
C. 35 m
D. 45 m

10. A car P of mass 1000 kg moves with a speed of 20 m s^{-1} and makes a head-on collision with a car Q of mass 1500 kg, which was moving with a speed of 10 m s^{-1} in the opposite direction before the collision. The two cars stick together after the collision. Find their common velocity immediately after the collision.

A. 2 m s^{-1} along the original direction of P
B. 2 m s^{-1} along the original direction of Q
C. 14 m s^{-1} along the original direction of P
D. 14 m s^{-1} along the original direction of Q

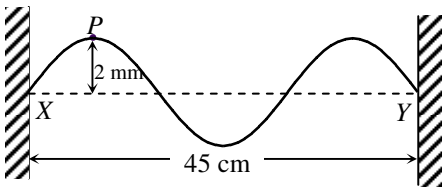
11.



The figure shows the shape of a transverse wave travelling along a string at a certain instant. Which statement about the motion of the particles P, Q and R on the string at this instant is correct ?

A. Particle P is moving downwards.
B. Particle Q is stationary.
C. Particle R attains its maximum acceleration.
D. P and Q are in phase.

12.



String XY is fixed at both ends. The distance between X and Y is 45 cm. Two identical sinusoidal waves travel along XY in opposite directions and form a stationary wave with an antinode at point P. The figure shows the string when P is 2 mm, its maximum displacement, from the equilibrium position. What is the amplitude and wavelength of each of the **travelling waves** on the string ?

	Amplitude	**Wavelength**
A.	1 mm	30 cm
B.	1 mm	15 cm
C.	2 mm	30 cm
D.	2 mm	15 cm

13. A Young's double-slit experiment was performed using a monochromatic light source. Which would result in a greater fringe separation on the screen ?

(1) Using monochromatic light source of longer wavelength
(2) Using double slit with greater slit separation
(3) Using double slit with larger slit width

A. (1) only
B. (1) and (2) only
C. (2) and (3) only
D. (1), (2) and (3)

14. An object is placed at the focus of a concave lens of focal length 10 cm. What is the magnification of the image formed ?

A. 0.5
B. 1.0
C. 2.0
D. infinite

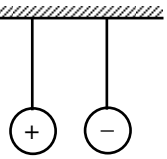
15. Which of the following statements about sound waves is/are correct ?

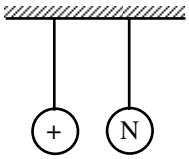
(1) Sound waves are longitudinal waves.
(2) Sound waves are electromagnetic waves.
(3) Sound waves cannot travel in a vacuum.

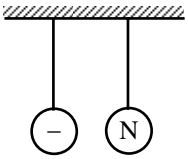
A. (2) only
B. (3) only
C. (1) and (2) only
D. (1) and (3) only

16. Two conducting spheres are hanging freely in air by insulating threads. In which of the following will the two spheres attract each other ?

Note : 'N' denotes that the sphere is uncharged.

(1) 

(2) 

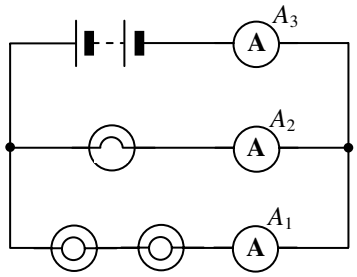
(3) 

A. (1) only
B. (2) only
C. (3) only
D. (1), (2) and (3)

17. If a 15 A fuse is installed in the plug of an electric kettle of rating '220 V, 900 W', state what happens when the kettle is plugged in and switched on.

A. The kettle will not operate.
B. The kettle will be short-circuited.
C. The output power of the kettle will be increased.
D. The chance of the kettle being damaged by an excessive current will be increased.

