Name	Class	Index Number

UNITY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2019

SECONDARY FOUR EXPRESS

PHYSICS 6091/01 **18 SEPTEMBER 2019**

PAPER 1 **1 HOUR**

Additional Materials : Optical Answer Sheet

READ THESE INSTRUCTIONS FIRST

1. This paper consists of **40** Multiple Choice Questions.
2. Answer all questions on the Optical Answer Sheet (**OAS**).
3. Write your name, class and shade your register number in the spaces on the **OAS**
4. Do not fold nor use any correction fluid on the **OAS**. Read the instructions on the **OAS** carefully.
5. The total mark for this paper is 40 marks.

This paper consists of **19** printed pages, including this cover page.

1 Which of the following statements is **CORRECT**?

A The length of a bus is about 1×10^2 m.

B The diameter of an atom is about 1×10^{-5} m.

C The diameter of the Earth is about 1×10^7 m.

D The thickness of a human's hair is about 1×10^{-2} m.

2 Figure I shows the reading of the zero error of the micrometer screw gauge. Figure II shows the reading of the same instrument when it is used to measure the width of an object.

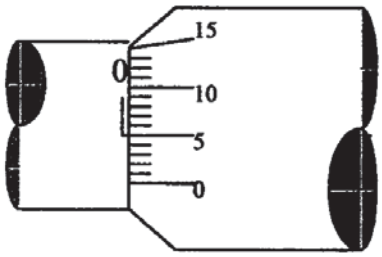


Figure I

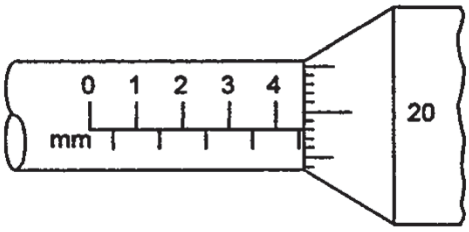


Figure II

What is the actual width of the object?

A 4.63 mm

B 4.73 mm

C 4.83 mm

D 4.85 mm

3 A car travels for 10 m in 2 seconds.

What can be deduced from the information given?

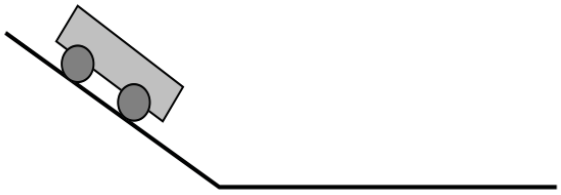
A The average speed of the car is 5 m/s.

B The car travels at a constant speed.

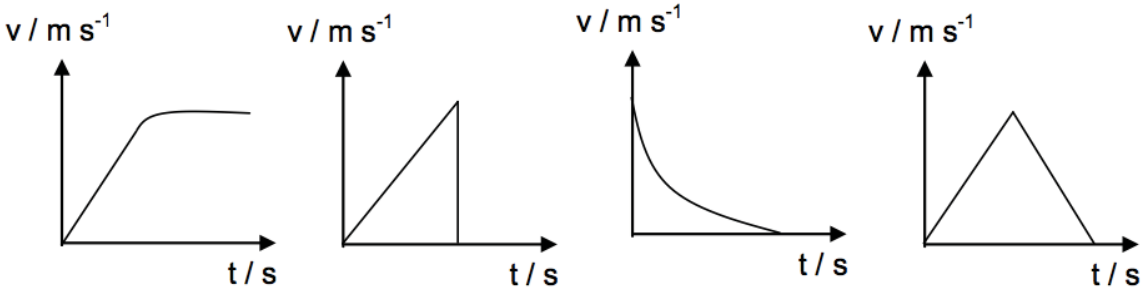
C The maximum speed of the car is 5 m/s.

D The minimum speed of the car is 5 m/s.

4 The diagram shows a trolley that starts rolling down a sloping runway connected to a flat floor. Assume all the surfaces are frictionless.



Which of the following velocity-time graphs best illustrates the motion of the trolley?



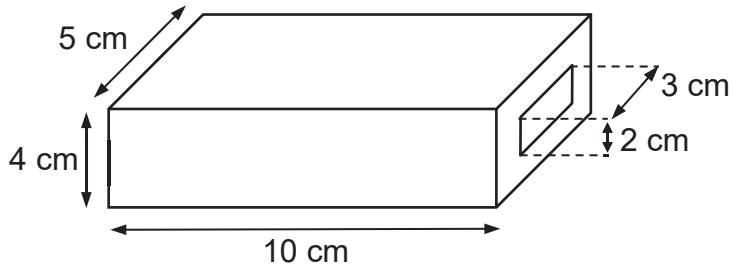
5 The total mass of a skydiver and her equipment is 80.0 kg when she jumps from an aircraft. When the parachute just opens, she decelerates at 2.5 m/s^2.

What is the tension in the cord at this instance?

A 200 N **B** 600 N

C 800 N **D** 1000 N

6 A hollow rectangle metal block has the dimensions shown. The hole in the middle goes all the way through the block. The density of the metal is 10 g/cm^3.



What is the mass of the block?

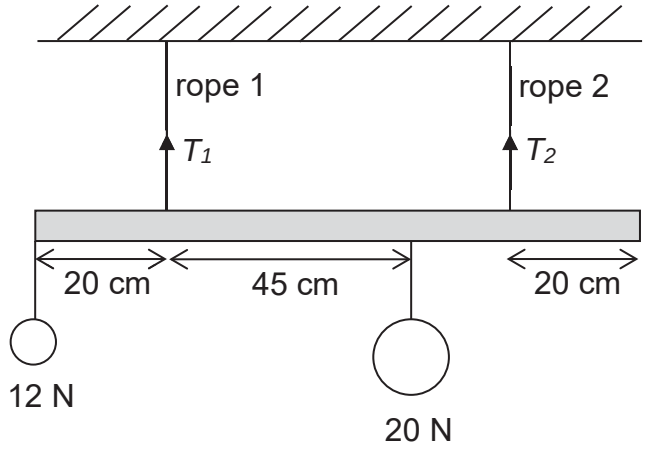
A 14 g

B 400 g

C 1400 g

D 2000 g

7 The figure below shows a metre rule hanging from the ceiling using two ropes. Two weights, 12 N and 20 N, are attached to the metre rule.

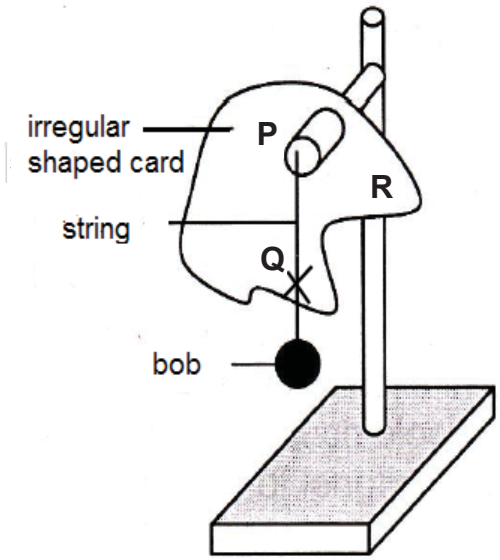


Assuming the weight of the metre rule is negligible, what is the tension T_2?

A 11 N **B** 12 N

C 21 N **D** 32 N

8 The diagram shows the first step in an experiment to determine the position of the centre of gravity of mass of an irregular shaped card.



What is the next step in this experiment?

A find the mid-point of **PQ**

B hang the card from **R**

C measure the mass of the card

D measure the thickness of the card

9 Which of the following objects is in neutral equilibrium?

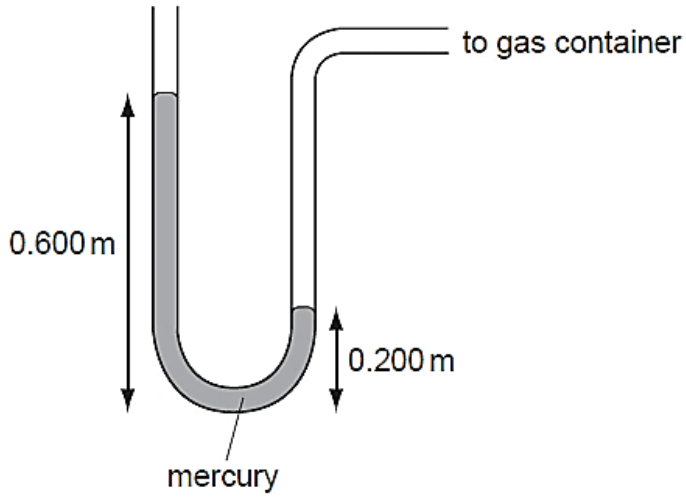
A a pencil balanced on its sharp tip

B a playground swing that is at rest

C a traffic cone that is upright

D an ice cream cone resting on its slant edge

10 The diagram shows a mercury manometer connected to a gas container. The density of mercury is 13 600 kg/m^3. The gravitational field strength g is 10 N/kg.



What is the pressure difference between the gas in the container and the atmosphere?

A 27 200 Pa **B** 40 800 Pa

C 54 400 Pa **D** 81 600 Pa

11 A lift of mass 1000 kg rises 50 m in 2.0 minutes.

If the efficiency of the lift is 80 %, what is the power supplied to the motor? (The gravitational field strength on Earth, g, is 10 N/kg.)

A 3.33 kW

B 5.00 kW

C 5.21 kW

D 250 kW

12 A tungsten wire has a resistance of 30 Ω at -10 °C and 50 Ω at 90 °C.

What is the working temperature of the wire if its resistance is 70 Ω?

A 100 °C **B** 170 °C

C 190 °C **D** 210 °C

13 Diagram I shows a thermocouple with junction **P** and **Q**. The millivoltmeter shows a deflection that depends on the temperature difference between the junctions **P** and **Q**. Diagram II shows how the temperature difference between junctions **P** and **Q** corresponds to the deflection in the millivoltmeter.

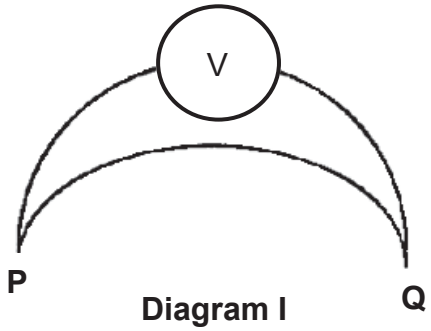


Diagram I

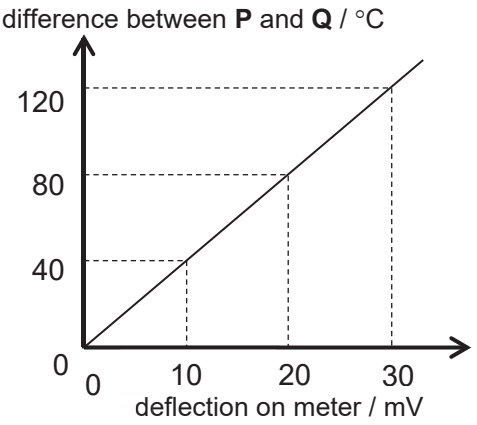


Diagram II

If **P** is placed in a substance of 20 °C and **Q** is placed in another substance of higher temperature, a deflection of 30 mV is seen.

