Name: _____ ( ) Class: _____

Centre Number: _____ Index Number: _____

4E

KRANJI SECONDARY SCHOOL
Preliminary Examination
Secondary 4 Express

PHYSICS **6091/01**
Paper 1 Multiple Choice

Tuesday **20 August 2018** **1 hour**

INSTRUCTIONS TO CANDIDATES

There are **forty** questions in this paper. Answer **all** questions.
For each question there are four possible answers, **A, B, C** and **D**.
Choose the one you consider to be correct and record your choice in **soft pencil** on the OMR provided.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

INFORMATION FOR CANDIDATES

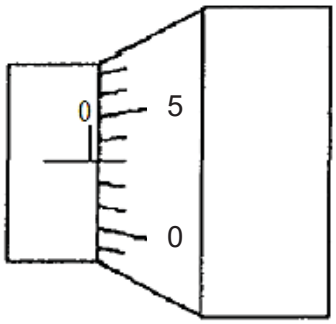
Take the acceleration due to gravity, g, to be 10 m/s^2.

Set by : Koh Tai Xiang

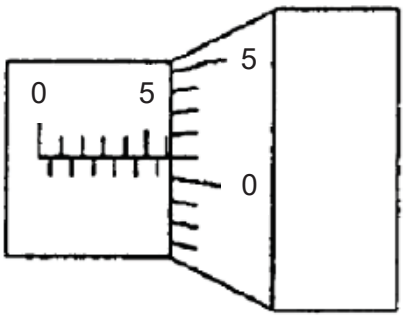
This question paper consists of 16 printed pages.

[Turn over

1 A micrometer screw gauge is used to measure the diameter of a steel ball. A student takes an initial zero error reading and then a reading of the diameter of the steel ball as shown below.



zero error reading



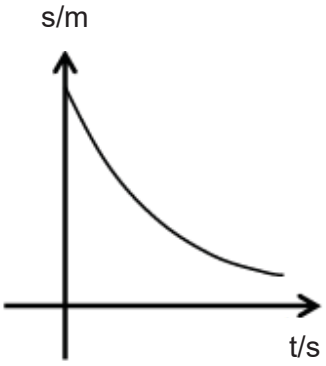
reading of diameter of steel ball

What is the actual diameter of the steel ball?

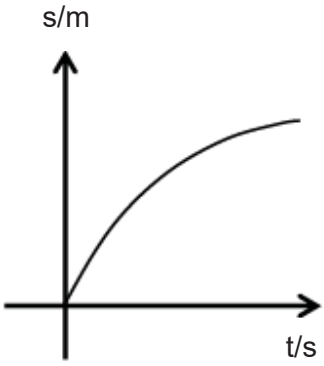
A 5.48 mm **B** 5.94 mm **C** 5.98 mm **D** 6.04 mm

2 The graphs below show how the displacement, s, of an object changes with time, t.

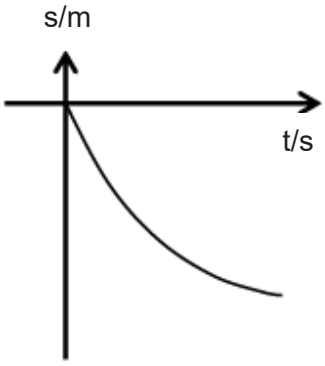
graph **A**



graph **B**



graph **C**



Which graph(s) show(s) the **distance travelled by** the object increasing at a decreasing rate?

A graph B only
B graph B and C only
C graph A and C only
D all of the above

3 A car driver immediately stepped on the brakes when he saw a cat dashing across the road.

The car decelerated at a constant rate of 10 m/s^2. The car finally came to a stop after it travelled for 45 m.

What is the speed of the car when the driver stepped on the brakes?

A 3.0 m/s **B** 21 m/s **C** 22 m/s **D** 30 m/s

4 A parachutist of mass 70 kg is falling through air when he opens his parachute. After the parachute opens, the initial deceleration of the parachutist is 20 m/s^2.

The gravitational field strength g is 10 N/kg.

What is the initial air resistance acting on the parachutist after the parachute opens?

A 700 N **B** 1400 N **C** 2100 N **D** 2400 N

5 Which of the following statement(s) about an object moving in a straight line through air is correct?

I When it moves at a steady speed, the air resistance acting on it is zero.
II When it moves at a steady speed, the resultant force acting on it is zero.
III When it moves, there is a resultant force acting on it.

A **II** only

B **I** and **III** only

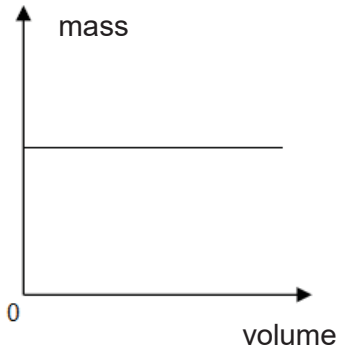
C **II** and **III** only

D **I, II** and **III**

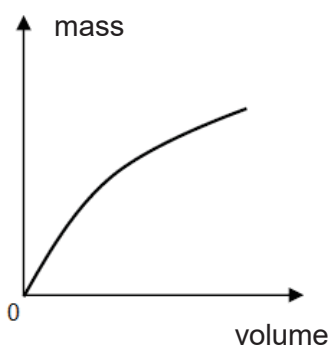
6 In an experiment to determine the density of substance Z, the mass and volume of different samples of Z are measured.

Which of the following graphs shows the correct relationship between the mass and volume of Z?