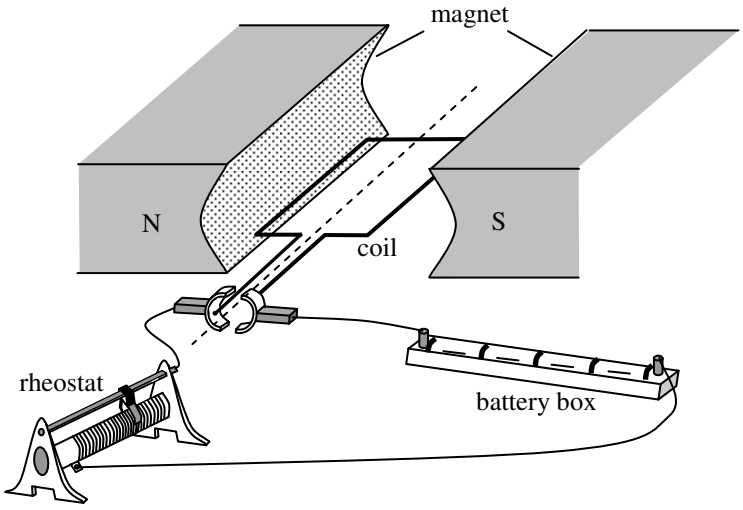
18.



In the above circuit, the bulbs are identical. The reading of ammeter A_1 is 1 A. Find the readings of ammeters A_2 and A_3.

	Reading of A_2	**Reading of A_3**
A.	2 A	2 A
B.	2 A	3 A
C.	0.5 A	1 A
D.	0.5 A	1.5 A

19.

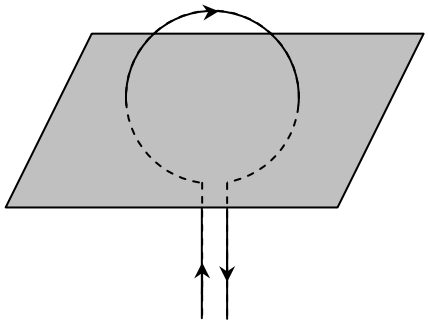


The figure shows a simple motor. Which of these changes would increase the turning effect of the coil ?

(1) using a stronger magnet
(2) reducing the resistance of the rheostat
(3) using a coil with a smaller number of turns

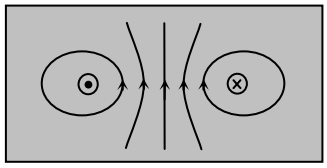
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

20.

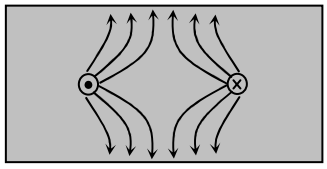


Which diagram shows the magnetic field pattern around a flat circular current-carrying coil, in the plane shown ?

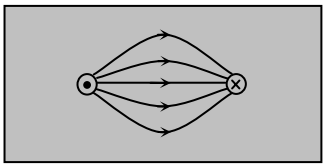
A.



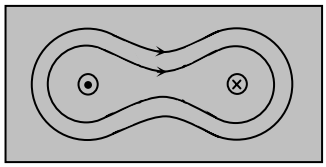
B.



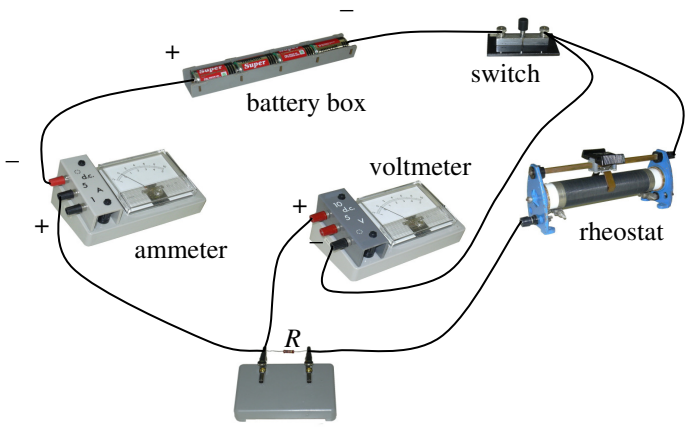
C.



D.



21.

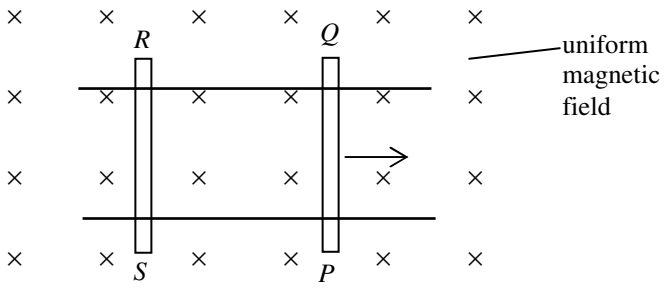


A student wants to measure the resistance of a resistor R and sets up the circuit shown. The student made which of these mistakes setting up the circuit ?