What is the temperature of **Q**?

A 20 °C **B** 100 °C

C 120 °C **D** 140 °C

14 A gas in a sealed cylinder with fixed volume is heated.

Which of the following does **NOT** increase as the gas is heated?

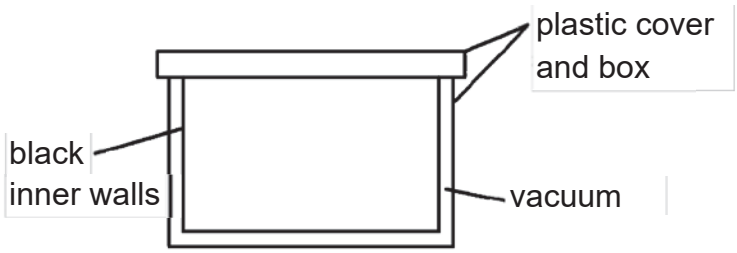
A The average distance between the gas molecules.

B The average kinetic energy of the gas molecules.

C The average number of gas molecules hitting the cylinder walls per second.

D The average speed of the gas molecules.

15 The diagram below shows the cross-section of a plastic container that a manufacturing company has created.



The company claims that the container can keep food warm for a duration that surpasses other brands of container. It offers the following explanations to justify their claims:

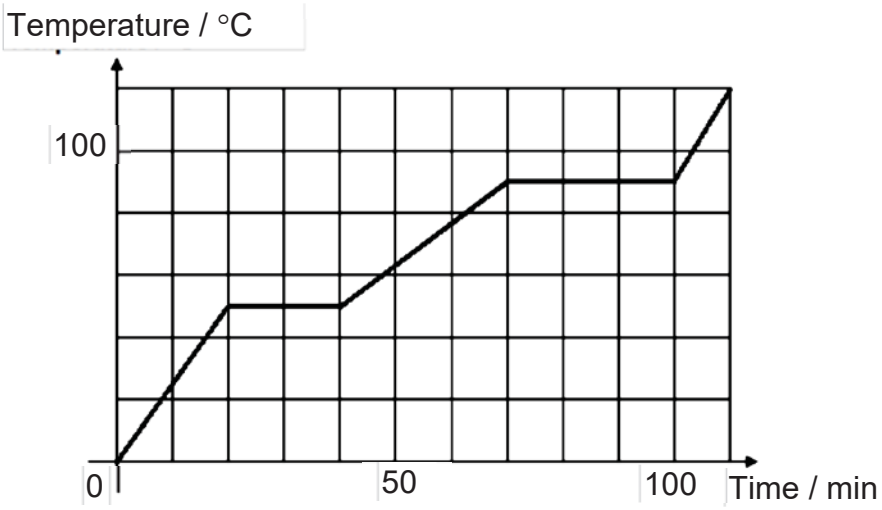
1. The plastic cover will reduce heat loss through conduction as plastic is a poor conductor of heat.
2. The black inner walls will absorb heat from the environment to keep food warm since black surfaces are good absorbers of heat.
3. The vacuum between the interior and exterior walls of the container will prevent heat losses to the surroundings through conduction, convection and radiation.

Which of the statements is/are **CORRECT**?

A 1 only **B** 1 and 2 only

C 2 and 3 only **D** All of the above

16 The graph shows the change in temperature when heat is supplied at 200 W to 1 kg of the substance.



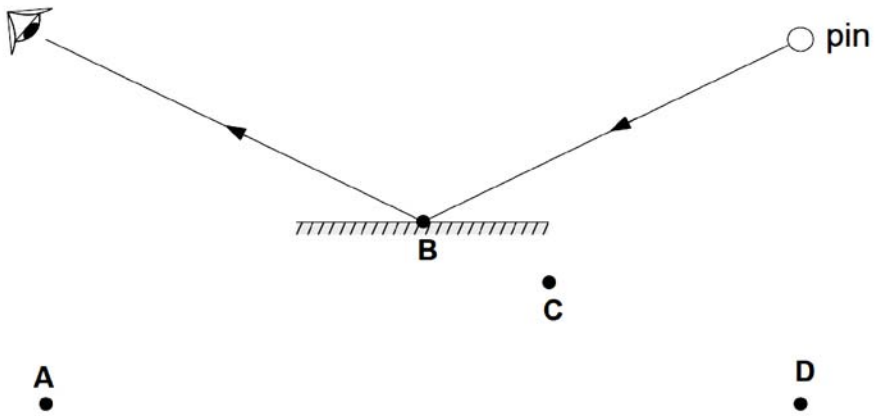
The specific latent heat of vaporisation of the substance is _____ J/kg.

A 4 000 **B** 6 000

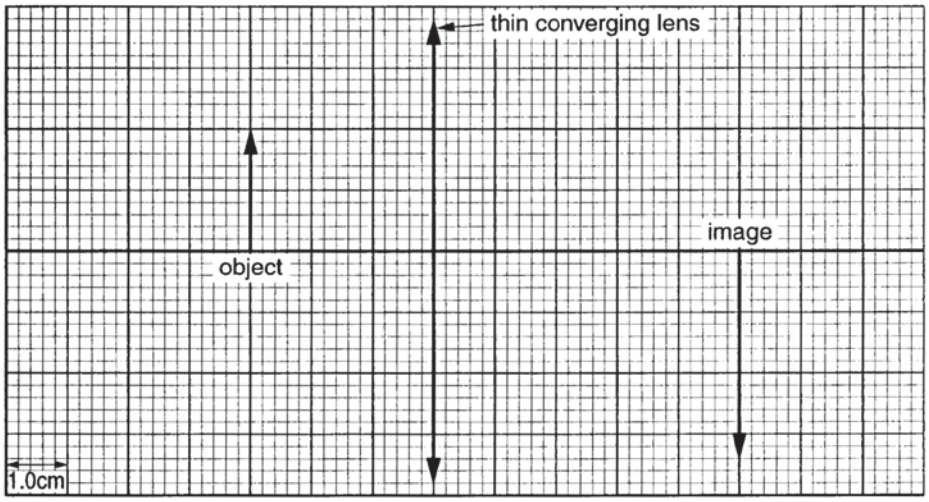
C 240 000 **D** 360 000

17 A pin is placed in front of a plane mirror as shown.

Where is the image of the pin?



18 The diagram below shows an image of an object formed by a thin converging lens.



The lens is replaced with another lens of twice the focal length.

What are the properties of the new image?

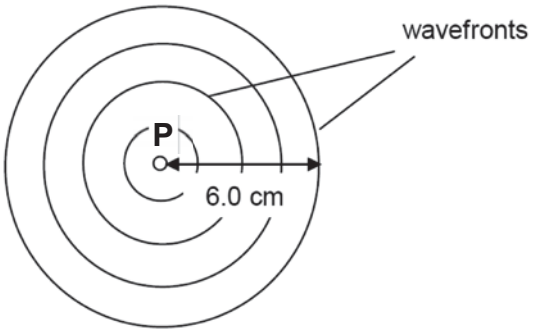
A real, inverted, diminished

B real, inverted, same size

C real, inverted, enlarged

D virtual, upright, enlarged

19 The diagram below shows circular wavefronts radiating from a point source **P**.



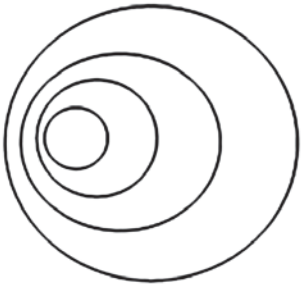
The point source is then set to vibrate with a gradually decreasing frequency.

Which of the following shows the possible resulting wavefronts?

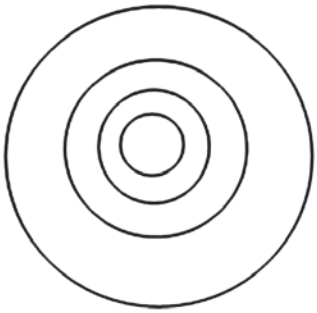
A

B

C



D



20 The wavelength of X-rays is roughly the size of an atom.

What is the frequency of the X-rays?

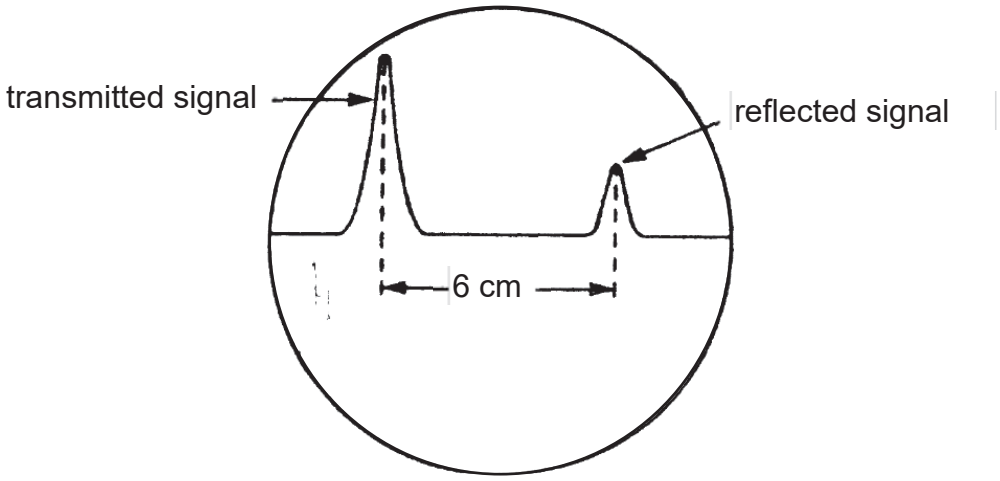
A 1×10^{-10} Hz

B 3×10^{8} Hz

C 1×10^{10} Hz

D 3×10^{18} Hz

21 Sonar waves are emitted from a surface vessel to determine the depth of the sea. The emitted signal and its reflection from the sea bed are displayed on the screen of a cathode-ray oscilloscope as shown below.



Given that the speed of sound in water is 1200 m/s and that the time-base of the oscilloscope is 8 cm/s. What is the depth of the sea at this point?

A 450 m

B 800 m

C 900 m

D 7200 m

22 The frequencies of two musical notes **X** and **Y** are 256 Hz and 512 Hz respectively.

If **X** and **Y** have the same amplitude, which of the following statements is/are **TRUE**?

1. **Y** has a higher pitch than **X**.
2. The loudness of **X** is larger than that of **Y**.
3. The wavelength of **Y** is longer than that of **X**.

