NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2014

SUBJECT : PHYSICS 5059 (PAPER 1) DATE : 28 AUG 2014

LEVEL : SECONDARY 4 EXPRESS DURATION : 1 HOUR

INSTRUCTIONS TO CANDIDATES

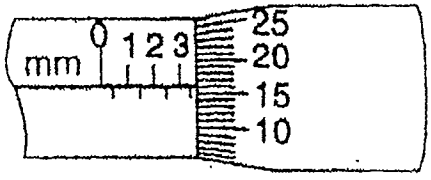
DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write your name, class and index number on the **Question Paper** and the **Optical Answer Sheet** in the spaces provided. **It is also required that you WRITE and SHADE your index number on the Optical Answer Sheet.**
2. Answer **ALL** questions on the **Optical Answer Sheet** provided.
3. Throughout the paper, the **acceleration due to gravity on Earth** is taken as 10 N/kg **unless stated otherwise.**
4. Calculators may be used where necessary. **Where numerical answers are not exact, give answers to THREE (3) significant figures.**
5. Submit the **Optical Answer Sheet** and the **Question Paper SEPARATELY** at the end of the examination.

This question paper consists of **16** *. printed pages.*

Each question is provided with ***four*** *possible answers (A, B, C and D). Select the m appropriate answer and* ***shade*** *your choice on the* ***Optical Answer Sheet*** *provided.*

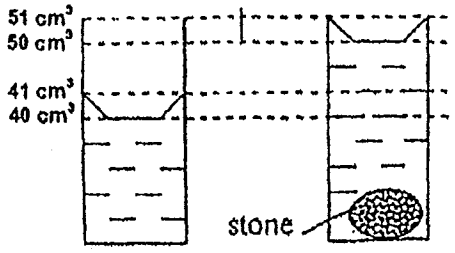
1 The diagram shows the reading on a micrometer screw gauge when measuring diameter of a rod.



What is the diameter of the rod?

A 3.16 mm
B 3.26 mm
C 3.65 mm
D 3.66 mm

2 The diagram shows experimental setups to find the density of a given stone.



From the information provided in the diagram, which one of the following shows correct working for finding the density of the stone with mass 20 g?

A $\frac{20}{50-40}$
B $\frac{20}{51-41}$
C $\frac{50-40}{20}$
D $\frac{51-41}{20}$

3 An object is falling under gravity with terminal velocity.

What is happening to its speed?

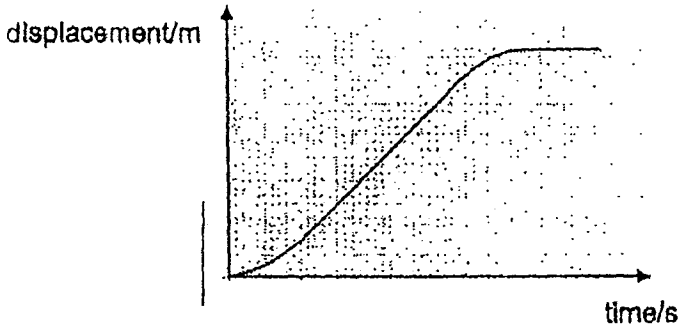
A It is decreasing to a lower value.
B It is decreasing to zero.
C It is increasing.
D It is staying constant.

4 Two objects **X** and **Y** are identical in size and shape but **X** has 3 times the mass of **Y**. When they are both released at the same time from the same height in an evacuated container, they reach the floor of the container at the same time. Which of the following statement(s) is/are true?

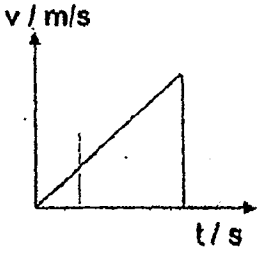
I The rate of change of velocity is the same for **X** and **Y**.
II On reaching the floor, the speed of **X** is the same as the speed of **Y**.
III On reaching the floor, the kinetic energy of **X** is greater than that of **Y**.

A I only
B II only
C I and III only
D I, II and III

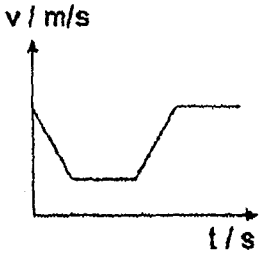
5 The graph shows the displacement-time graph of a runner from a fixed point, along a straight track.