(1) The polarity of the ammeter was reversed.
(2) The polarity of the voltmeter was reversed.
(3) The voltmeter was connected across both R and the rheostat.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

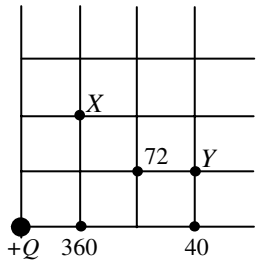
22.



The figure shows conducting rods *PQ* and *RS* placed on two smooth, parallel, horizontal conducting rails. A uniform magnetic field is directed into the plane of the paper. *PQ* is given an initial velocity to the right and left to roll. Which statement is **INCORRECT** ?

A. The induced current is in the direction *PQRS*.
B. The magnetic force acting on rod *PQ* is towards the left.
C. Rod *RS* starts moving towards the right.
D. Rod *PQ* moves with a uniform speed.

23.



The figure shows the location of an isolated charge of size $+Q$. The size (in an arbitrary unit) of the electric field strength is marked at certain points. What is the size (in the same arbitrary unit) of the electric field strength at *X* and *Y* ?

	electric field strength at *X*	**electric field strength at *Y***
A.	72	30
B.	72	36
C.	90	30
D.	90	36

24. Power is transmitted over long distances at high alternating voltages. Which statements are correct ?

(1) Alternating voltages can be stepped up or down efficiently by transformers.
(2) For a given transmitted power, the current will be reduced if a high voltage is adopted.
(3) The power loss in the transmission cables will be reduced if a high voltage is adopted.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

END OF SECTION A

List of data, formulae and relationships

Data

speed of light in vacuum	$c = 3.00 \times 10^8$ m s^{-1}
acceleration due to gravity	$g = 9.81$ m s^{-2} (Close to the Earth)
charge of electron	$e = 1.60 \times 10^{-19}$ C
electron rest mass	$m_e = 9.11 \times 10^{-31}$ kg
permittivity of free space	$\varepsilon_o = 8.85 \times 10^{-12}$ C^2 N^{-1} m^{-2}

Rectilinear motion

For uniformly accelerated motion :

$$\begin{aligned} v &= u + at \\ s &= ut + \frac{1}{2}at^2 \\ v^2 &= u^2 + 2as \end{aligned}$$

Mathematics

Equation of a straight line $y = mx + c$

Arc length = $r\theta$

Surface area of cylinder $= 2\pi rh + 2\pi r^2$

Volume of cylinder $= \pi r^2 h$

Surface area of sphere $= 4\pi r^2$

Volume of sphere $= \frac{4}{3}\pi r^3$

For small angles, $\sin\theta \approx \tan\theta \approx \theta$ (in radians)

$E = mc\,\Delta T$	energy transfer during heating and cooling	$F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$	Coulomb's law
$E = l\,\Delta m$	energy transfer during change of state	$E = \frac{Q}{4\pi\varepsilon_0 r^2}$	electric field strength due to a point charge
$F = m\frac{\Delta v}{\Delta t} = \frac{\Delta p}{\Delta t}$	force	$E = \frac{V}{d}$	energy field between parallel plates (numerically)
moment = $F \times d$	moment of a force	$R = \frac{\rho l}{A}$	resistance and resistivity
$E_P = mgh$	gravitational potential energy	$R = R_1 + R_2$	resistors in series
$E_K = \frac{1}{2}mv^2$	kinetic energy	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$	resistors in parallel
$F = kx$	Hooke's law	$P = IV = I^2 R$	power in a circuit
$P = Fv = \frac{W}{t}$	mechanical power	$\frac{V_s}{V_p} \approx \frac{N_s}{N_p}$	ratio of secondary voltage to primary voltage in a transformer

B

Please stick the barcode label here.

Candidate Number								

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

COMBINED SCIENCE — PHYSICS

(Sample Paper)

Section B : Question-Answer Book B

This paper must be answered in English

INSTRUCTIONS

(1) Write your Candidate Number in the space provided on Page 1.

(2) Stick barcode labels in the spaces provided on Pages 1, 3, 5 and 7.