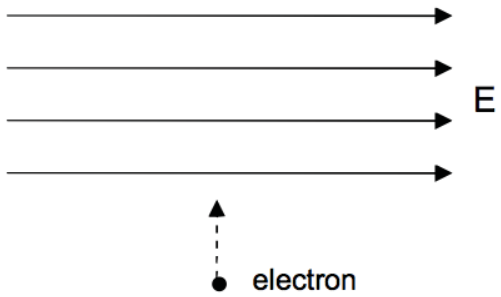
A 1 only

B 3 only

C 1 and 3 only

D 2 and 3 only

23 An electron is projected at right angles to a uniform electric field **E** as shown in the diagram.



In the absence of other fields, in which direction is the electron deflected?

A to the left

B to the right

C into the plane of the paper

D out of the plane of the paper

24 A bird is seen standing safely on a high voltage transmission line.

Which statement best explains this?

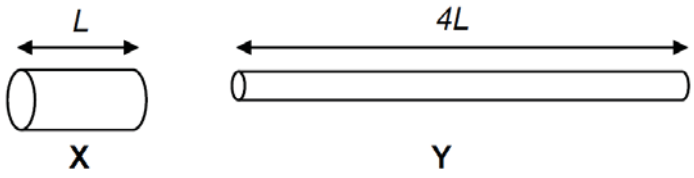
A The body of the bird has a high resistance.

B The scaly feet of the bird are good insulators.

C The trapped air in the feathers of the bird acts as an electrical insulator.

D There is negligible potential difference between the two feet.

25 The diagram below shows two copper wires **X** and **Y**. Both wires have the same volume and wire **Y** is four times as long as wire **X**.



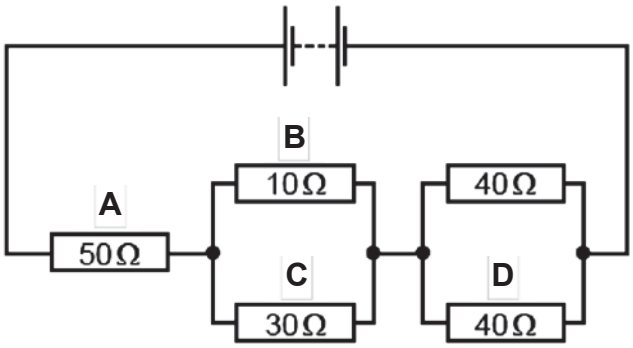
What is the ratio of the resistance of wire **Y** to resistance of wire **X**?

A 4:1 **B** 8:1

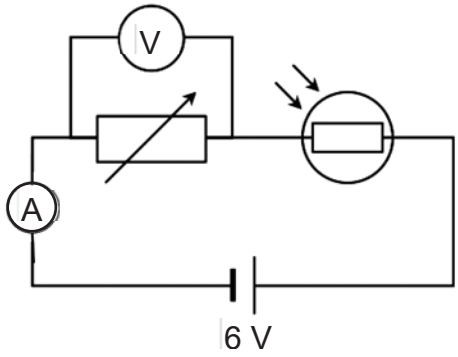
C 16:1 **D** 64:1

26 The diagram shows a circuit containing five resistors connected to a battery.

Through which resistor is the current the smallest?



27 The diagram below shows a circuit with a variable resistor and light dependent resistor (LDR) connected in series.



When light shines brighter on the LDR, what will happen to the reading on the ammeter and voltmeter?

	ammeter reading	**voltmeter reading**
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

28 An electrical circuit uses insulated copper wire and the wire overheats.

Which of the following correctly explains how the wire should be replaced to prevent it from overheating again?

A Use thicker copper wire which has less resistance.

B Use thicker insulation to reduce conduction.

C Use thinner copper wire which has more resistance.

D Use thinner insulation to reduce conduction.

29 Ben connects a fuse along the neutral wire of a fan.

Which of the following statement(s) is/are **CORRECT**?

1. The fan will be safe to touch after the fuse blows.
2. When there is a large current, the fuse will blow and prevents the fan from overheat.
3. There is no current passing through the neutral wire after the fuse blows.

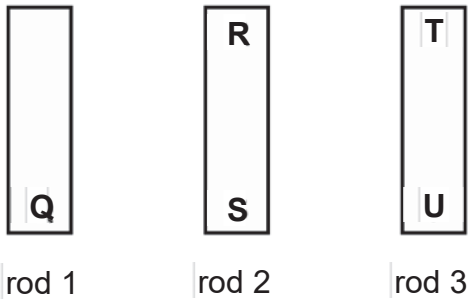
A 3 only

B 1 and 2 only

C 1 and 3 only

D 2 and 3 only

30 The ends of three metal rods are tested by holding end **Q** of rod 1 close to the others in turn.



The results are as follows:

End **Q** attracts end **R**.
End **Q** attracts end **S**.
End **Q** attracts end **T**.
End **Q** repels end **U**.

Which metal rod is a magnet?

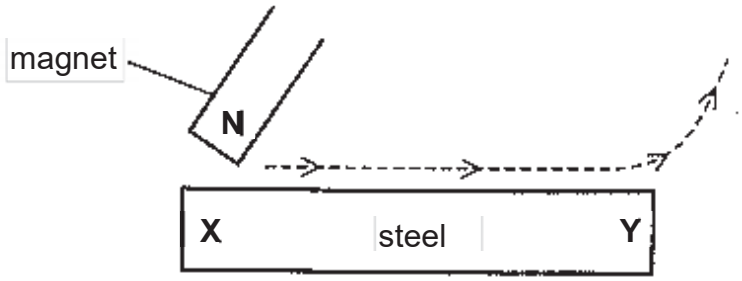
A rod 1 only

B rod 1 and rod 2

C rod 1 and rod 3

D rod 3 only

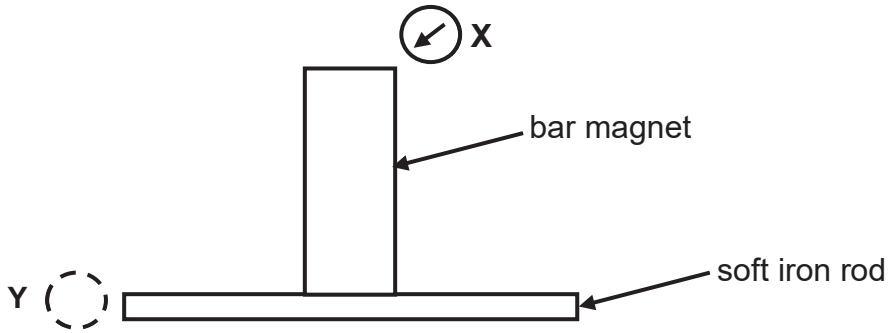
31 A piece of steel can be magnetised by stroking it with a magnet.



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

	X	**Y**
A	North	North
B	South	North
C	North	South
D	South	South

32 A soft iron rod is attracted by a bar magnet as shown the diagram below. When a plotting compass is placed at **X**, the needle points in a direction as shown.



Which of the following shows the correct direction of the compass needle when it is moved from position **X** to **Y**. (Ignore earth's magnetic field)

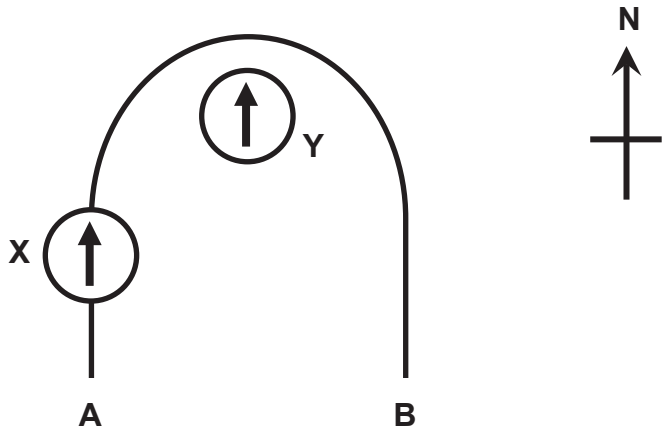
A 

B 

C 

D 

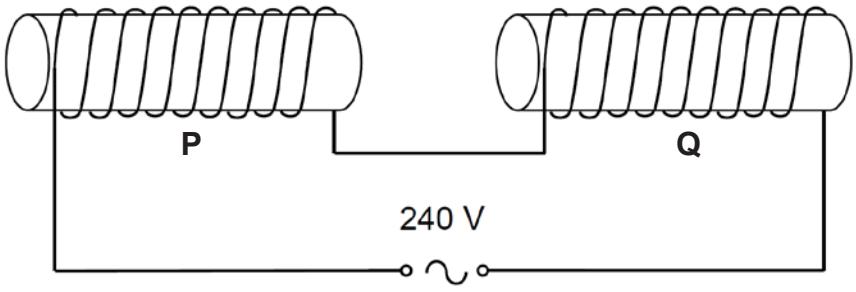
33 The diagram shows a wire **AB** that is bent into a U-shape and placed along the earth's north-south direction. Two plotting compasses are placed at the positions **X** and **Y**. The compass at **X** is above the wire.



What will happen when a current flows from **A** to **B** in the wire?

	compass at X	**compass at Y**
A	deflects to the right	remains in the position shown
B	deflects to the right	deflects to the left
C	deflects to the left	deflects to the right
D	remains in the position shown	remains in the position shown

34 Two iron bars **P** and **Q** are placed inside two solenoids as shown below.



What will happen to **P** and **Q**, when the solenoids are connected to an a.c. power supply?

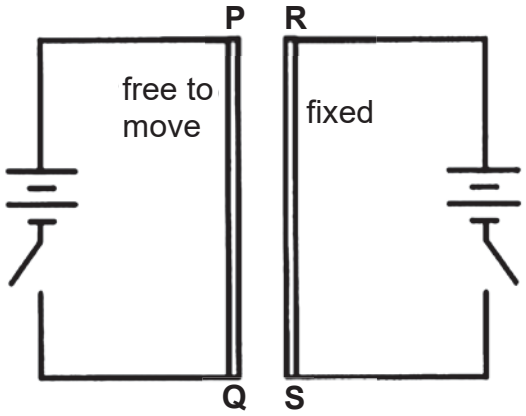
A repel each other

B attract each other

C oscillate towards and away from each other.

D oscillate upwards and downwards

35 Two long parallel wires **PQ** and **RS** are connected to batteries as shown in the diagram. **PQ** can move freely in any direction but **RS** is fixed.



When both switches are closed, what happens to wire **PQ**?

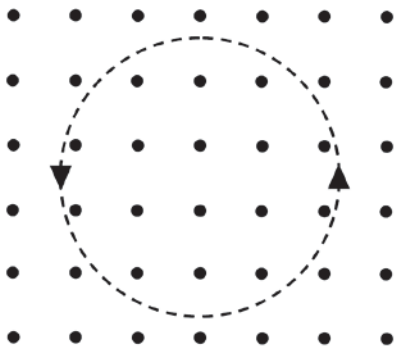
A **PQ** moves away from **RS**.