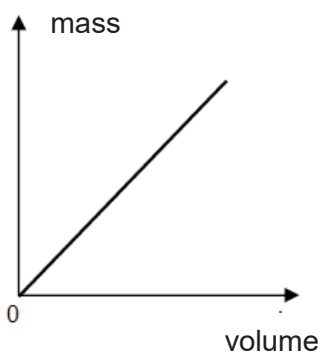
A



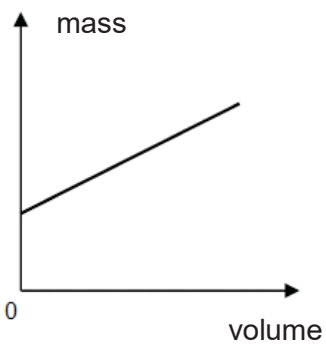
B



C



D

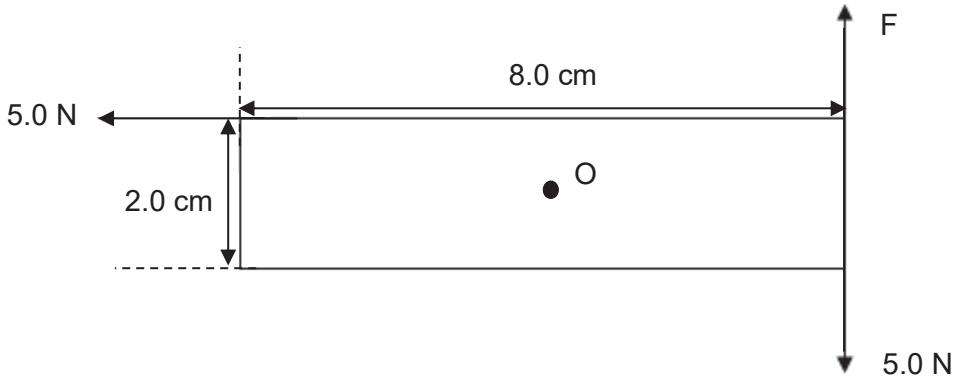


7 A bottle full of water has a mass of 70 g. When the same bottle is filled up with another unknown liquid Y, the total mass is 410 g.

If the mass of the empty bottle is 20 g and density of water is 1.0 g/cm^3, what is the density of Y?

A 7.8 g/cm^3 **B** 8.2 g/cm^3 **C** 13.0 g/cm^3 **D** 20.5 g/cm^3

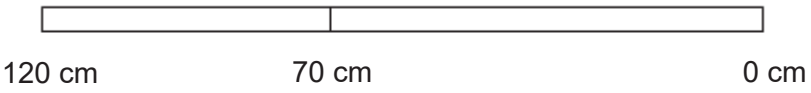
8 Three forces are applied to a rectangular cardboard of size 8.0 cm by 2.0 cm as shown. The cardboard is pivoted at the centre O.



What is the size of force F such that the cardboard does not rotate about pivot O?

A 3.75 N **B** 5.00 N **C** 6.25 N **D** 10.0 N

9 The diagram below shows a uniform wooden plank with a length of 120 cm. The mass of the wooden plank is 700 g.



If the plank is pivoted at the 70 cm mark, which of the following mass should be used to balance the plank?

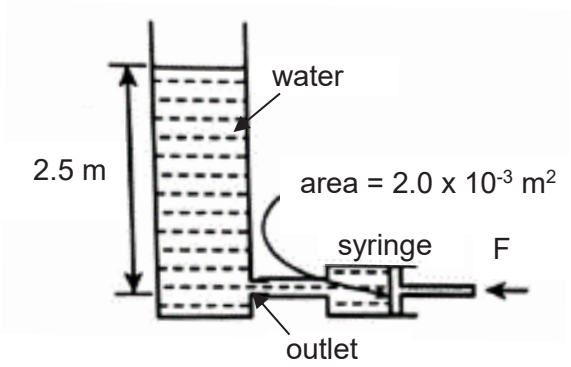
A mass of 70 g placed at 100 cm mark

B mass of 175 g placed at the 30 cm mark

C mass of 350 g placed at the 90 cm mark

D mass of 700 g placed at the 10 cm mark

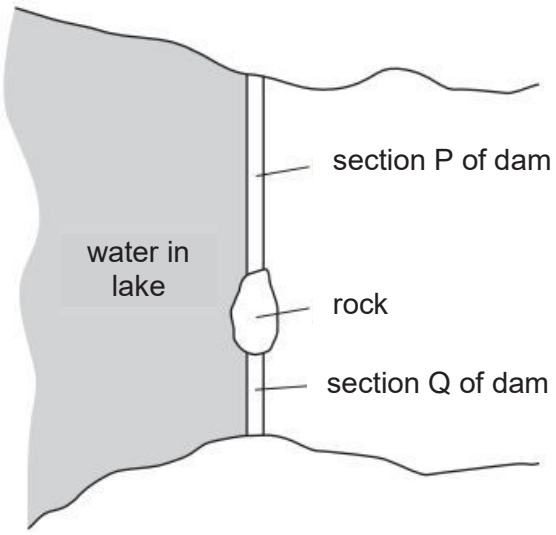
10 The diagram shows a tall cylinder containing some water. A syringe is used to prevent the water from spurting out from the outlet at the bottom of the cylinder. The height of the water above the outlet is 2.5 m. The density of water is 1000 kg/m^3 and the cross-sectional area of the piston of the syringe is 2.0 x 10^{-3} m^2.



What is the minimum force F that must be applied to the piston of the syringe to prevent it from moving outwards?

A 1.25 N **B** 8.0 N **C** 50 N **D** 12500 kN

11 A dam across a lake is divided into two sections by a rock. Section P of the dam is longer than section Q but the two sections are otherwise identical. The water in the lake by the dam is the same depth everywhere. The diagram shows a view from above of the lake and the dam.



The water exerts a total force on each section of the dam and an average pressure on each section of the dam.

Which statement is correct?

A The average water pressure on P equals the average water pressure on Q.

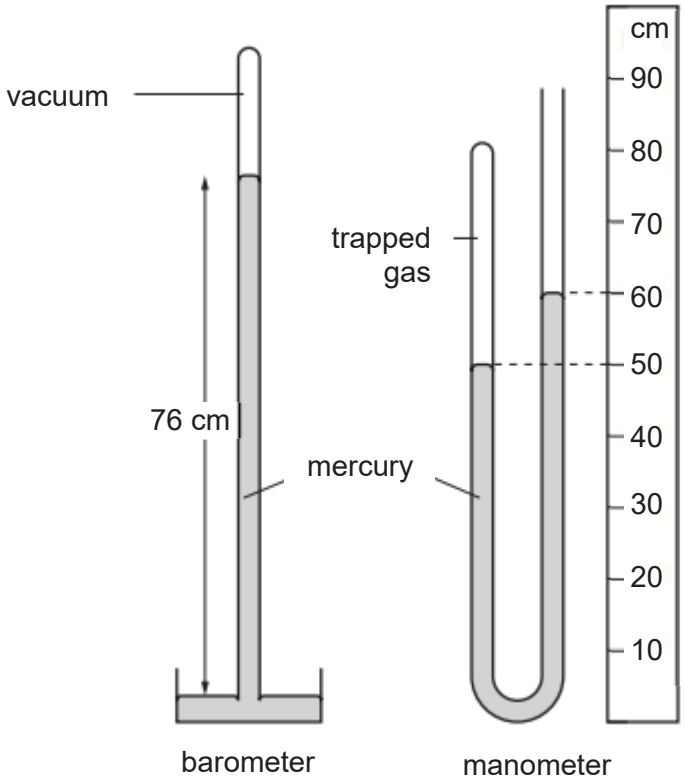
B The average water pressure on P is less than the average water pressure on Q.