(3) This section carries 56 marks. Answer **ALL** questions.

(4) Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) Supplementary answer sheets will be provided on request. Write your Candidate Number, mark the question number box and stick a barcode label on each sheet. Tie them loosely but securely with a string INSIDE this Question-Answer Book.

(6) The diagrams in this section are **NOT** necessarily drawn to scale.

	Marker's Use Only		**Examiner's Use Only**	
	Marker No.		Examiner No.	
Question No.	Marks		Marks	
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Total				

Answer **ALL** questions. Write your answers in the spaces provided.

1.

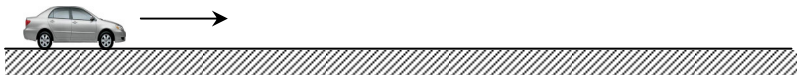


Figure 1.1

In a road test, John drives his car along a straight horizontal road (see Figure 1.1). The car takes 9.3 s to accelerate from rest to 100 km h^{-1}. The total mass of John and his car is 1400 kg.
(Note: 100 km h^{-1} = 27.8 m s^{-1})

(a) Find the total kinetic energy of John and his car when travelling at 100 km h^{-1}. Hence estimate the average output power of the car during this acceleration. (3 marks)

(b) A similar road test is conducted on an inclined road. The car now takes more than 9.3 s to accelerate from rest to 100 km h^{-1} along the road (see Figure 1.2). Assume the output power of the car remains unchanged. Explain why it takes a longer time for the car to accelerate up an inclined road than along a horizontal road. (2 marks)

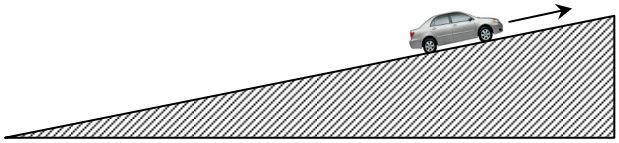


Figure 1.2

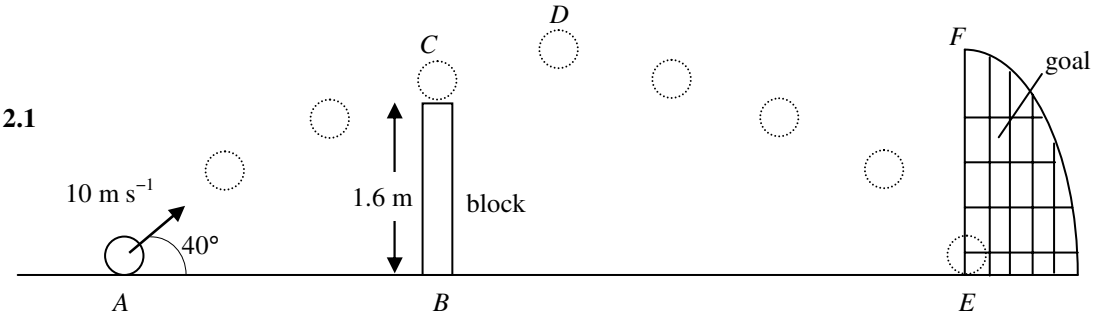
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Please stick the bar[illegible]here.

2. A ball is kicked and moves with an initial velocity of 10 m s^{-1} at an angle of 40° to the horizontal. The ball then just passes a block of height 1.6 m, reaching the highest point *D*, and finally hits the ground at *E* as shown in Figure 2.1. (Neglect air resistance and the size of the ball.)

Figure 2.1



(a) Draw an arrow to indicate the direction of acceleration of the ball at *C*. (1 mark)

(b) For a projectile of initial velocity u that makes an angle θ with the horizontal, show that its horizontal range is given by $\frac{u^2 \sin 2\theta}{g}$. Hence, or otherwise, find another angle of projection such that the ball can still reach *E* with the same initial speed of 10 m s^{-1}.
(Given: $2\sin\theta\cos\theta = \sin 2\theta$) (4 marks)

(c) Calculate the speed of the ball at *C*. (2 marks)

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3.