B **PQ** moves towards **RS**.

C **PQ** moves in a direction into the plane of the paper.

D **PQ** moves in a direction out of the plane of the paper.

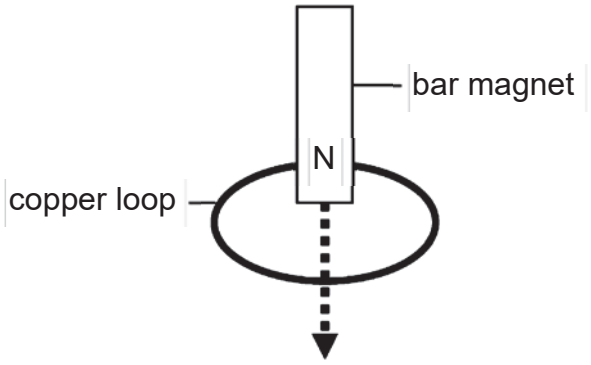
36 The diagram below shows the circular anti-clockwise path of a charged particle in a field. The direction of the field is out of the paper.



Ignoring the effect of gravity, which of the following correctly describes a possible state of charge of the particle and the nature of the field?

	charge	**field**
A	negative	magnetic
B	positive	electric
C	negative	electric
D	positive	magnetic

37 A bar magnet is dropped through a loop of copper wire as shown.



Which of the following statement(s) is/are **CORRECT**?

1. When the magnet approaches the copper loop, a current is induced in the loop that flows in clockwise as seen by the observer from the top of the loop.

2. When the magnet moves through the copper loop, the current induced in the copper loop sets up a magnetic field that always repel the magnet.

3. Heat is produced in the copper loop.

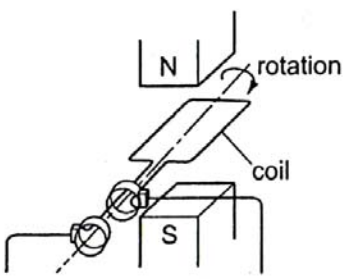
A 2 only

B 1 and 2 only

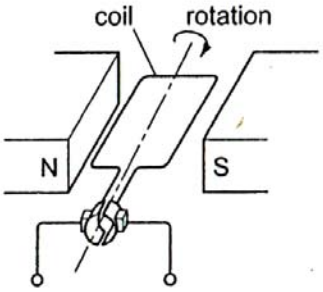
C 2 and 3 only

D 3 only

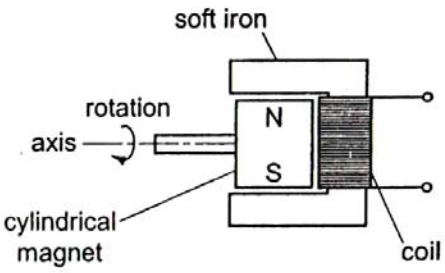
38 The diagrams show three generators, **X**, **Y** and **Z**.



X



Y



Z

Which is/are alternating current generator(s)?

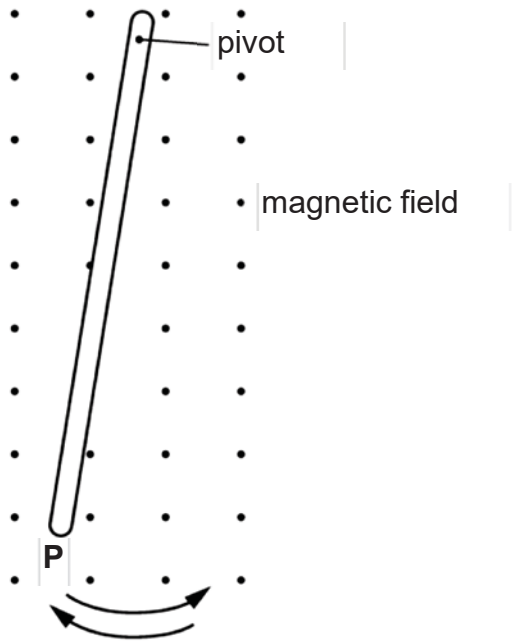
A **X** only

B **Y** only

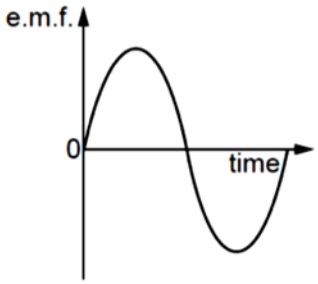
C **X** and **Y** only

D **X** and **Z** only

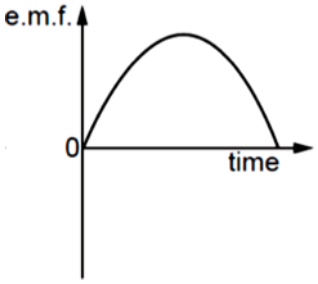
39 The diagram shows a metal bar swinging like a pendulum across a uniform magnetic field. The motion induces an e.m.f. between the ends of the bar.



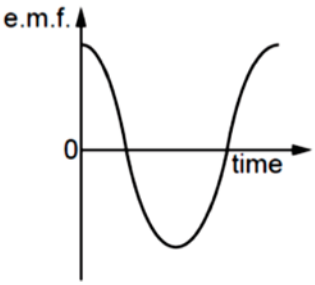
Which graph represents this e.m.f. during one complete oscillation of the bar, starting and finishing at **P**?



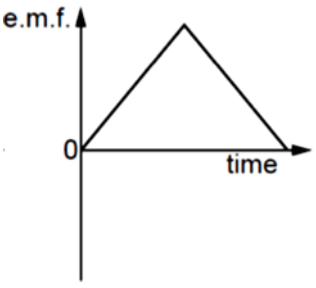
A



B



C



D

40 The number of turns in a primary coil and secondary coil of a transformer is N_p and N_s respectively.

Which pairs of values for N_p and N_s will result in an output voltage of 240 V when the input voltage is 20 000 V?

	N_p	N_s
A	2 000	240
B	10 000	240
C	10 000	480
D	30 000	360

*****END OF PAPER*****

Name	Class	Index Number

UNITY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2019

SECONDARY FOUR EXPRESS

PHYSICS 6091/02 **18 SEPTEMBER 2019**

PAPER 2 **1 HOUR 45 MINUTES**

Additional Materials : NIL

READ THESE INSTRUCTIONS FIRST

1. Answer **ALL** questions in Section **A** on the question paper.
2. In **Section B**, answer Questions **10** and **11**, and ***either part*** of Question **12**. Write your answers in the spaces provided on the question paper.
3. All workings and constructions must be shown clearly. **Omission of essential working will result in loss of marks**
4. The number of marks is given in brackets [ ] at the end of each question or part question.
5. You are expected to use an electronic calculator to evaluate explicit numerical expression.
6. The total mark for this paper is 80 marks.

This paper consists of **19** printed pages, including this cover page.

Section A [50 Marks]

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

1 A fisherman's buoy is held submerged in sea water by a rope anchored to the sea bed. Currents in the sea cause the buoy to be displaced so that the rope makes an angle of 30° with the vertical as shown in Fig. 1.1.

The buoy may be considered to be acted upon by three forces: the tension *T* in the rope which is 600 N, a horizontal force of sea current *D* and a vertical force known as upthrust *V*.

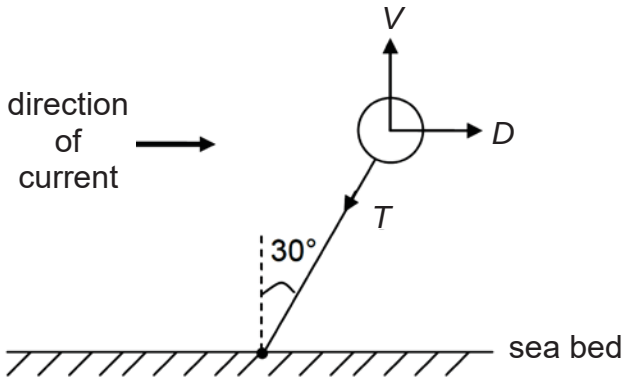


Fig. 1.1

By means of a scale drawing, determine the value of the upthrust, *V* and horizontal force, *D*.

scale …….. [1]

upthrust, *V* = …….. [2]

force, *D* = …….. [1]

2 Fig. 2.1 shows a diver working below the surface of a lake. The density of the water in the lake is 1000 kg/m^3, the atmospheric pressure at the surface is 1.0 x 10^5 Pa.

Fig. 2.1

The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

(a) Calculate the total pressure acting on the balloon at 15 m below the surface of the lake.

pressure = …….. [2]

(b) The diver releases the tray and the balloon, and they begin to rise. The temperature of the air in the balloon does not change. The volume of the balloon is 0.3 m^3 at 15 m depth.

Calculate the volume of the balloon when it reaches the surface.

volume = …….. [2]

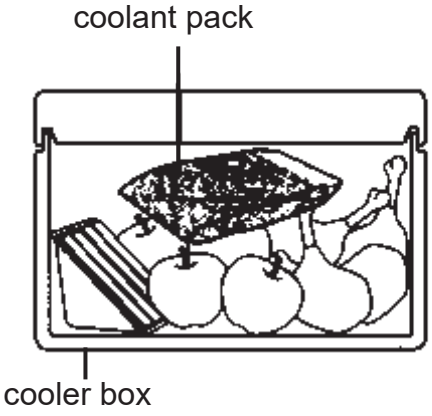
(c) Explain, in terms of the air molecules inside the balloon, why the air pressure in the balloon is less at the surface.

……

……

…….. [2]

3 Fig. 3.1 shows a cooler box packed with food and a coolant pack is placed on top. Fig. 3.2 shows the temperature-time graph of the contents over a period of six hours.