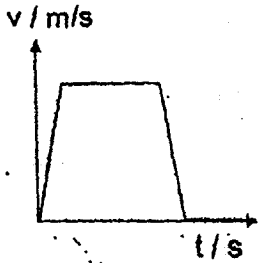
Which one of the following graphs represents the velocity of the same runner over the same period of time?



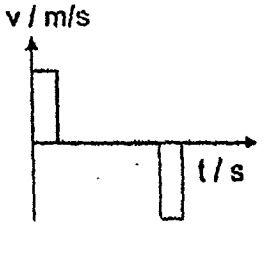
A



B



C

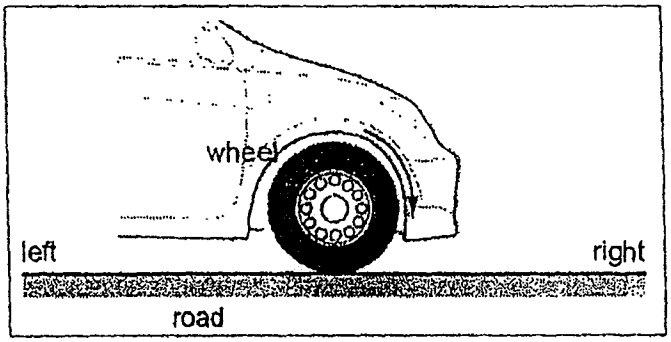


D

6 It was found that it is just as hard to accelerate a car on a level surface on the Moon as it is here on the Earth. This is because

A the mass of the car is independent of gravity.
B the weight of the car is independent of gravity.
C gravity on Earth and gravity on the Moon is different.
D the finding was wrong. A car is much more easily accelerated on the Moon than on the Earth.

7. The front wheel of a car is turned in a clockwise direction by the engine as the car accelerates towards the right, as shown in the diagram.



There is a force of friction between the wheel and the road.

What are the directions of the friction on the wheel of the car and on the road?

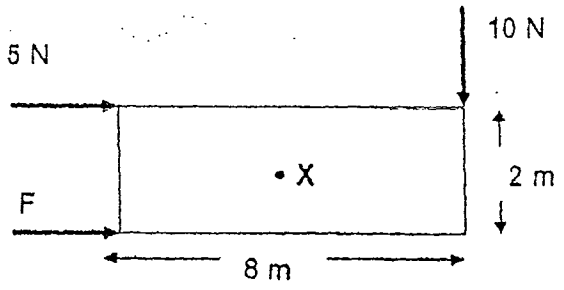
	Direction of friction on wheel	Direction of friction on road
A	to the left	to the left
B	to the left	to the right
C	to the right	to the left
D	to the right	to the right

8 The engine of an 800 kg sports car exerts a constant forward force of 500 N on the car. When the parachute is opened, the car decelerates at 2.5 m/s^2 while the engine continues to provide the forward force of 500 N.

Assuming that there is no other resistive force, what is the tension in the cord at this instance?

A 5.0×10^2 N
B 1.5×10^3 N
C 2.0×10^3 N
D 2.5×10^3 N

9 The figure shows a uniform rectangular board with three forces acting on its edges.

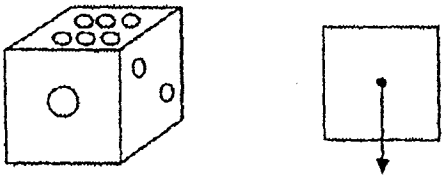


X is a pivot at the centre of the board.

What should be the value of F so that the board remains in equilibrium?

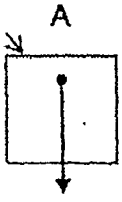
A 30 N
B 40 N
C 45 N
D 90 N

10 An unbiased dice is a cube with the centre of gravity at the middle as shown in th diagram.

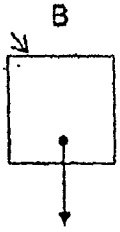


Which one of the following biased dice will allow a higher chance of getting a '6 when rolled?