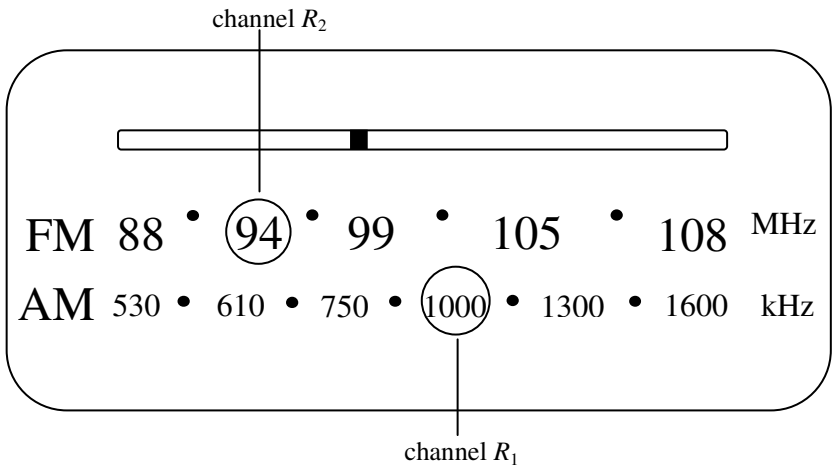

Figure 3.1

Figure 3.1 shows the display panel of a radio and the broadcasting frequencies of two radio channels R_1 and R_2. Given : speed of electromagnetic waves = 3.00×10^8 m s^{-1}

(a) Find the wavelength of the radio waves used by channel R_1. (1 mark)

(b) Anita's house is surrounded by hills and at her house, the reception of one of the two radio channels is better. For which radio channel is the reception better ? Explain your answer. (2 marks)

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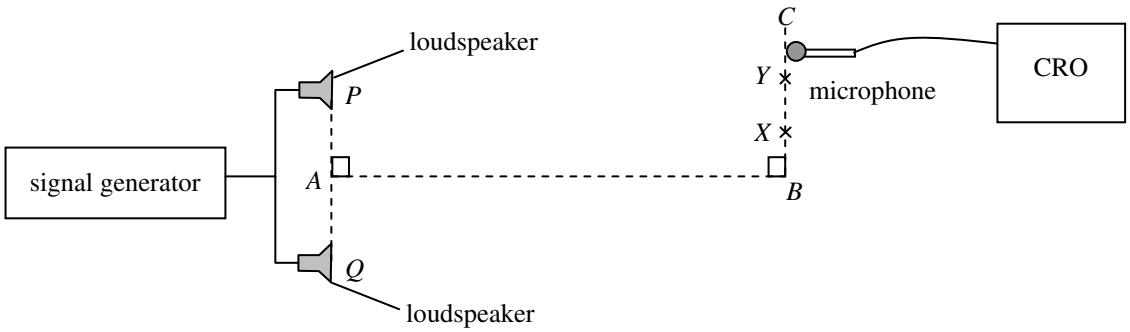

Figure 4.1

Figure 4.1 shows two identical loudspeakers *P* and *Q* are connected to a signal generator. Position *A* is the mid-point of *PQ*. A microphone connected to a CRO is moved along *BC*. The amplitude of the CRO trace increases as the loudness of the sound detected increases. Figure 4.2 shows how the amplitude of the CRO trace varies with the position of the microphone.

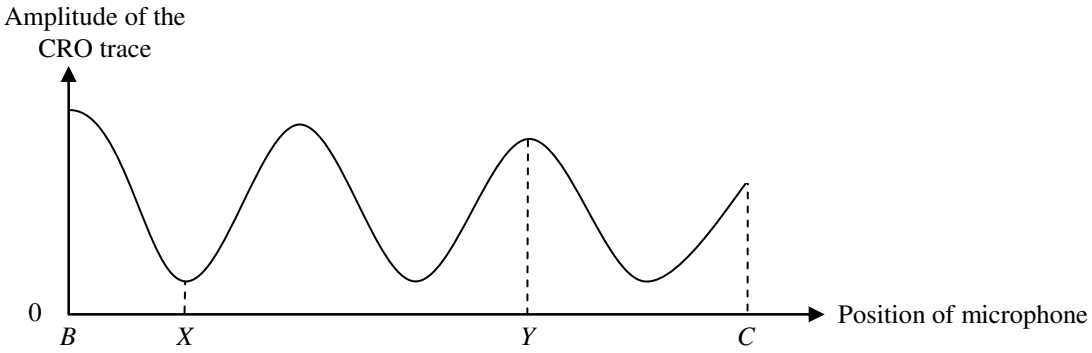

Figure 4.2

(a) (i) Explain why the loudness of the sound varies along *BC*. (2 marks)

(ii) State **ONE** reason why the amplitude of the CRO trace is **NOT** zero at position *X*. (1 mark)

(b) If *PY* = 5.10 m and *QY* = 5.78 m, find the wavelength of the sound. (2 marks)

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5. Amy uses the motor of a toy fan as a simple generator. She connects a bulb to the two terminals of the motor. This is shown in Figure 5.1.