Manufacturer's information on coolant pack:

mass = 0.20 kg

specific heat capacity
of liquid coolant= 3820 J/(kg °C)

specific latent heat of fusion
of coolant =2.1 x 10^5 J/kg

Fig. 3.1

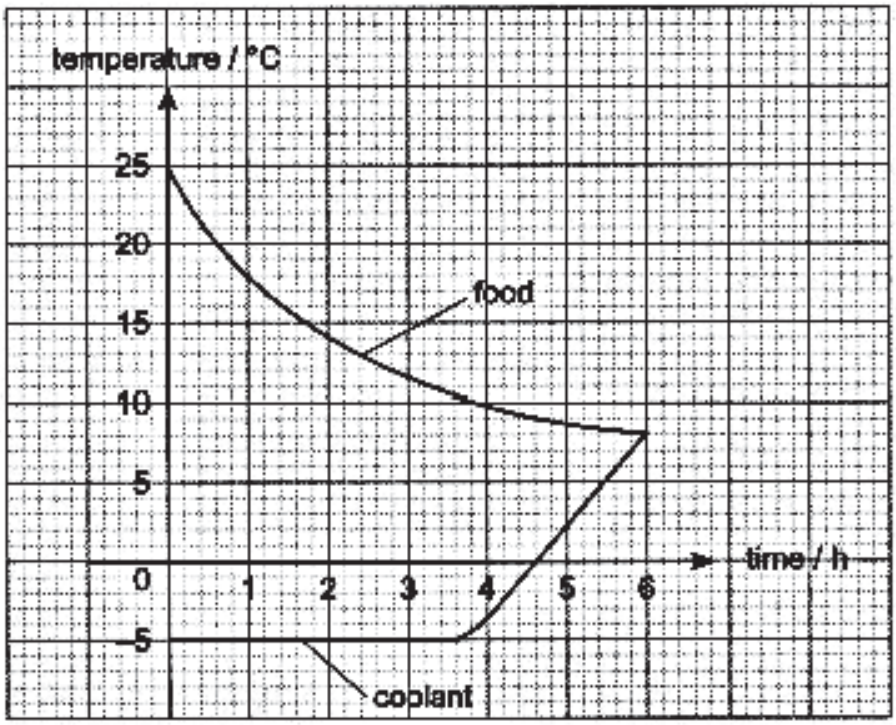


Fig. 3.2

(a) Explain why the coolant pack must be placed on top of the food in order to bring down the temperature.

……

……

…… [2]

(b) Explain why coolant at solid state is better in keeping the content cold for a longer period of time as compare to coolant at liquid state.

……

……

……

…… [2]

(c) Using the information given in Fig 3.1 and 3.2, calculate the total energy lost by the food to the coolant pack during the period of six hours. Assume that there is no energy lost to the surrounding outside the cooler box.

total energy lost = …….. [3]

4 Fig. 4.1 shows a narrow laser beam directed towards a point **A** on a vertical wall. A semicircular glass block **G** is placed symmetrically across the path of the beam.

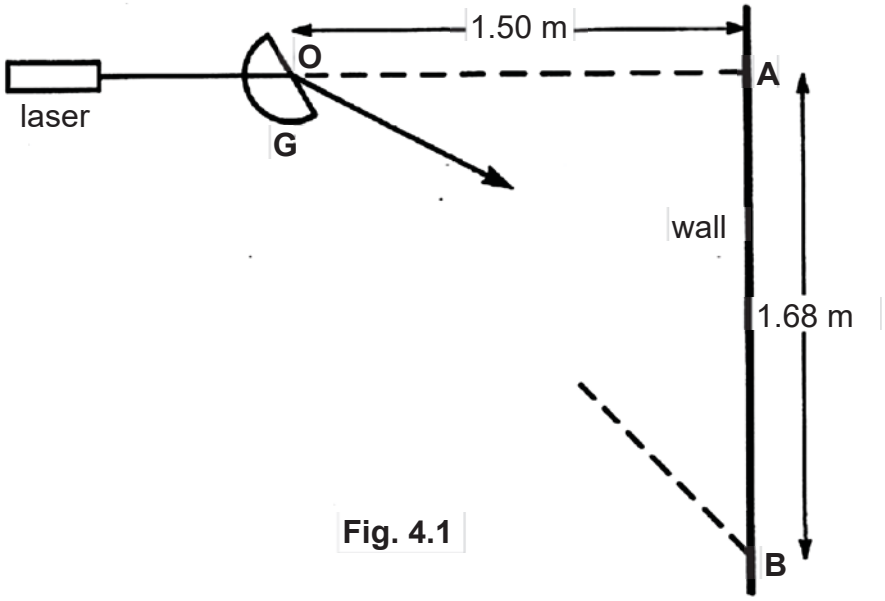


Fig. 4.1

When the beam strikes the wall at **A**, a bright spot is formed at **A**. The glass block is then rotated about the centre, **O**, and the bright spot moves down from **A** to **B** and then disappears.

(a) State the direction of rotation (clockwise or anticlockwise) of the glass block **G** in order to obtain the bright spot to move down from **A** to **B**.

…… [1]

(b) Explain why the bright spot disappears as it moves beyond **B**.

……

……

…… [2]

(c) Given that **OA** = 1.50 m and **AB** = 1.68 m,

(i) calculate the critical angle of the glass block,

critical angle = …….. [2]

(ii) and hence determine the refractive index of the glass block.

refractive index = …….. [1]

5 Fig. 5.1, not drawn to scale, shows water waves generated by a dipper vibrating in a ripple tank with the wave travelling from the deep region to the shallow region.

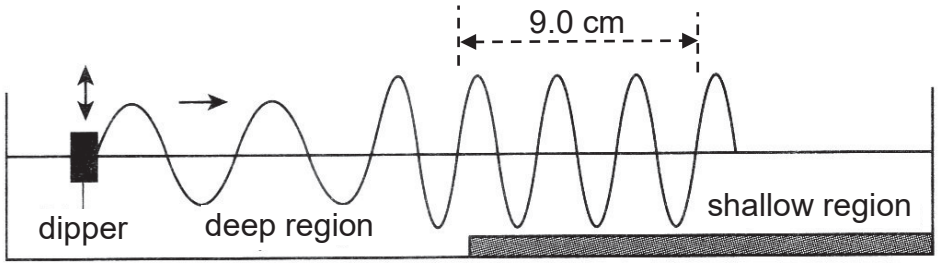


Fig. 5.1

(a) State what happens to the frequency and speed of the water waves as it moves from the deep region to the shallow region.

……

…… [2]

(b) The vibrating dipper makes 10 vibrations in 2 s.
Calculate the speed of the water waves in the shallow region.

speed = …… [2]

(c) The rate of vibration of the vibrating dipper is doubled.

State what will happen to the speed and the wavelength of the wave in the shallow region.

……

…… [1]

6 Fig. 6.1 shows a positively charged sphere held with an insulating handle. When the sphere is brought near the metal plate, the galvanometer needle deflects momentarily.

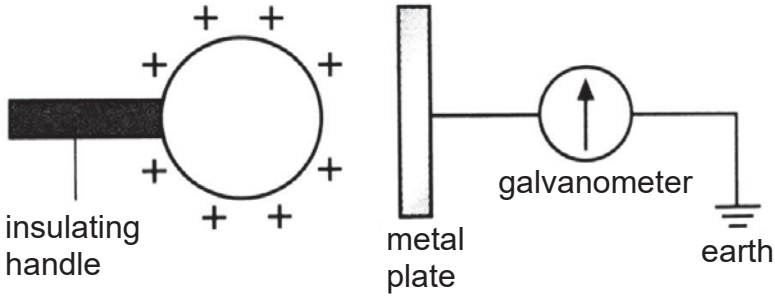


Fig. 6.1

(a) Explain clearly why there is a momentary deflection in the galvanometer needle.

……

……

……

……

……

…… [3]

(b) Suggest a method that would increase the magnitude of the deflection.

……

…… [1]

(c) State clearly what can be observed when the positively charged sphere is removed quickly.

……

…… [1]

7 Fig. 7.1 below shows a circuit connected to a battery of unknown e.m.f.

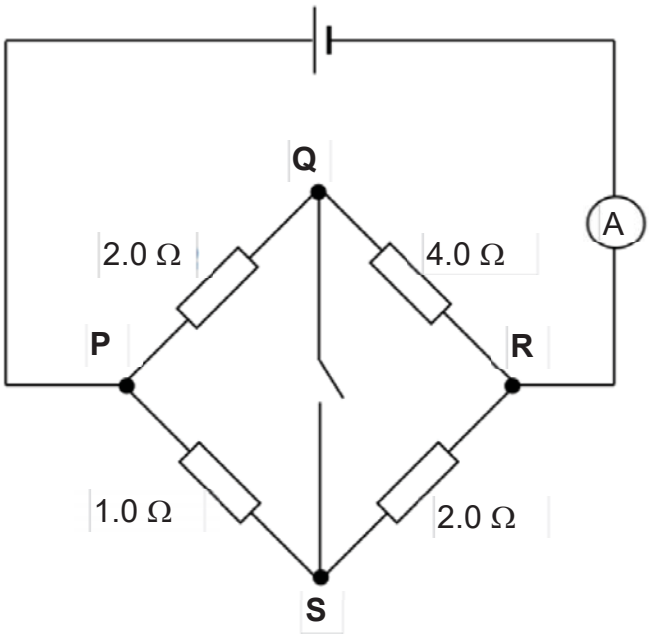


Fig. 7.1

(a) When the switch is opened, the ammeter reads 3.0 A.

(i) Calculate the e.m.f. of the battery.

e.m.f. = …….. [2]

(ii) Calculate the current passing through **PSR**.

current = …….. [1]

(b) The switch is now closed. Explain whether a current will flow through **QS**.

……

……

……

…… [2]

8 A student has made a battery tester shown in Fig. 8.1. It uses a magnet, wire that is flexible and springy, and a pointer. With it, she can check whether a small battery is "live" or "dead". When she connects a battery to the tester, the pointer moves.

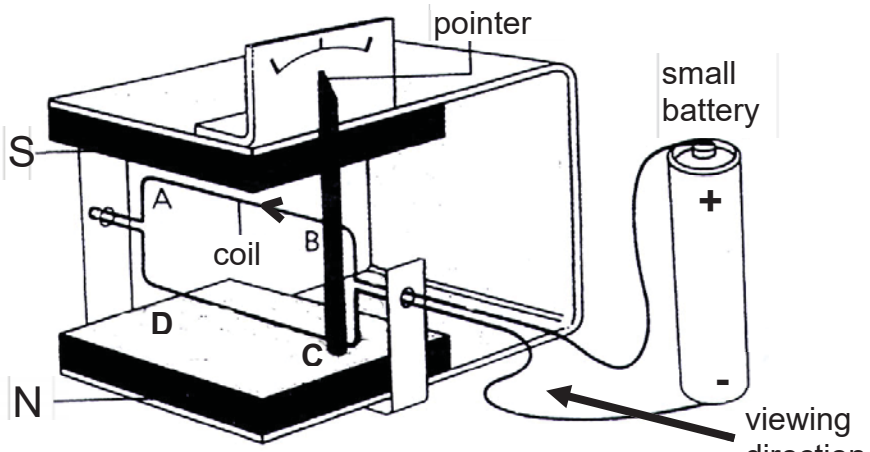


Fig. 8.1

(a) Fig. 8.2 shows the magnet and coil as viewed in the direction shown in Fig. 8.1. In Fig. 8.2, draw

(i) magnetic field lines around the cross-section of wires **AB** and **CD**. [1]

(ii) arrows to indicate the direction of motion of wires **AB** and **CD**. [1]

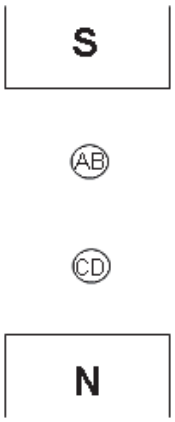


Fig. 8.2

(b) State the observation on the pointer if

(i) the battery delivers less current;

…….. [1]

(ii) the battery terminals are reversed;

…….. [1]

(iii) the battery is replaced by an alternating current source.