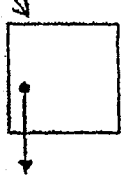
face with '6' A



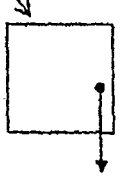
face with '6' B



face with '6' C



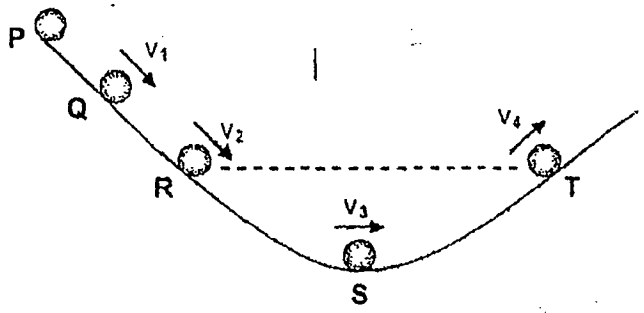
face with '6' D



11 Which one of the following object, when displaced, is seen to be in ne equilibrium?

A A heavy weight suspended on a string.
B A pencil balanced on its sharp tip.
C A cone resting on its slant edge.
D A pyramid resting on its base.

12 P, Q, R, S and T are five points on a smooth curved rail. Point R is directly ac point T as shown in the diagram.

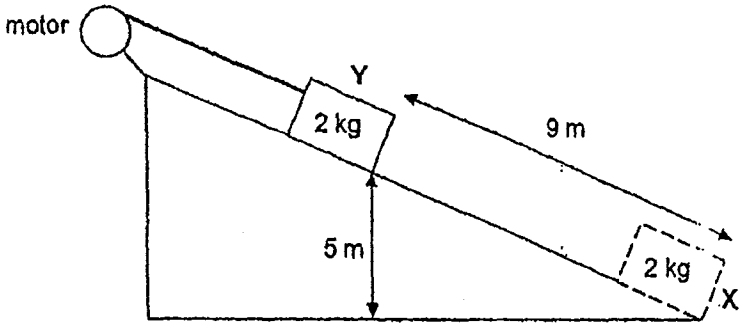


A marble released from rest at point P slides along the rail. The speeds of the ma at points Q, R, S and T are v_1, v_2, v_3 and v_4 respectively.

Which of the following about the speeds is correct?

A $v_4 > v_3 > v_2 > v_1$
B $v_1 > v_2 > v_3 > v_4$
C $v_4 = v_2 > v_3 > v_1$
D $v_3 > v_4 = v_2 > v_1$

13 A motor is used to lift up a mass of 2 kg up a ramp as shown in the diagram.



The frictional force between the mass and the ramp is 8 N.

Calculate the power of the motor if the mass is lifted from point X to point Y in 4 s.

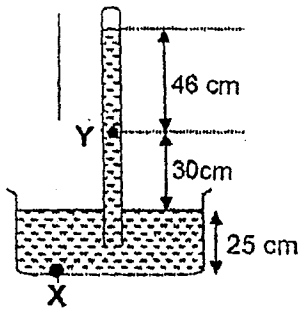
A 4.5 W
B 18 W
C 25 W
D 43 W

14 Which of the following is/are true description(s) of molecules in a liquid?

I The molecules are free to move around within the liquid.
II The molecules are less densely packed than in the solid.
III The molecules haye weak attraction to their neighbours.

A I only
B II only
C I and III only
D I, II and III

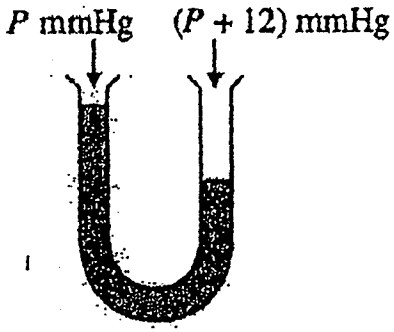
15 The diagram shows a simple mercury barometer.



What is the difference in pressure between X and Y?

A 5 cm Hg
B 21 cm Hg
C 46 cm Hg
D 55 cm Hg

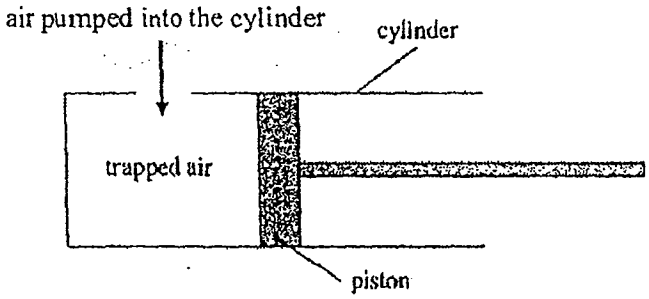
16 The diagram shows a mercury manometer.