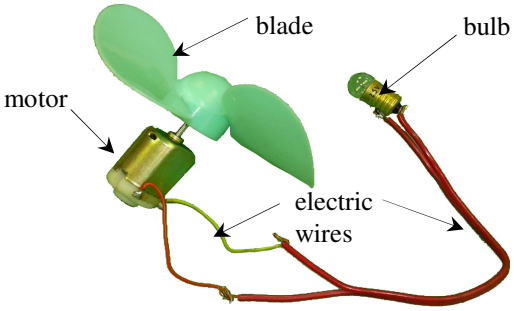

Figure 5.1

The bulb lights up when the blades are turned rapidly. Explain why and state the energy conversion taking place in this process. (4 marks)

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6.

Figure 6.1

Figure 6.1 shows a microwave oven. Mary wants to estimate the useful output power of the oven. She is provided with the apparatus and material shown in Figure 6.2.

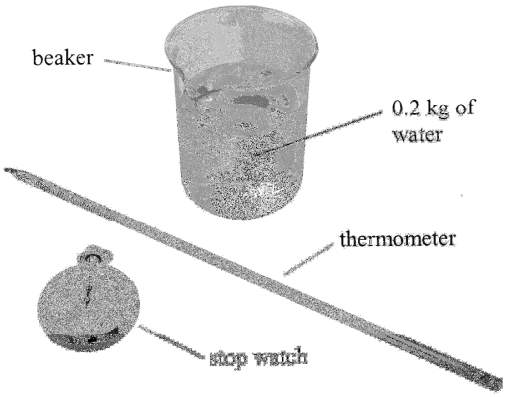

Figure 6.2

(a) Describe how Mary should conduct the experiment. Specify all measurements Mary has to take. State **EITHER** one precaution taken **OR** one assumption made when conducting this experiment. Write down an equation for calculating the useful output power. (5 marks)

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(b) The value obtained by Mary is found to be smaller than the rated power of the oven. Suggest one possible reason to account for this difference. (1 mark)

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(c) Explain whether increasing the mass of water used in the experiment would improve the accuracy of the experiment. (1 mark)

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7.

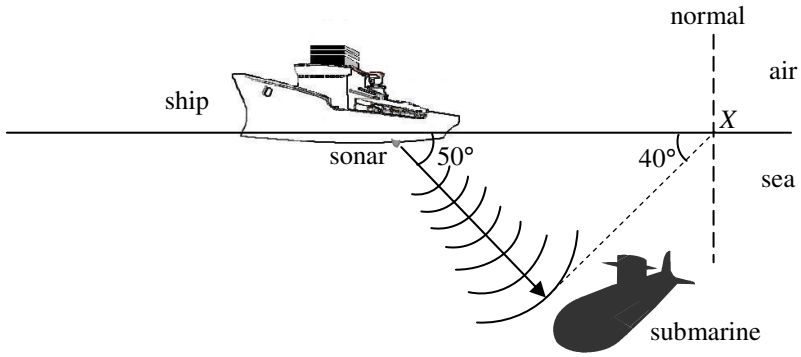

Figure 7.1

Figure 7.1 shows a ship equipped with sonar. The sonar emits ultrasonic waves of frequency 25 kHz into the sea. The waves propagate at an angle of 50º to the surface of the sea and are reflected from a submarine back to the ship after 0.15 s.