…….. [1]

9 A bar magnet is suspended by a spring so that it can oscillate vertically and freely in and out of a coil as shown in Fig. 9.1. The coil is connected to an an oscilloscope.

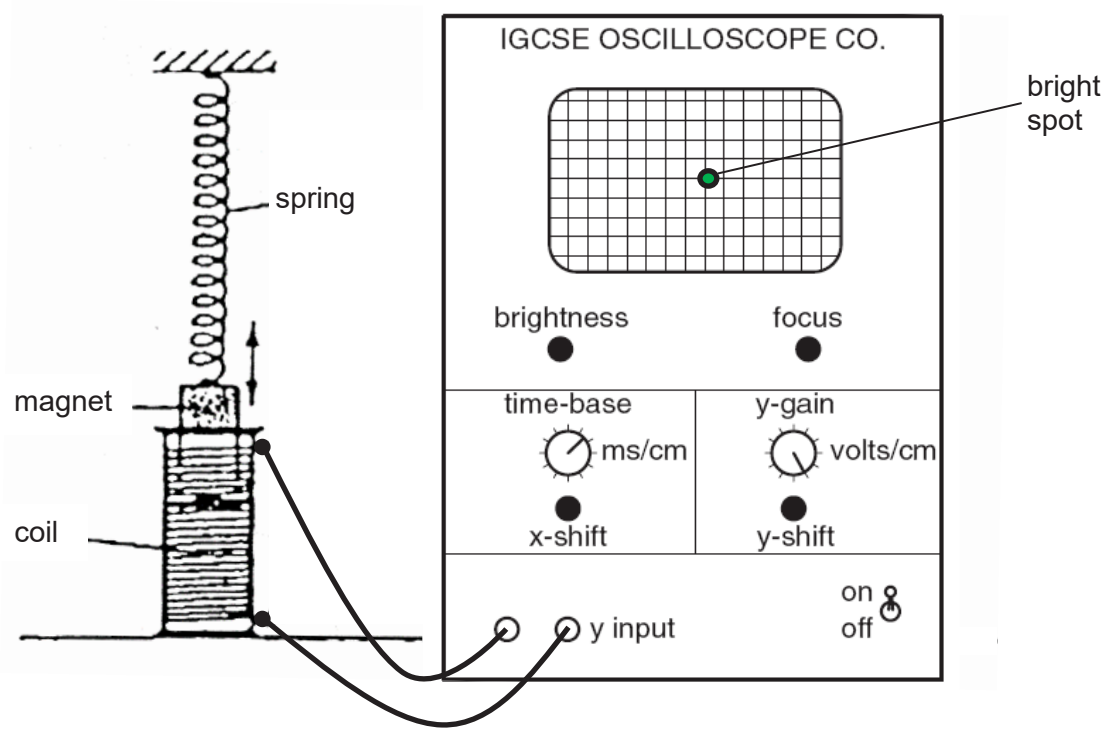


Fig. 9.1

(a) The time-base is switched off, and the oscilloscope is adjusted so that the bright spot is in the middle of the screen when the magnet is not oscillating.

(i) Describe and explain what is seen on the screen as the magnet oscillates.

……

……

……

……

……

…… [3]

(ii) Describe the changes that will be observed on the screen when the magnet oscillates at a faster rate.

……

…… [1]

(b) With the magnet still in motion, the time-base of the oscilloscope is switched on. The controls are suitably adjusted until the trace in Fig. 9.2 is seen on the screen.

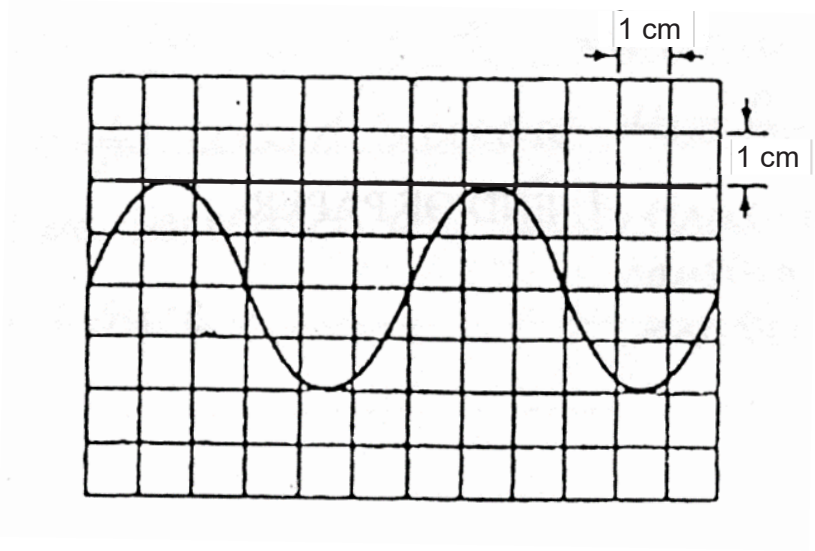


Fig. 9.2

On Fig. 9.2, mark with "**X**" one position of the bright spot that corresponds to the position of the magnet when the magnet is at the lowest point. [1]

(c) The trace in Fig. 9.2 is obtained when the time-base control is set to 0.50 s/cm. Determine the frequency of the oscillation of the magnet.

frequency = …….. [2]

Section B [30 Marks]

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12**.

10 Fig. 10.1 shows two of the towers that support a single cable of total length 5.0 km, which links a factory to the electrical grid.

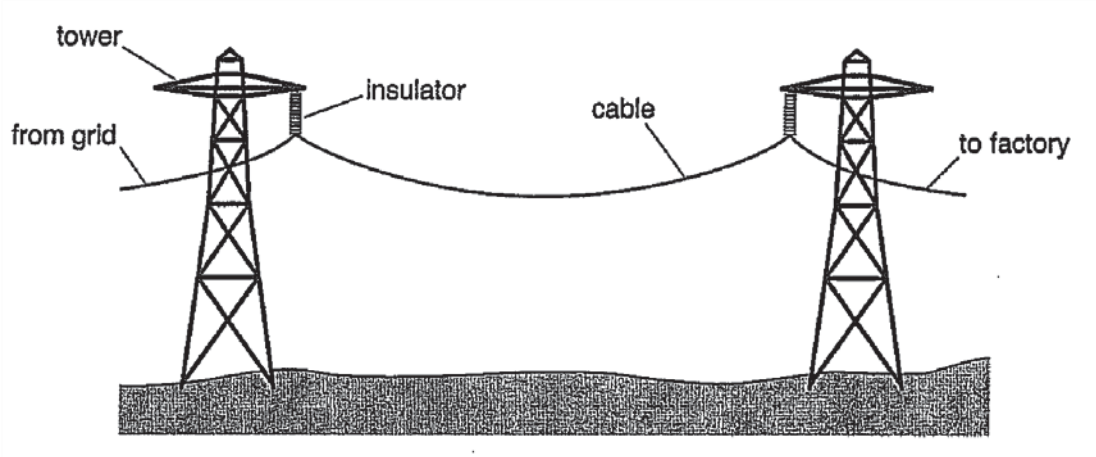


Fig. 10.1

If the weight of the cable between two towers is larger than a given force *F*, then the cable breaks. The value of *F* depends on the material from which the cable is made. The table gives the value of *F* and other data for three cables made from different materials.

cable	material	*F* / N	resistance of 1 km / Ω	density / kg/m^3	cross-sectional area / m^2
1	aluminum	6 000	0.075	2 700	3.0×10^{-4}
2	copper	9 000	0.050	8 900	3.0×10^{-4}
3	steel	27 000	210	7 800	3.0×10^{-4}

(a) Assuming that *g* is 10 N/kg, calculate

(i) the mass of a copper cable of length 5.0 km,

mass = …….. [2]

(ii) the minimum number of towers needed between the grid and the factory to support this copper cable.

number = ……..…….. [2]

(b) The cable used is actually made from aluminium and the current in it is 500 A.

For this cable, calculate

(i) the potential difference (p.d.) between the grid and the factory,

p.d. = …….. [1]

(ii) the power loss in the cable,

power = …… [2]

(iii) the cost of this power loss in 1 day. 1 kWh costs 22 cents.

cost = …… [2]

(c) Using data from the table, explain why

(i) the aluminium is more suitable material than copper for the cable,

……

……

……

……

……..… [2]

(ii) steel is an unsuitable material for the cable.

……

……..… [1]

11 At a sharp corner on a car racing circuit there is an escape lane, as shown in Fig. 11.1.

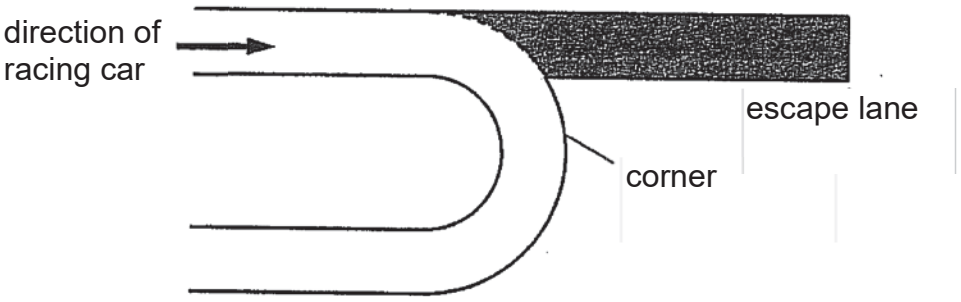


Fig. 11.1

The escape lane is a bed of small stones. The escape lane slopes upwards. A car of mass 700 kg approaches at a speed of 40 m/s. The brakes fail and the car stops in the escape lane.

(a) Describe what happens to the kinetic energy of the car as it stops.

……

……

…….. [2]

(b) The car comes to rest 40 m along the escape lane, having risen through a vertical distance of 3.0 m. The acceleration of free fall is 10 m/s^2.
Calculate

(i) the change in gravitational potential energy of the car,

change = ……[2]

(ii) the average frictional force on the car in the escape lane.

force = ……[3]

(c) The frictional force on the car in the escape lane is not constant. Suggest one factor, apart from the car's speed, that affects the value of the frictional force.

……

…….. [1]

12 EITHER

An appliance is connected to the live, neutral and earth conductors of the mains supply. The current in the circuit is 4.0 A and the rating of the fuse is 5 A.

(a) Explain what is meant by

(i) *live*,

……

…….. [1]

(ii) *neutral*.

……

…….. [1]

(b) When a fault occurs in the appliance, no damage or injury is caused provided that the correct fuse is used and the metal case is connected to earth.