C The total force on P equals the total force on Q.

D The total force on P is less than the total force on Q.

12 The diagram shows a simple mercury barometer alongside a mercury manometer.

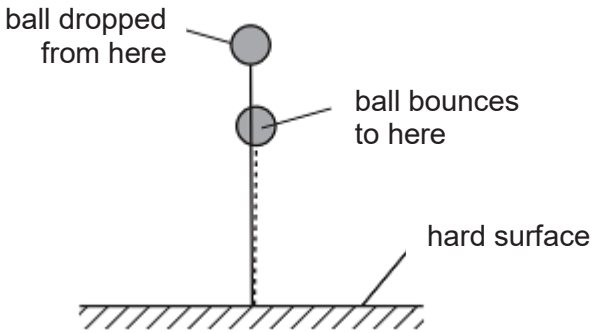
The manometer contains some trapped gas.



What is the pressure of the trapped gas?

A 10 cmHg **B** 50 cmHg **C** 66 cmHg **D** 86 cmHg

13 A ball is dropped on to a hard surface and bounces. It does not bounce all the way back to where it started.



Which statement accounts for this?

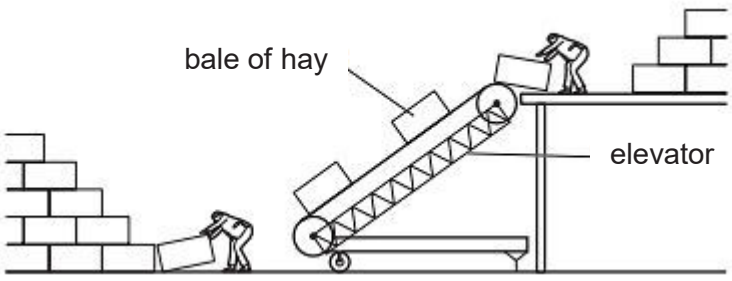
A Energy was destroyed as the ball hit the ground.

B Energy was destroyed as the ball travelled through the air.

C The thermal energy of the ball and its surroundings have increased.

D The chemical potential energy and elastic potential energy of the ball have increased.

14 Two farmers use an electrically powered elevator to lift bales of hay. All the bales of hay have the same mass.

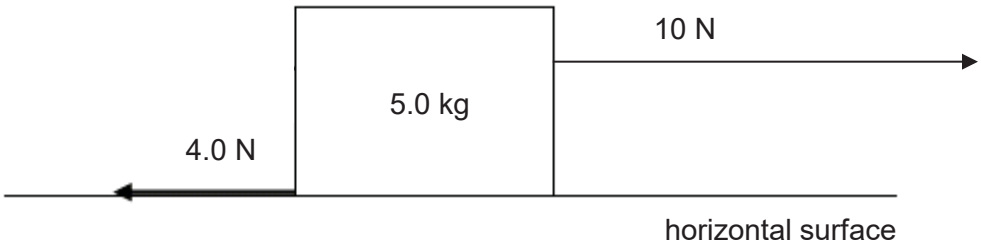


As sunset approaches, they decrease the speed of the elevator so that less bales are lifted up in a given time.

How does this affect the work done in lifting each bale and the useful output power of the elevator?

	work done in lifting each bale	useful output power of the elevator
A	decreases	increases
B	decreases	decreases
C	no change	increases
D	no change	decreases

15 A box with mass of 5.0 kg is pushed through a distance of 20 m along a horizontal surface by a uniform force of 10 N. The frictional force opposing the motion is 4.0 N.



How much of the work done is converted into thermal energy and kinetic energy?

	thermal energy / J	kinetic energy / J
A	80	120
B	120	200
C	80	200
D	120	120

16 When a gas is rapidly compressed to a smaller volume, its temperature increases.

What happens to the gas molecules?

A They move closer together and their average speed decreases.

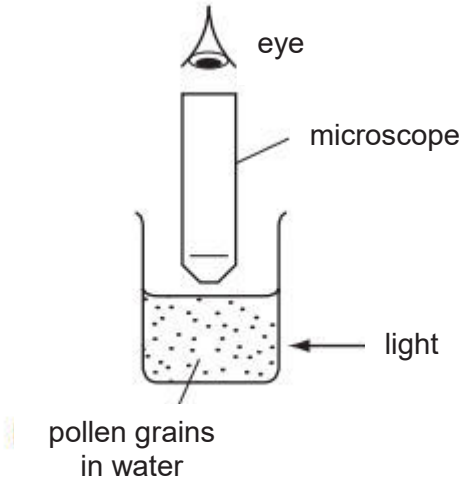
B They move closer together and their average speed increases.

C They decrease in size and their average speed remains unchanged.

D They decrease in size and their average speed increases.

17 Very small pollen grains are suspended in a beaker of water. A bright light shines from the side as shown in the diagram.

Small, bright dots of light are seen through a microscope. The dots move in rapidly changing, random directions.



What are the bright dots?

A pollen grains being hit by other pollen grains

B pollen grains being hit by water molecules

C water molecules being hit by other water molecules

D water molecules being hit by pollen grains

18 Which of the following objects gain heat by radiation only?

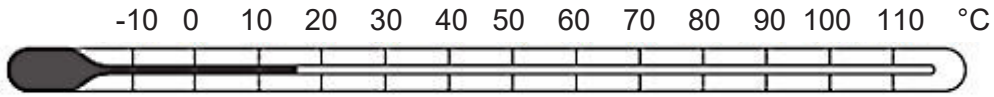
A an ice cube at 0 °C, in air

B a car with black metal surfaces at 35 °C, in air under the sun

C a metal ball with white surface at 25 °C, in water at 50 °C

D a shiny metal satellite at 28 °C, in space, facing the sun

19 A student wishes to check the upper and the lower fixed points on a Celsius scale thermometer.



She has four breakers P, Q, R and S.