Given : speed of sound in air = 340 m s^{-1}
speed of sound in sea water = 1500 m s^{-1}

(a) Calculate the vertical distance of the submarine beneath the sea surface. (2 marks)

(b) Some of the reflected waves propagate along the dotted line and emerge into the air at *X*. Calculate the angle of refraction in air. (2 marks)

(c) Is it possible for ultrasonic waves, at certain angles of incidence, to undergo total internal reflection when they go from sea water to the air ? Explain. (2 marks)

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8. A spacecraft with an astronaut on board is launched on a rocket. The rocket with the spacecraft has an initial mass of 4.80×10^5 kg at take-off. The rocket engine expels hot exhaust gas at a constant speed of 2600 m s^{-1} downwards relative to the rocket. Assume that 1.15×10^3 kg of gas is expelled in the first 0.5 s. (Neglect air resistance.)

(a) Calculate the average thrust (the upward force) acting on the rocket due to the exhaust gas during the first 0.5 s. (2 marks)

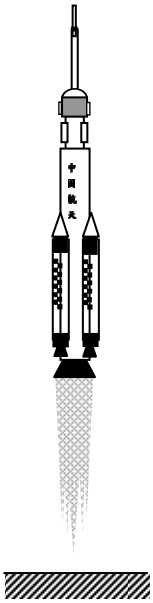

Figure 8.1

(b) On Figure 8.1, draw and label an arrow for each force acting on the rocket. Assuming that the change in mass of the rocket during the first 0.5 s is negligible, estimate the acceleration of the rocket. (3 marks)

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9.

Figure 9.1

Iris uses the apparatus shown in Figure 9.1 to study the lifetime of AA-size cells when used to power a bulb. She connects a cell and a switch to the bulb and uses a voltage sensor to measure the voltage across the bulb.

(a) Draw a circuit diagram to illustrate how the apparatus is connected. Use the symbol Ⓥ to denote the voltage sensor and the data-logger. (2 marks)

(b) Iris conducts the experiment with a zinc-carbon cell, an alkaline cell and a lithium cell separately. Figure 9.2 shows the variation of the voltage across the bulb with time for the cells. The bulb lights up as long as the voltage across it is above 0.6 V.

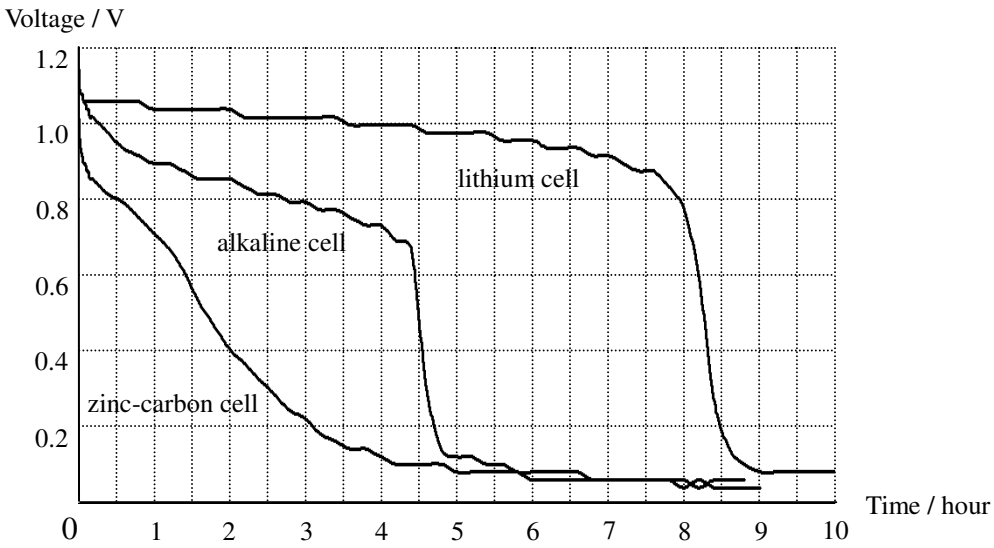

Figure 9.2

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(b) (i) A salesman claims that the lifetime of a lithium cell for lighting up the bulb is five times that of an alkaline cell. Determine whether the claim is correct or not. (2 marks)

(ii) Table 9.3 shows the prices of the three types of cell.

Type of cells	Price per cell
zinc-carbon	$ 1.5
alkaline	$ 3.8
lithium	$25.0

Table 9.3

Which type of cells is the best buy, in terms of the cost per hour for lighting up the bulb ? Show your calculations. (3 marks)

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10. Josephine conducts an investigation on transformers. Primary and secondary coils are wound on two soft-iron C-cores to form a transformer. She sets up a circuit as shown in Figure 10.1.