Pressure of (P + 12) mmHg and P mmHg are exerted at the right and left tubes respectively. What will happen to the mercury level in the left tube when the pressure exerting at the right tube decreases by 8 mm Hg?

A Increases by 4 mm
B Increases by 8 mm
C Decreases by 4 mm
D Decreases by 8 mm

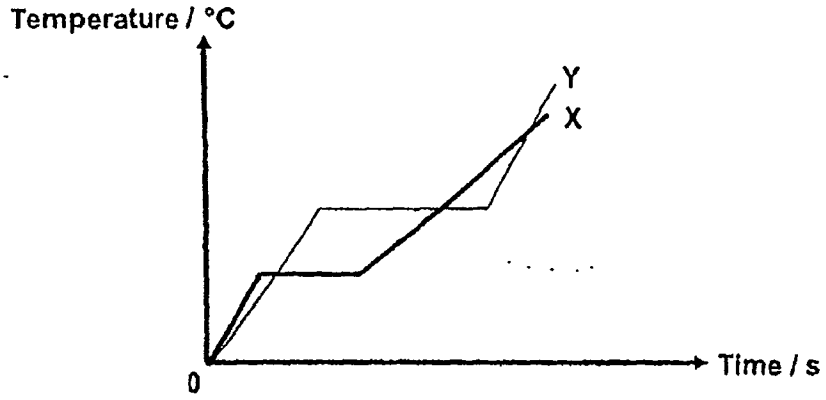
17 A smooth piston and cylinder combination is placed horizontally as shown in the diagram.



Some air has been pumped into the cylinder. Which one of the following is true after some time?

	Pressure of trapped air	Volume of trapped air
A	Increases	Remains constant
B	Remains constant	Increases
C	Increases	Increases
D	Decreases	Remains constant

18 Equal masses of two solids X and Y are heated successively in a well-lagged calorimeter. Heat energy is supplied to each of them at the same rate. The diagram shows the temperature-time graph for the heating process.



Which of the following statement(s) is/are true about X and Y?

I Solid X has a lower melting point than solid Y.
II Solid X has a higher specific heat capacity than solid Y.
III Solid X has a higher specific latent heat of fusion than solid Y.
IV Liquid X has a higher specific heat capacity than liquid Y.

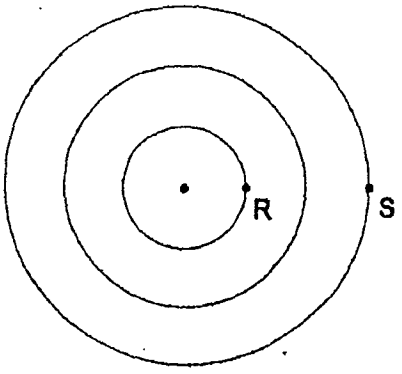
A I and IV only
B II and III only
C I, II and IV only
D I, II, III and IV

19 In calibrating a thermocouple thermometer, one of its junctions is kept in melting ic and the other in boiling water. The current reading on the ammeter is 200 μA, an the pointer points to the right.

If the 'hot junction' is immersed in another substance and the reading is 20 μA wit the pointer pointing to the left, what is the temperature of the substance?

A − 10 °C
B − 20 °C
C 10 °C
D 20 °C

20 The figure shows a pebble is dropped into still water so that circular wavefronts ar seen to travel outwards with a speed v.



If the wavelength is λ, what is the time taken for the disturbance at R to reach S?

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

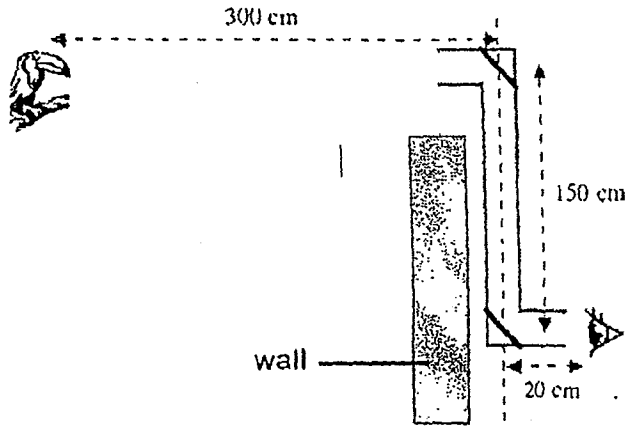
21 Under normal 'working' conditions, radio loudspeakers, industrial machinery an children in a playground all produce sound waves. Under the same air condition these sound waves all

A have the same amplitude.
B have the same frequency.
C have the same wavelength.
D travel with the same speed.