- Beaker P contains a mixture of ice and salt.
- Beaker Q contains a mixture of ice and water.
- Beaker R contains boiling salt solution.
- Beaker S contains boiling water.

Which two beakers should she use to check the fixed points?

A P and R **B** P and S **C** Q and R **D** Q and S

20 The length of mercury in the bore of a thermometer is 5.0 cm at 0°C and 11.0 cm at 60°C.

What is the length of the mercury in the bore when the temperature is 45 °C?

A 3.3 cm **B** 4.5 cm **C** 8.3 cm **D** 9.5 cm

21 The same quantity of thermal energy is supplied to two solid objects W and X. The increase in temperature of object W is smaller than the increase in temperature of object X.

Which statement explains this?

A W has a higher melting point than X.

B W has a higher density than X.

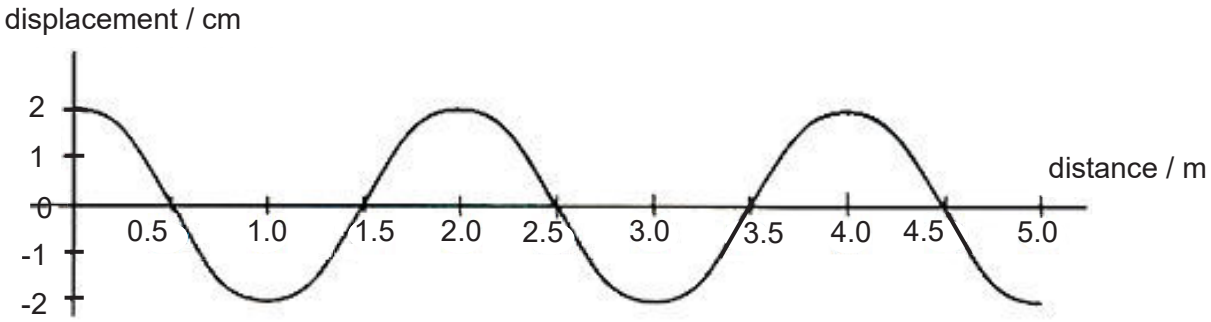
C W has a higher heat capacity than X.

D W is a better thermal conductor than X.

22 What happens to the speed, frequency and wavelength of a water wave as the depth of the water increases?

	speed	frequency	wavelength
A	increases	increases	increases
B	increases	remains constant	increases
C	decreases	increases	remains constant
D	decreases	remains constant	decreases

23 The diagram below shows a wave represented on a displacement-distance graph. The speed of the wave is 30 m/s.

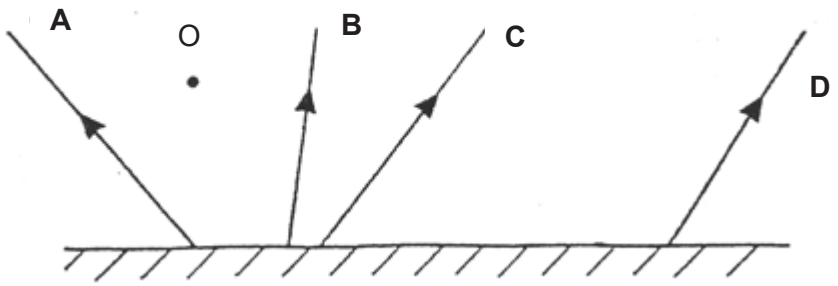


Which of the following information is correct about its amplitude and frequency?

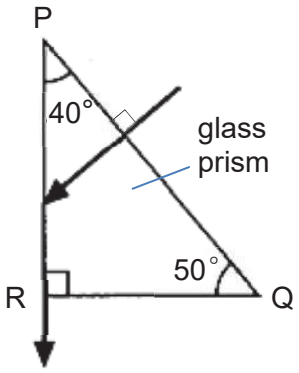
	amplitude	frequency
A	2.0 cm	15 Hz
B	2.0 cm	75 Hz
C	4.0 cm	15 Hz
D	4.0 cm	75 Hz

24 The diagram below shows the plane view of an object O placed in front of a plane mirror.

Which one of the reflected rays of light appears to come from the image of O?



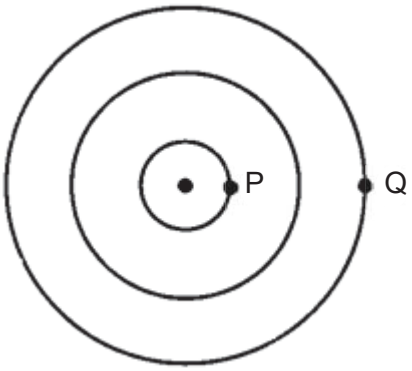
25 A ray of light enters a glass prism perpendicularly to the surface PQ and travels along the path as shown below.



What is the speed of light in glass?

A 1.93×10^8 m/s **B** 2.00×10^8 m/s **C** 2.05×10^8 m/s **D** 2.14×10^8 m/s

26 A pebble is dropped into a still water so that circular wavefronts are seen to travel outwards with a speed *v*.



If the wavelength is λ, what is the time taken for the disturbance at P to reach Q?

A $\lambda / (2v)$ **B** λ / v **C** $3\lambda / (2v)$ **D** $2\lambda / v$

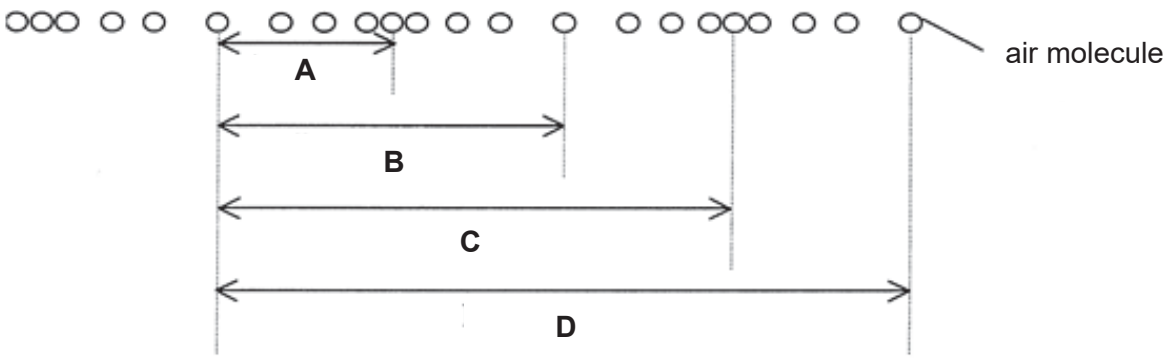
27 An infrared radiation is emitted at 6.7×10^{13} Hz.