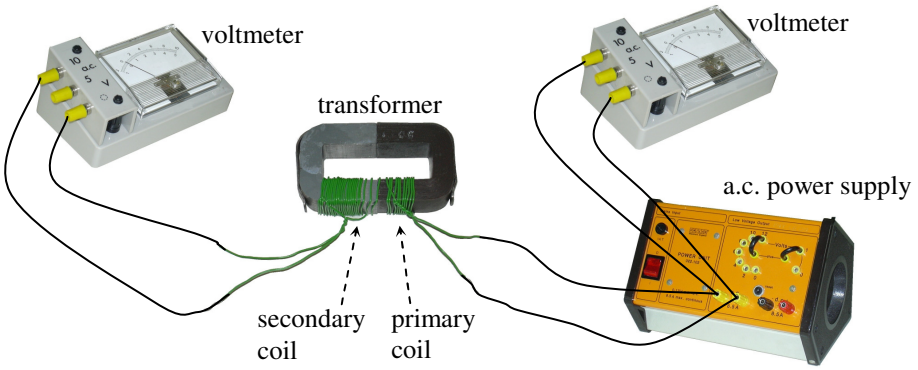

Figure 10.1

(a) Josephine varies the input voltage V_1 to the transformer and records the corresponding output voltage V_2. The results are shown in Table 10.2. Figure 10.3 shows the graph of V_2 against V_1. Draw a conclusion for this investigation. (1 mark)

V_1 / V	V_2 / V
1.5	2.5
3.0	5.1
4.5	7.6
6.0	10.0

Table 10.2

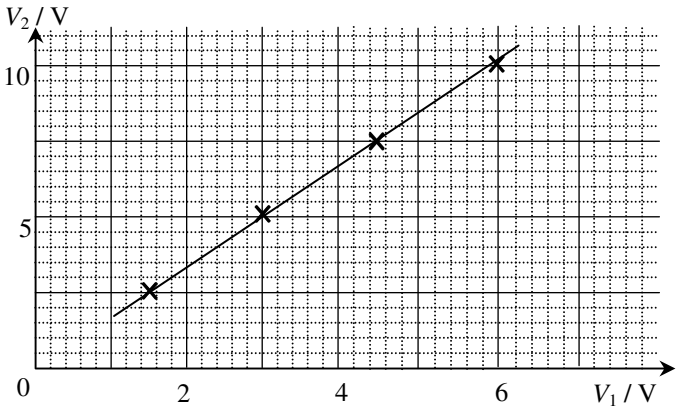

Figure 10.3

(b) Deduce the value of V_2 that will be produced when V_1 equals 8.0 V. (1 mark)

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(c) Josephine wants to study the relationship between the output voltage and the number of turns in the secondary coil of the transformer. Describe how she can conduct the experiment. (2 marks)

(d) Josephine adds a bulb to the circuit as shown in Figure 10.4. Suggest how Josephine can estimate the efficiency of the transformer. State the measurement(s) she must take. Additional apparatus may be used if necessary. (3 marks)

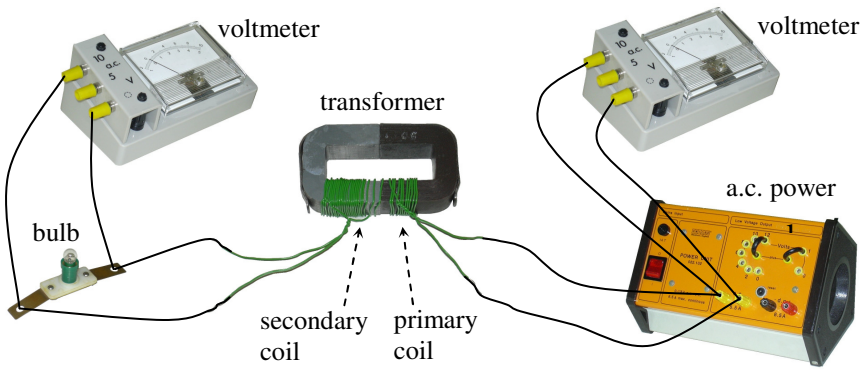

Figure 10.4

END OF PAPER

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