(i) The 5 A fuse is replaced by a 30 A fuse.

Explain why this presents a risk of damage or injury.

……

……

……

……

…….. [2]

(ii) The earth is **not** connected to the metal case.

Explain why this present a risk of damage or injury.

……

……

……

……

…….. [2]

(c) State one advantage of using a circuit breaker rather than a fuse to protect the appliance.

……

…….. [1]

(d) Describe an experiment to check that a fuse blows at 5 A.

In your account

- draw a diagram of the apparatus,
- describe the procedure to be taken. [3]

……

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……

12 OR

Fig. 12.1 shows a thermistor connected to a battery of e.m.f. 6.0 V in a circuit.

Fig. 12.2 shows the variation of the voltmeter reading with the temperature of the thermistor.

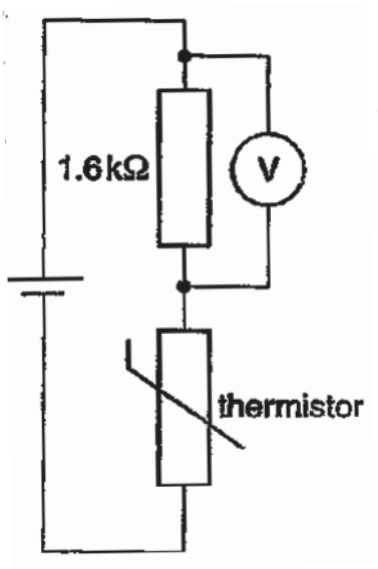

Fig. 12.1

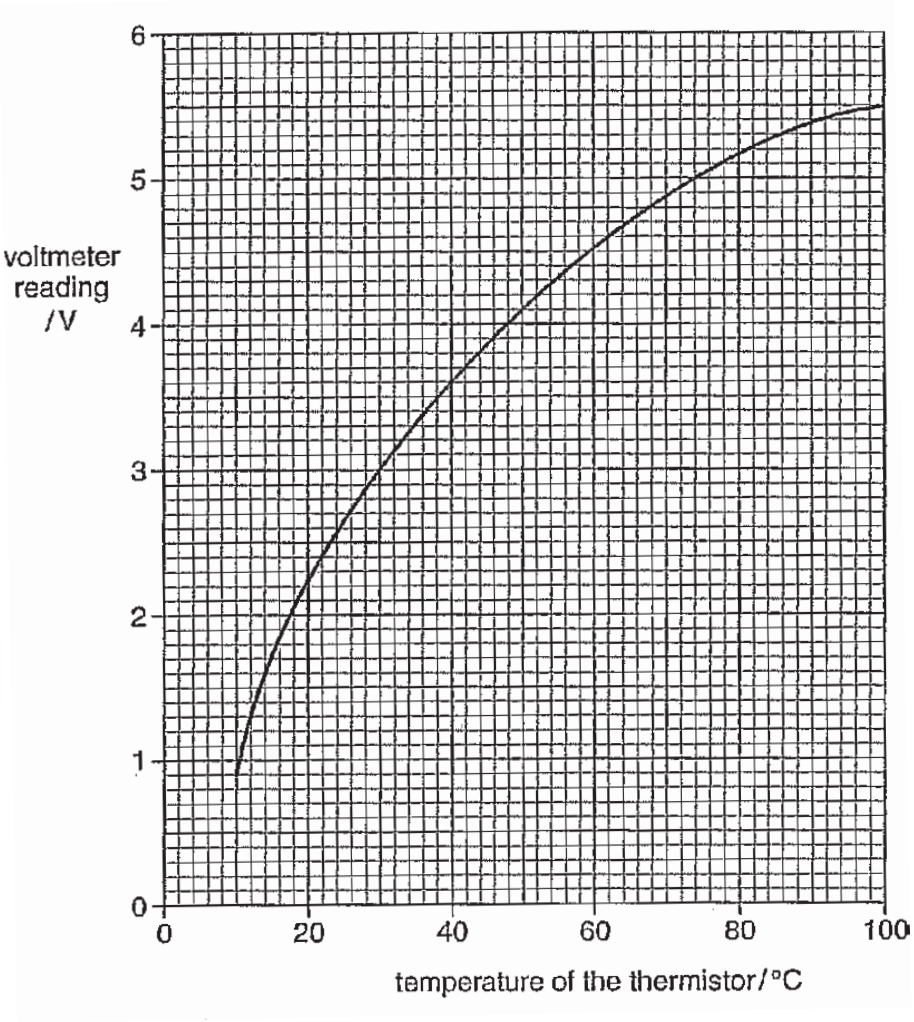

Fig. 12.2

(a) Explain why the voltmeter reading increases as the temperature rises.

.....

.....

.....

.....

.....

..... [2]

(b) Determine the resistance of the thermistor when its temperature is 40°C.

resistance = …… [3]

(c) On Fig. 12.2, draw a graph to show how the voltage across the thermistor varies with the temperature. [2]

(d) Describe an experiment, using the circuit of Fig. 12.1, to produce the graph of the voltmeter reading in Fig. 12.2.

In your account

- List all the apparatus you use, apart from the apparatus shown in Fig. 12.1,
- Describe the procedure you use to obtain the readings. [3]

……

……

……

……

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……

……

……

……

……

……

……

……

***** End of Paper *****

Sec 4E Express (Physics) Prelim Exam Marking Scheme 2019

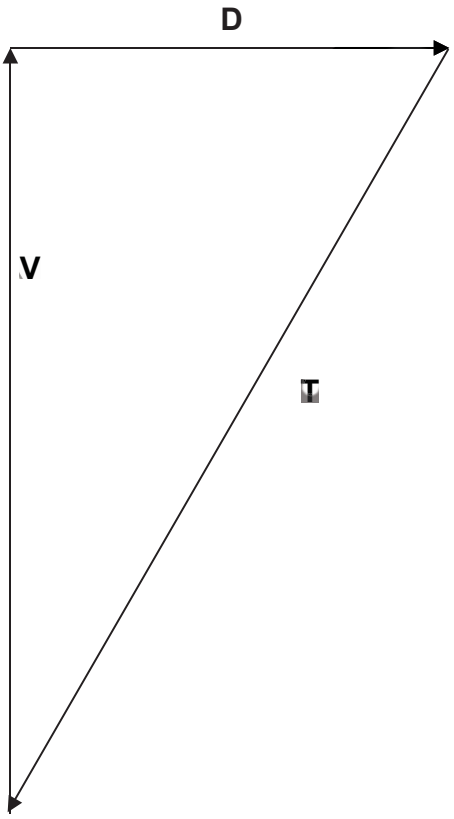
P1 MCQ:

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

P2 Section A:

1

scale 1 cm : 50 N **[A1]**
Correct diagram **[M1]**
upthrust, V = 520 N ± 10 N **[A1]**
force, D = 300 N ±10 N **[A1]**



2(a) Pressure = $(1.0 \times 10^5) + (15 \times 1000 \times 10)$ **[M1]**
= 250 000 Pa **[A1]**

2(b) $P_1V_1 = P_2V_2$
$V_2 = P_1V_1 / P_2$
= (250 000)(0.3) / (100 000) **[M1]**
= 0.75 m^3 **[A1]**

2(c) As the balloon increases in volume, this causes the number of air molecules per unit volume decreases. **[A1]**
The frequency of the air molecules colliding with the inner wall decreases. **[A1]**

3(a) The air at the top is cooled and the cold air contracts, becomes more dense and sink. **[A1]**
The warmer air at the bottom rises up to replace the sunken cool air. This cycle continues to setup a convection current to bring the temperature down quickly and uniformly. **[A1]**

3(b) The coolant at solid state absorb a lot more heat from the content to change to liquid state. It will then absorb more heat to increase its temperature. **[A1]**
Coolant at liquid state only absorb a limited amount of heat from the content to increase its temperature. Therefore, coolant at solid state absorb more heat from the content. **[A1]**

3(c) total energy lost by food = total energy absorb by coolant
= $ml_f + mc\Delta\theta$
= $(0.2 \times 2.1 \times 10^5)$ **[M1]** + (0.2 x 3820 x 13) **[M1]**
= 51 932 J
= 51 900 J **[A1]**

4(a) anticlockwise **[A1]**

4(b) When the glass block is rotated further, the angle of incidence becomes more than the critical angle **[A1]** and the laser undergoes total internal reflection. **[A1]**

4(c)(i) Angle AOB = $\tan^{-1}$ (1.68 / 1.50)
= 48.2° **[M1]**
c = 180° – 90° – 48.2° = 41.8° **[A1]**

4(c)(ii) n = 1/sin c
= 1 / sin 41.8°
= 1.50 **[A1]**

5(a) Frequency remains the same. **[A1]**
Speed decreases. **[A1]**

5(b) f = 10 / 2 = 5 Hz
λ = 9 / 3 = 3 cm
Speed = $f\lambda$ = 5 x 3 **[M1]**
= 15 cm/s **[A1]**

5(c) Speed remains the same.
Wavelength reduce by half. **[A1]**

6(a) Electrons are attracted from earth by the positively charged sphere as unlike charges attract. **[A1]**
The flow of electrons which carry negative charges is detected by the galvanometer and hence there is a deflection. **[A1]**
The electrons remain attracted by the positively-charged sphere and they stay in the metal plate. There is no flow of electrons and the galvanometer needle return to zero. **[A1]**

6(b) Use a positively-charged sphere with higher magnitude of charge. **[A1]**
OR
Bring the sphere closer to the plate.