What is its wavelength and period of oscillation?

	wavelength / m	period / s
A	4.48×10^{-6}	2.23×10^5
B	4.48×10^{-6}	1.49×10^{-14}
C	2.23×10^5	2.23×10^5
D	2.23×10^5	1.49×10^{-14}

28 The diagram below represents the position of the air molecules in a sound wave. The wavelength of this wave is 2.0 cm.

Which distance represents 4.0 cm?



29 Why are humans not able to hear ultrasound?

A The amplitude is too high.

B The frequency is too high.

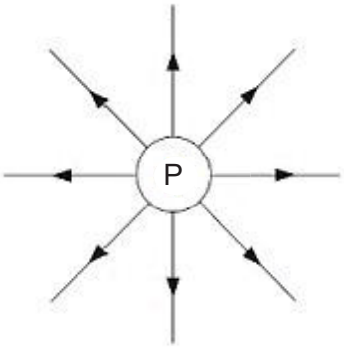
C The speed is too high.

D The wavelength is too long.

30 X, Y, Z and P are light insulated balls suspended on strings. When they are brought near each other, they behave as follows:

X repels Y,
X attracts Z and
Z repels P.

The electric field of P is given in the diagram below.



Which of the following statements must be true?

A Y must be positively charged.

B Y may be positively charged or neutral.

C Y may be neutral or negatively charged.

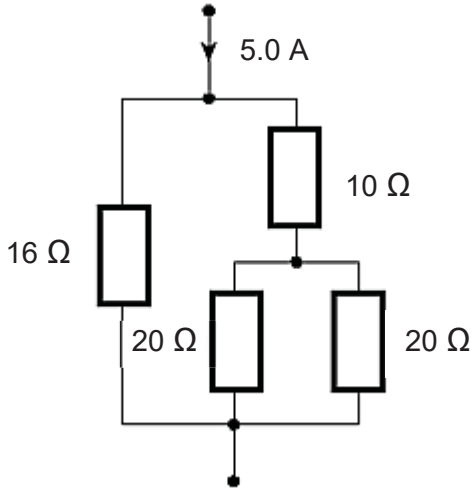
D Y must be negatively charged.

31 A spotlight labelled 240 V, 500 W is connected to a 240 V supply. The spotlight shines at normal brightness for 3 hours.

What is the size of the charge that passes through the spotlight in this time?

A 6.25 C **B** 375 C **C** 5 184 C **D** 22 500 C

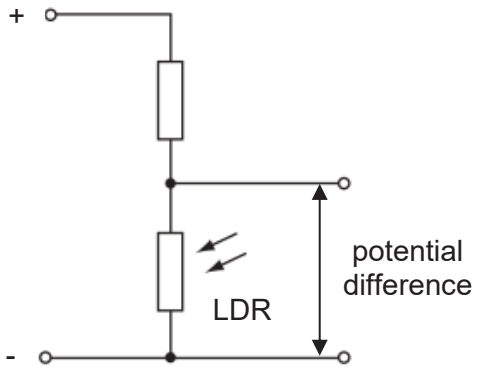
32 The following diagram shows part of a complete circuit.



What is the current through the 16 Ω resistor?

A 1.11 A **B** 1.39 A **C** 2.22 A **D** 2.78 A

33 The diagram shows part of a circuit used to switch street lamps on and off automatically.



Which row shows the effect on the resistance of the light-dependent resistor (LDR) and on the potential difference (p.d.) across it as it gets brighter?

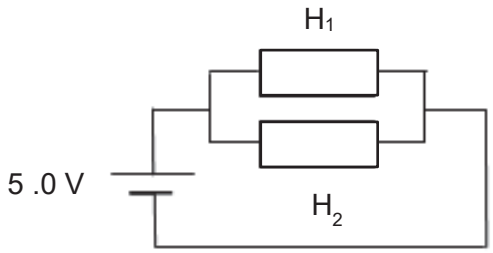
	resistance of LDR	p.d. across LDR
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

34 A 240 V electrical appliance is used for 200 hours. The current in the appliance is 6.5 A.

If one unit of electricity costs $0.22, what is the cost of using this electrical appliance?

A $10.56 **B** $34.32 **C** $68.64 **D** $286.00

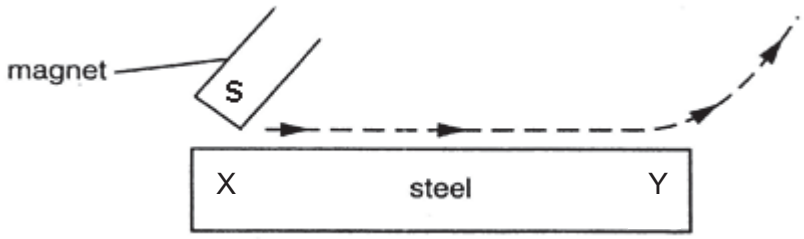
35 The diagram below shows a heater H_1 marked "10 V, 50 W" connected in parallel to another heater H_2 marked "10 V 25 W". Both heaters are connected to a 5.0 V supply.



If P_1 and P_2 are the powers dissipated in heaters H_1 and H_2 respectively, which of the following is correct?

	P_1 / W	P_2 / W
A	12.5	6.25
B	25	50
C	25	12.5
D	50	25

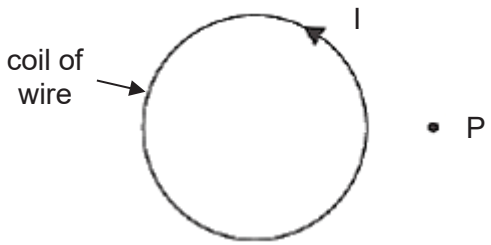
36 A piece of steel can be magnetised by stroking it with a magnet.