22 Which one of the following statements about sound is correct?

A Ultrasonic sounds have frequencies below 20 kHz.
B Ultrasonic sounds have frequencies above 20 kHz.
C Supersonic sounds have frequencies below 20 kHz.
D Supersonic sounds have frequencies above 20 kHz.

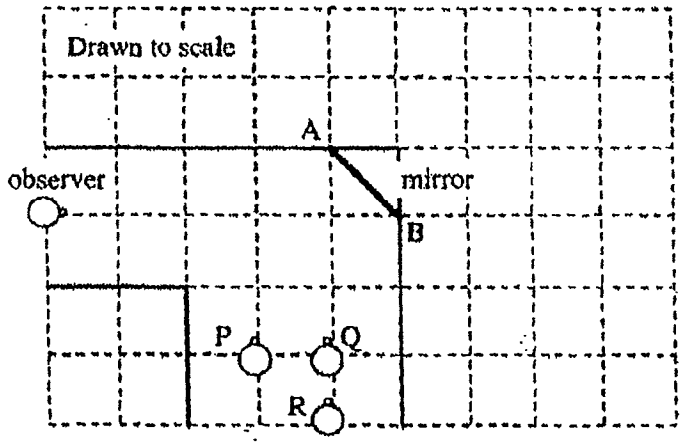
23 A mirror periscope is used to observe a bird as shown in the diagram.



How far away will the bird seem to be from the observer?

A 320 cm
B 470 cm
C 620 cm
D 940 cm

24 A plane mirror AB is positioned at the corner of a road as shown in the diagram.



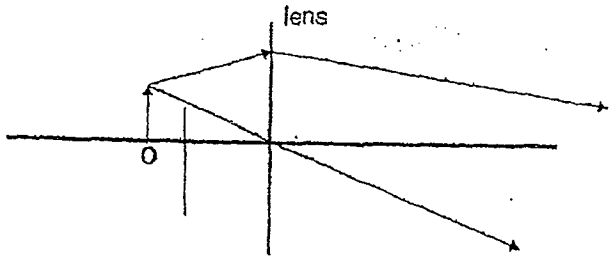
Which men, P, Q and R can be seen by the observer O through the mirror?

A P and Q only
B P and R only
C Q and R only
D P, Q and R

25 Refraction is due to _____ .

A bending of waves in the same material
B different frequencies in different materials
C change in wavelength in the same material
D different speed of light in different materials

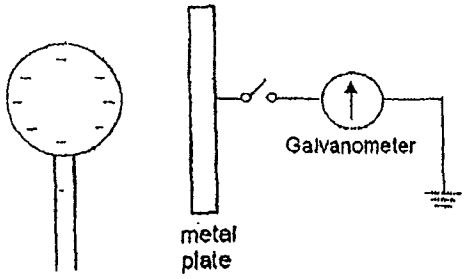
26 The diagram shows an object O placed in front of a lens with a focal length, f.



Which one of the following is correct about the type of lens and the object distance?

	Type of lens	Object distance
A	converging	more than f
B	converging	less than f
C	diverging	more than f
D	diverging	less than f

27 A negatively charged sphere is held with an insulating handle and brought near a metal plate.



When the switch is closed, galvanometer deflects momentarily because the

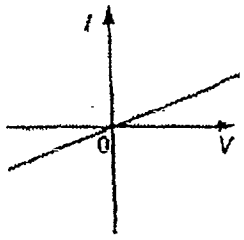
A electrons, attracted by the negatively charged sphere, flows from earth to the metal plate.
B electrons, repelled by the negatively charged sphere, flows from the metal plate to the earth.
C protons, attracted by the negatively charged sphere, flows from earth to the metal plate.
D protons, repelled by the negatively charged sphere, flows from sphere to earth.

28 A resistor of length L and cross-sectional area A has a resistance of R. A second resistor of resistance 3R is made from wire of the same material but of cross-sectional area 2A.