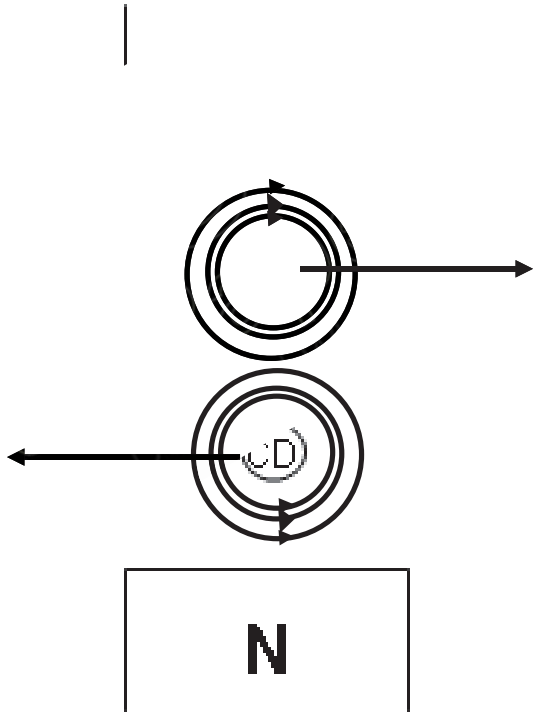
6(c) The galvanometer deflect momentarily to the other side. **[A1]**

7(a)(i) R_{eff} $= (1/6 + 1/3)^{-1}$
$= 2\ \Omega$
Emf $= 3A \times 2\Omega$ **[M1]**
$= 6V$ **[A1]**

7(a)(ii) $I = 6V / 3\Omega = 2A$ **[A1]**

7(b) The potential difference across PQ is $1A \times 2\Omega = 2V$. So potential at Q is 6V -2V = 4V
The potential difference across PS is $2A \times 1\Omega = 2V$. So potential at S is 6V - 2V = 4V. **[M1]**
Since Q and S has same potential, potential difference is zero, so no current flow. **[A1]**

8(a)(i) concentric circles – closer (near to wire), further apart (far from wire)
8(a)(ii)



8(b)(i) deflect less to right **[A1]**

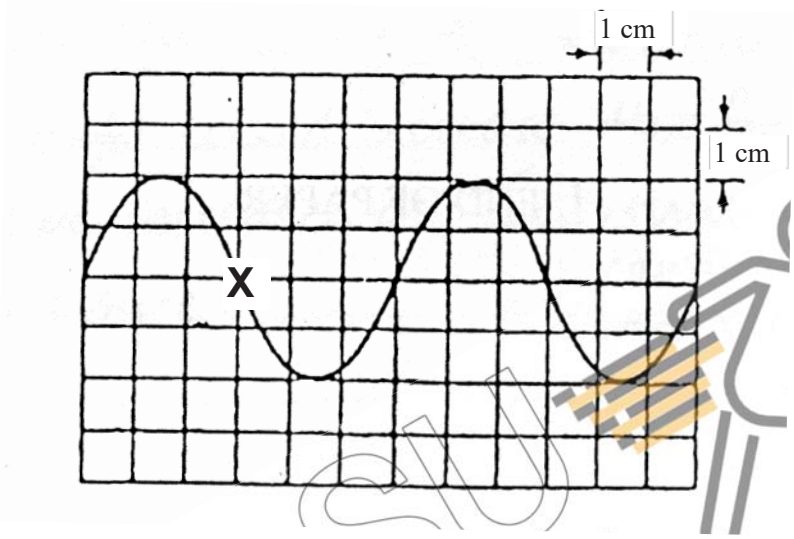
8(b)(ii) deflect to left **[A1]**

8(b)(iii) vibrate to and fro between left and right. **[A1]**

9(a)(i) A vertical line is seen on the screen. **[A1]**
When magnet moves down into the coil, there is cutting of magnetic field lines and an emf is induced in the coil. This causes the y-plates to be charged which moves the electron beam either up or down. **[A1]**
When the magnet moves up out of the coil, there is cutting of magnetic field lines in the opposite direction and an emf is induced in the opposite direction. This causes the y-plates to move the electron beam the other direction. **[A1]**

9(a)(ii) The vertical line becomes longer. **[A1]**

9(b)



9(c) T = 6 x 0.5 = 3 s **[M1]**
f = 1/3 = 0.333 Hz **[A1]**

Section B

10(a)(i) m = 8900 x 5000 x 3.0 x 10^{-4} **[M1]**
= 13 350 kg
= 13 400 kg **[A1]**

10(a)(ii) number = 133500 N / 9000N **[M1]**
= 14.83 = 15 **[A1] (accept 16) ecf 10a(i)**

10(b)(i) R = 0.075 x 5 = 0.375Ω
pd = 500A x 0.375 Ω
= 187.5 = 188 V **[A1]**

10(b)(ii) power loss = I^2R
= 500A x 500A x 0.375Ω **[M1{**
= 93 750 W
= 93 800 W **[A1]**

10(b)(iii) cost = 24h x 93.75kW x $0.22 **[M1]**
= $495 **[A1]**

10(c)(i) Aluminium wire has a much lower density than copper, about 3 times lower. **[A1]** The number of towers used to support 5km of the wire can be reduced by 3 times. **[A1]**

10(c)(ii) The resistance of steel is too high compare to aluminium and copper. This will incur lots of power loss. **[A1]**

11(a) The kinetic energy is converted into thermal, sound **[A1]** and gravitational potential energy **[A1]** as it stops.

11(b)(i) GPE = 700 x 10 x 3 **[M1]**
= 21 000 J **[A1]**

11(b)(ii) KE = ½ x 700 x 40^2
= 560 000 J **[M1]**

KE = GPE + loss
Loss = KE – GPE
Friction x distance = KE – GPE
Friction = (KE – GPE) / distance
= (560 000 – 21 000) / 40 **[M1]**
= 13 475 N
= 13 500 N **[A1]**

11(c) Texture (size of the small stones) of the escape lane, weight of car, **[A1]**

12 EITHER

12(a)(i) having a high potential **[A1]**

12(a)(ii) maintain at zero potential **[A1]**

12(b)(i) When a current of larger than 4.0 A passes through the appliance, the large current is not large enough to blow the 30 A fuse. **[A1]**
The large current can then cause over heating in the appliance and may lead to fire. **[A1]**

12(b)(ii) When there is a fault in the appliance, the metal case may become live. With the absence of earth wire, the current is not able to flow between the metal case to the earth terminal to blow the fuse or trip the ELCB. **[A1]**
If a user touches the metal case, large current will flow through the user between the metal case and the earth and may lead to electric shock. **[A1]**

12(c) When large current trip a circuit breaker, we do not need to replace the circuit breaker. But we will need to replace a fuse if it is blown by a large current. **[A1]**

12(d)

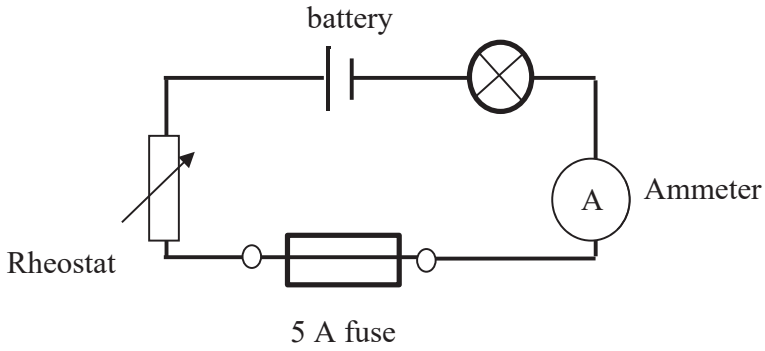


Diagram [A1]

1. Adjust rheostat to give the largest resistance and minimum reading in ammeter.
2. Adjust rheostat slowly to decrease the resistance and increase the ammeter reading to 4 A.
3. Adjust rheostat slowly to **increase the ammeter reading by 0.1A each time. [A1]**

4. Repeat step 3 until **bulb goes off.** When the bulb goes off, this indicates that the fuse has blown.
5. The reading on the ammeter just before the bulb goes off is the current which blows the fuse. **[A1]**

12 OR

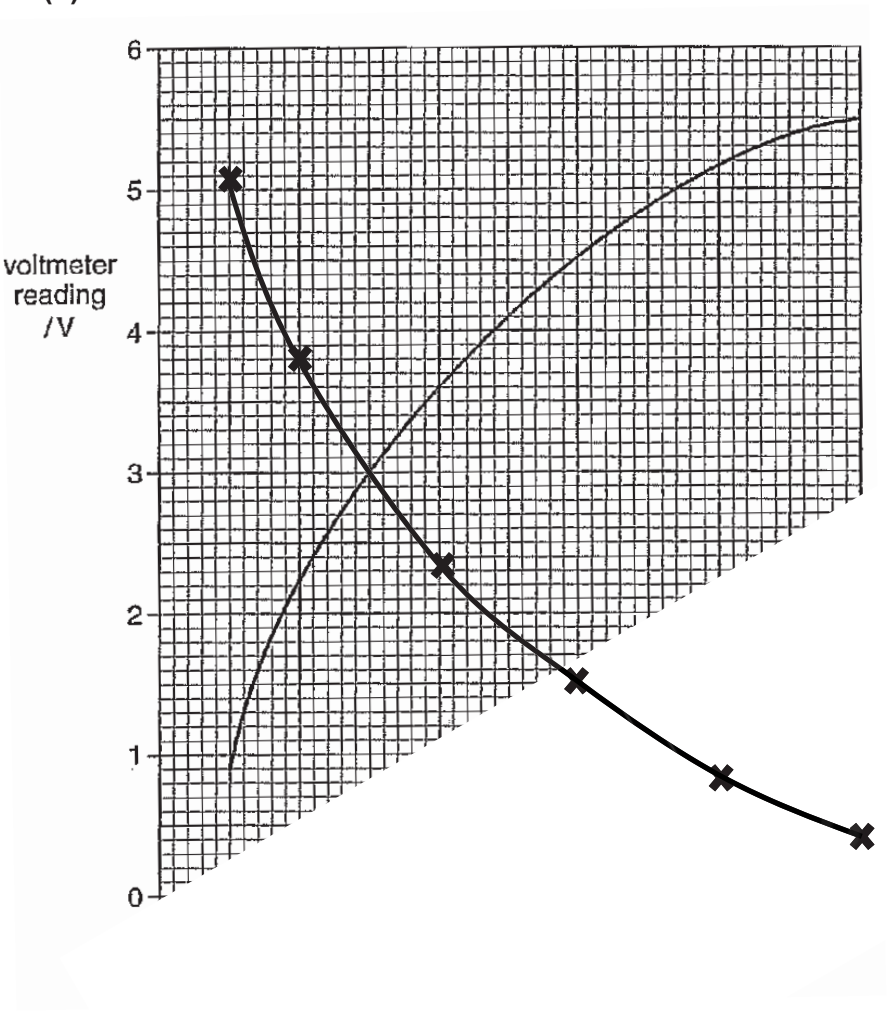
12(a) When temperature increases, the resistance of thermistor decreases. **[A1]**
The potential difference across the thermistor decreases.
Since the emf remains constant, the potential difference across the resistor increases. **[A1]**
Therefore the voltmeter reading increases.

12(b) At 40°C, pd across resistor = 3.6V

Current = 3.6V / 1600Ω = 0.00225 A **[M1]**

R of thermistor = (6V-3.6V) / 0.00225 A **[M1]**
= 1070 Ω **[A1]**

12(c)



12(d)

Apparatus:

a. Retort stand
b. Beaker
c. Plastic sheet
d. Laboratory thermometer
e. Wire gauze
f. Tripod
g. Bunsen burner

[A1]

Procedures:

1. Setup as shown in diagram. Use water use temperature of about 5 °C
2. Wrap the thermistor in a plastic sheet to prevent water from entering the thermistor and immerse it into the beaker of water. **[A1]**
3. Heat the water.
4. When thermometer shows 10°C, record the voltmeter reading.
5. Repeat step 4 for every increase in 10 °C until thermometer reaches 100 °C.**[A1]**
6. Tabulate Temperature of Thermistor (T) and voltmeter reading of resistor (V).
7. Plot a graph of V against T.