When the magnet is moved in the direction shown, which poles are produced at X and at Y?

	pole at X	pole at Y
A	south	south
B	south	north
C	north	south
D	north	north

37 A current I is flowing in a coil of wire in the direction shown.



Which of the following gives the correct direction of the magnetic field at point P?

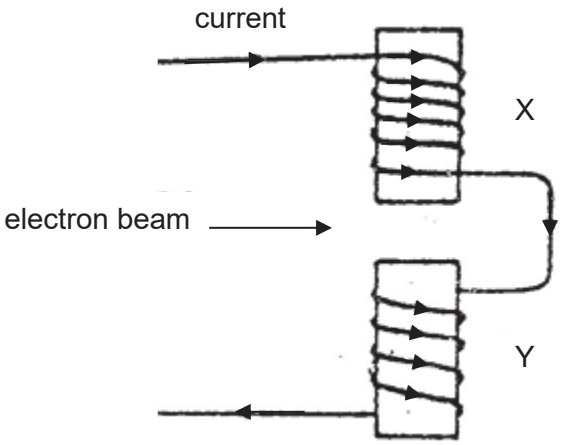
A out of the plane of the paper

B into the plane of the paper

C to the right

D to the left

38 An electron beam passes through a pair of electromagnets X and Y as shown below.



In which direction will the electron beam be deflected?

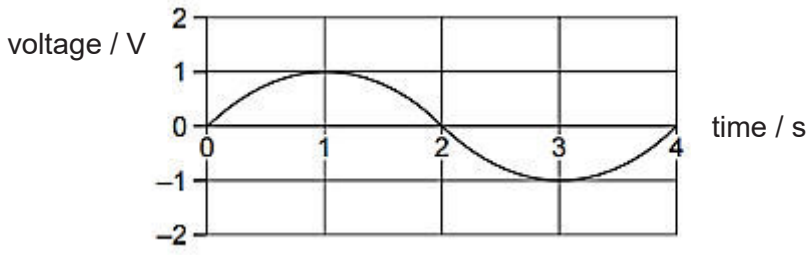
A towards X

B towards Y

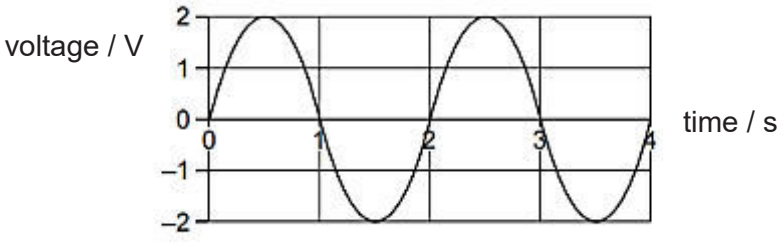
C into the paper

D out of the paper

39 A simple a.c. generator produces a voltage that varies with time as shown.



Some adjustments are made to the a.c. generator to produce the following graph.



What are the adjustments made?

	number of turns of the coil	speed of rotation
A	remains constant	doubled
B	doubled	doubled
C	remains constant	halved
D	doubled	halved

40 A door bell is designed to operate when connected to a 12 V supply. When connected to a transformer the current in the door bell is 1.5 A and it operates normally.

The transformer is connected to the 240 V mains supply and it has an efficiency of 90%.

What current is drawn from the mains supply?

A 0.075 A **B** 0.083 A **C** 27 A **D** 30 A

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Name: _____ ( ) Class: _____

Section B [30 marks]

Answer **all** the questions in this section.

Answer only one of the two alternative questions in **Q11**.

9 Fig. 9.1 shows a light shuttlecock that is used for playing badminton. In an experiment using electronic apparatus, a shuttlecock is released from rest and the distance d fallen is measured at different times t.

Fig. 9.1

Fig. 9.2 shows the results obtained when the shuttlecock is dropped from a height of a few metres.

t / s	d / m
0	0
0.20	0.19
0.40	0.74
0.60	1.56
0.80	2.56
1.00	3.68
1.20	4.86
1.40	6.06
1.60	7.31
1.80	8.56
2.00	9.81

Fig. 9.2

(a) On Fig. 9.1, draw and label the forces acting on the falling shuttlecock. [1]

(b) Explain how the data in Fig. 9.2 for the light shuttlecock suggest that the speed is increasing at t = 0.40 s.

.....

.....

..... [1]

(c) Using the data in Fig. 9.2, determine the terminal velocity of the light shuttlecock.

terminal velocity = ... [2]

(d) Explain, in terms of forces,

(i) why the shuttlecock accelerates at first,

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..... [2]

(ii) why the shuttlecock reaches a steady speed.

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..... [2]

(e) Explain what will happen to the terminal speed of a shuttlecock which has a mass added inside the cone of the shuttlecock.

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..... [2]

10 **(a)** Fig. 10.1 shows a simple alternating current (a.c.) generator which can be used to generate electricity.

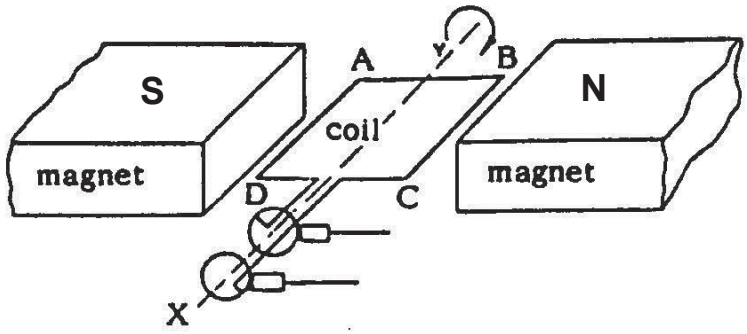

Fig. 10.1

(i) State the name of the two rings shown in Fig. 10.1.

..... [1]

(ii) The rectangular coil is rotated clockwise as shown in Fig. 10.1. Draw an arrow in Fig. 10.1 to indicate the direction of the induced current in wire BC. [1]

(b) A farmer connects a house to the mains supply of electricity. The house is at a long distance from the nearest 230 V mains supply of electricity.

Fig.10.2 shows the mains supply connected to the house.