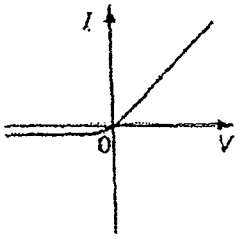
What is the length of the second resistor?

A 0.67L
B 1.5L
C 3L
D 6L

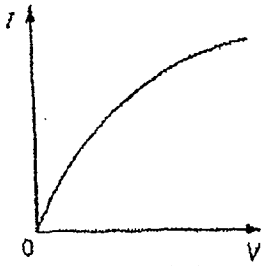
29 Three graphs X, Y and Z show the I-V characteristics for three different components.



graph X



graph Y



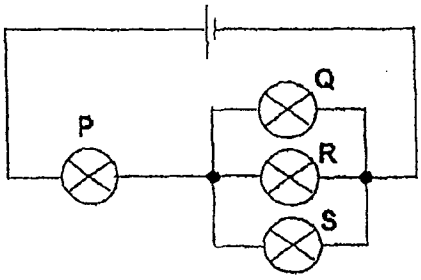
graph Z

Which electrical component does each graph represents?

	Graph X	Graph Y	Graph Z
A	Filament lamp	Metallic conductor	Semiconductor diode
B	Metallic conductor	Semiconductor diode	Filament lamp
C	Metallic conductor	Filament lamp	Semiconductor diode
D	Semiconductor diode	Filament lamp	Metallic conductor

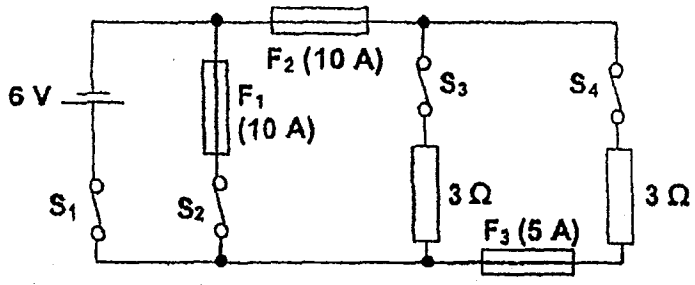
30 Four identical lamps are connected as shown in the diagram.

If R is removed, which one of the following statements is correct?



A P, Q and S are all equally bright.
B P is brighter than it was but not as bright as Q or S.
C P is less bright than it was but not as bright as Q or S.
D P is less bright than it was but is brighter than Q and S.

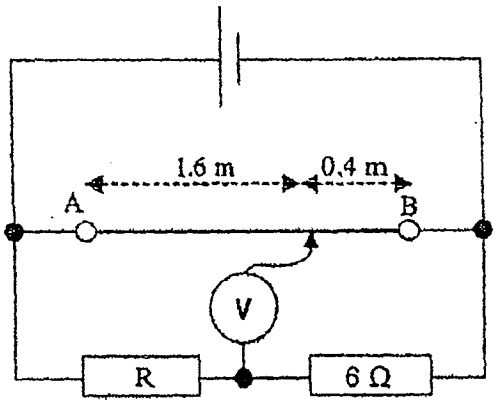
31



When all switches S_1, S_2, S_3 and S_4 are closed, which fuse(s) will be blown?

A F_1 only
B F_2 only
C F_3 only
D F_1 and F_2 only

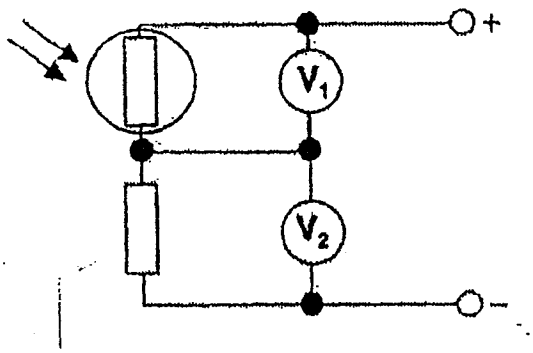
32 A 100 Ω resistance wire **AB** is connected in a circuit as shown in the diagram.



Given that the reading of the voltmeter is 0 V when the jockey is at the positior shown. What is the resistance of the resistor R?