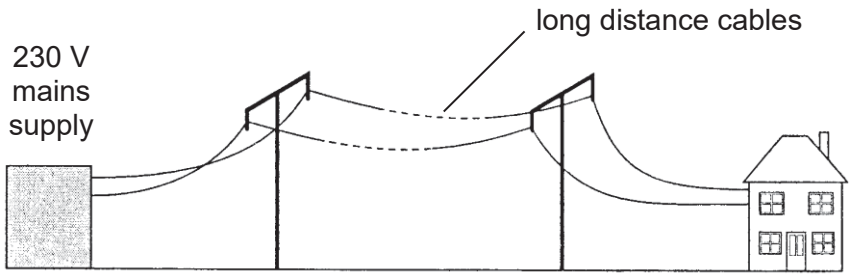

Fig. 10.2

(i) The farmer uses 230 V lamps in the house but they do not light up at their normal brightness. Explain why the lamps are dim.

.....

..... [1]

(ii) The farmer added transformers, as shown in Fig.10.3.

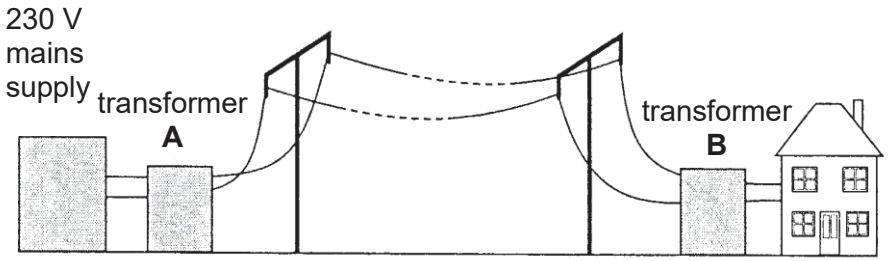

Fig. 10.3

The lamps in the distant house light up at normal brightness. Explain why the lamps are now brighter.

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.....

..... [2]

(c) Fig. 10.4 shows a transformer with 2 coils, Q and R, which are wound on an iron core.

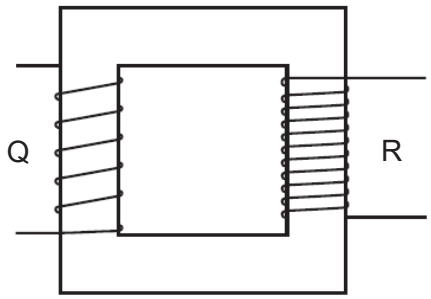

Fig. 10.4

Coil Q has 200 turns and coil R has 600 turns. The e.m.f. induced across coil R is 24 V. The transformer operates with 100% efficiency.

(i) Calculate the voltage of the power supply provided to coil Q,

voltage = ...[2]

(ii) Explain why an alternating current supply should be connected to coil Q in order for the transformer to work properly.

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..... [3]

Either

11 A student performs an experiment with a semicircular glass block and a ray of white light. Fig. 11.1 shows the path taken by this ray of light as it enters the glass at P until it hits the straight edge at Q.

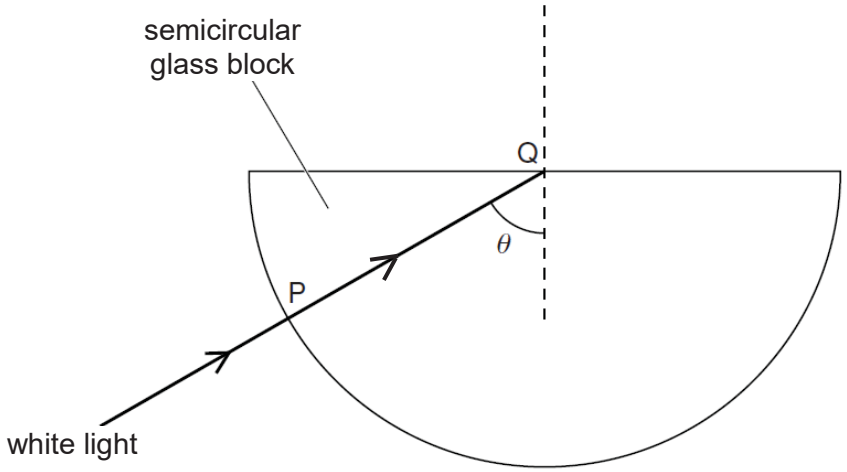

Fig. 11.1

The student finds that there is no change in direction as the ray enters the glass at P and that no light passes out of the glass at Q. The glass block has a refractive index of 1.6.

(a) Explain what is meant by a refractive index of 1.6.

.....

..... [1]

(b) Calculate the critical angle of the glass block.

critical angle = ...[2]

(c) Explain why the light ray does not change direction at P.

.....

..... [1]

(d) If the angle θ is 60°, explain what will happen to the light ray at Q.

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..... [2]

(e) The student directs the ray of light into the glass along different paths by reducing the angle θ slowly.

Describe the changes to the path of light at Q.

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.....

.....

..... [2]

(f) Visible light is part of electromagnetic spectrum.

If visible light has a frequency of 6.0×10^{14} Hz in vacuum, calculate its wavelength.

wavelength = ...[2]

OR

11 **(a)** Fig. 11.2 shows an electrical circuit. The e.m.f. of the battery is 6.0 V. R_1 and R_2 are identical resistors. When switch S is open, the ammeter reading is 0.60 A and the voltmeter reading is 2.4 V.

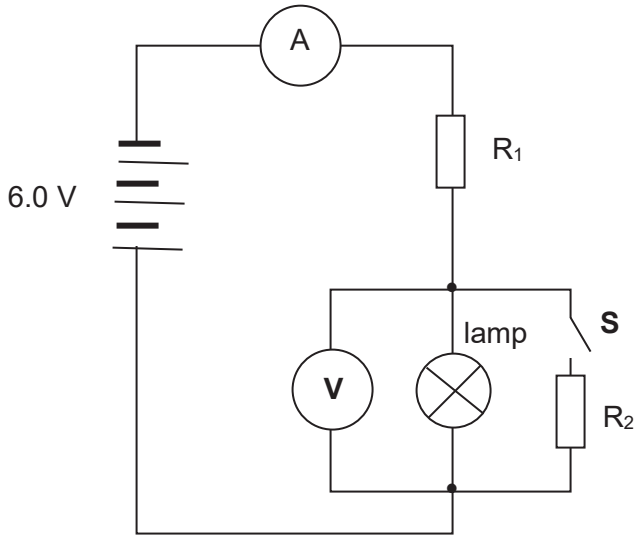

Fig. 11.2

(i) State what is meant by the battery has an *e.m.f. of 6.0 V.*

.....

..... [1]

(ii) Calculate the resistance of the lamp.

resistance of lamp = ...[2]

(iii) Calculate the resistance of resistor R_1.

resistance of R_1 = ...[2]

(iv) The switch **S** is then closed. Compare the brightness of the lamp now with the brightness of the lamp when the switch **S** is open. Explain your answer.

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..... [2]

(b) Fig. 11.3 shows a simplified diagram of an electrical appliance connected with Live (L), Neutral (N) and Earth (E) wires.

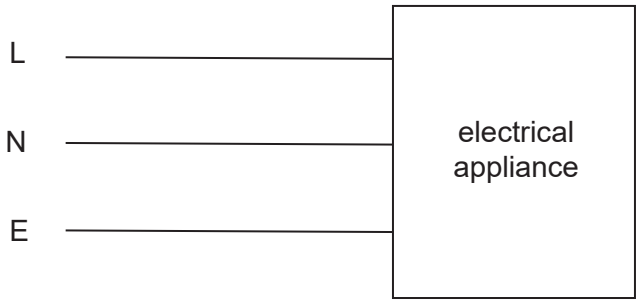

Fig. 11.3

(i) If a fuse is to be added as a safety device in the circuit shown in Fig. 11.3, draw a "X" in Fig. 11.3 where the fuse should be placed. [1]

(ii) Explain your answer for **(b)(i)**.

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..... [2]

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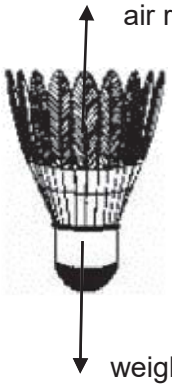
1	2	3	4	5	6	7	8	9	10
C	D	D	C	A	C	A	A	C	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	D	C	D	A	B	B	D	D	D
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
C	B	A	C	A	D	B	D	B	D
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
D	D	A	C	A	B	B	C	A	B

Physics Prelim P2 Answer Scheme

Section B

9(a)



correct arrows & label

weight and air resistance : [1]

(b) From t = 0.20 s to 0.40 s, the distance travelled travelled is (0.74 – 0.19) = 0.55 m.
From t = 0.40 s to 0.60 s, the distance travelled travelled is (1.56 – 0.74) = 0.82 m.

Since the distance travelled for the same period of time (0.02 s) increases,
the speed of the shuttle cock increases at t = 0.40 s. [1]

(c) terminal velocity = change in distance / time
= (9.81 – 6.06) / (2.00 - 1.40) [1]
= 6.25 m/s [1]

(d)(i) The shuttlecock falls due to its weight.
Its weight acting downwards is greater than the air resistance acting upwards. [1]
There is a downward resultant force. [1]
Thus, the shuttlecock accelerates downwards since a = F/m where m is constant.

(ii) As the speed of the shuttlecock increases, the air resistance acting upwards
increases until it is equal to the weight (downwards) of the shuttlecock. [1]
There is no resultant force acting on the shuttlecock, and thus there is no
acceleration for the shuttlecock since a = F/m where m is constant. [1]
Hence, the shuttlecock reaches its steady speed.

(e) The shuttlecock with greater mass has a greater weight.
It needs greater air resistance acting against it.
It takes a longer time for the air resistance to be equal to the new total weight. [1]
Thus, a greater terminal speed is reached. [1]

10 (a) (i) Slip rings. [1]

(ii) Direction of induced current is from C to B. [1]

(b) (i) The long distance cables has (relatively high) resistance, [1]
There is power/energy loss (or voltage drop) in the cable since $P = I^2R$. [1]

(ii) Transformer A steps-up the voltage, so the current in the transmission cable is lower.
This reduces the power / energy loss in cable since since $P = I^2R$. [1]
Transformer B is then used to step down the voltage to 230 V which will cause the lamps to light up at normal brightness. [1]

(c) (i) $Vs / V p = Ns / Np$
$24 / Vp = 600 / 200$ [1]
$Vp = 8.0$ V [1]

(ii) A.C. is a current that changes magnitude and direction. [1]
Hence the primary coil Q will produce a changing magnetic field. [1]
(The iron core will concentrate and link the magnetic field to coil R.)
Hence, there will be a change in magnetic field cutting coil R and there will be induced emf/current in coil R. [1]

Either

11 (a) Refractive index is the ratio of speed of light in vacuum to the speed of light in medium (glass) is 1.6. [1]

(b) $n = 1/\sin c$
$1.6 = 1/\sin c$ [1]
$C = 38.7^0$ or 39^0 [1]

(c) The ray hits the surface perpendicularly ($i = 0^0$). Hence, it will not change direction. [1]

(d) Total internal reflection will occur. [1]
It is because the ray is travelling from an optically denser medium to a less dense medium and the angle of incidence is greater than critical angle. [1]

(e) When i = critical angle (39^0), the ray will travel along the horizontal edge of the glass block. [1]
When $i < 39^0$, the ray will refract out of the glass block, bending away from the normal. [1]

(f) $v = f \times \text{wavelength}$
$3.0 \times 10^8 = 6.0 \times 10^{14} \times \text{wavelength}$
$\text{Wavelength} = 5.0 \times 10^{-7}$ m

OR

11 (a) (i) The work done by the source in driving a unit charge round a complete circuit is 6 J. [1]

(ii) Resistance of lamp = V/ I
= 2.4 / 0.6 [1]
= 4.0 Ω [1]

(iii) p.d. across R_1 = 6.0 – 2.4
= 3.6 V
R_1 = V /I
= 3.6 / 0.60 [1]
= 6.0 Ω [1]

(iv) When the switch S is closed, the total resistance of R_1 and lamp decreases (denotes as R'). [1]

The p.d. across the lamp decreases since $V_{lamp} = (R'/ R' + R_1) \times 6.0$.
Thus, the lamp is dimmer as it has lower power, $P = V^2/R$ where R is the resistance of lamp and is constant. [1]

(b) (i) "X" should be on the positive terminal side of the cell. [1]

(ii) When the current exceeds the fuse rating, the fuse will melt and open the circuit. [1]
It will disconnect the circuit from the high voltage at the live wire and prevent overheating of the circuit. [1]

End of Paper