A 12 Ω
B 18 Ω
C 24 Ω
D 30 Ω

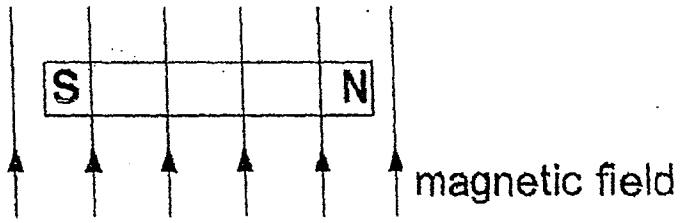
33



In the circuit shown, how do the voltmeter readings change as the surrounding get brighter?

	V_1	V_2
A	Increases	Decreases
B	Decreases	Increases
C	Increases	Increases
D	Decreases	Remains unchanged

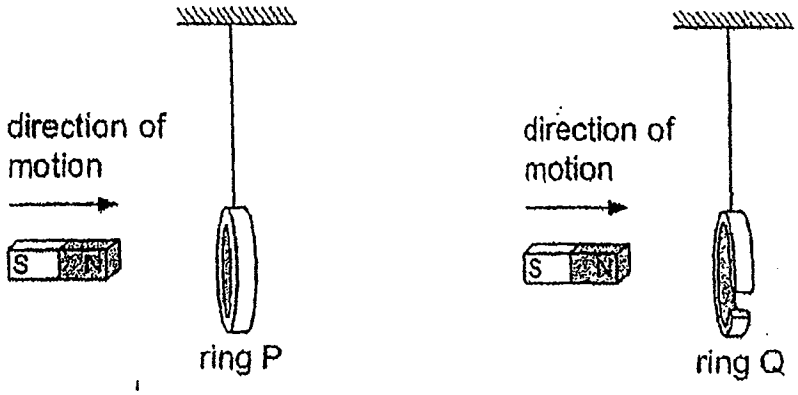
34 The diagram shows a bar magnet placed in a uniform magnetic field.



When the magnet is allowed to move freely, it will

A remain stationary.
B turn 90° clockwise.
C turn 90° anti-clockwise.
D turn 180° clockwise.

35 Two copper rings, **P** and **Q**, of identical diameters and thicknesses are e suspended from the ceiling by a soft cotton thread. Ring **P** is a complete ring w ring **Q** has a gap cut into it.

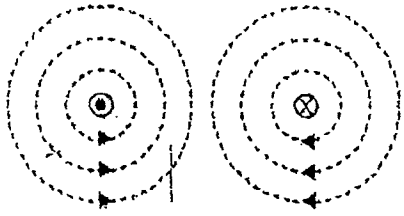


What happens when a permanent magnet is brought near each ring?

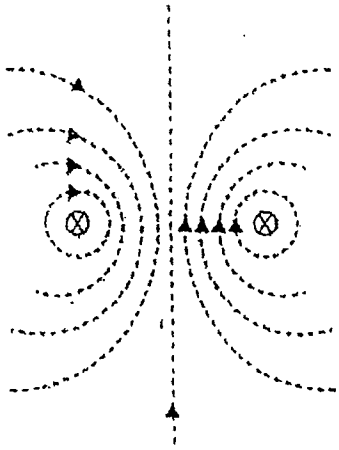
A Only ring **P** moves away from the magnet, remaining in its new position e when the magnet is stationary. Ring **Q** remains stationary.
B Both rings move away from the magnet, remaining in their new positions e when the magnet is stationary. Ring **P** moves further than ring **Q**.
C Only ring **P** moves away temporarily from the magnet, coming back to original position when the magnet is stationary. Ring **Q** remains stationary.
D Both rings move away temporarily from the magnet, coming back to t original positions when the magnet is stationary. Ring **P** moves further than **Q**.

36 Which one of the following diagrams shows the combined magnetic field pattern of parallel current-carrying wires?

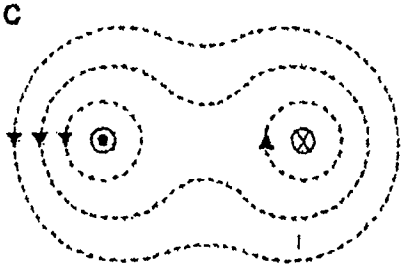
A



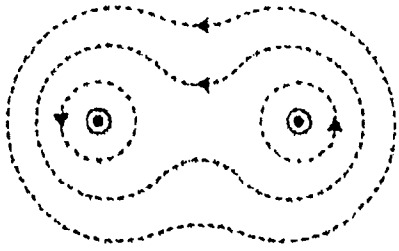
B



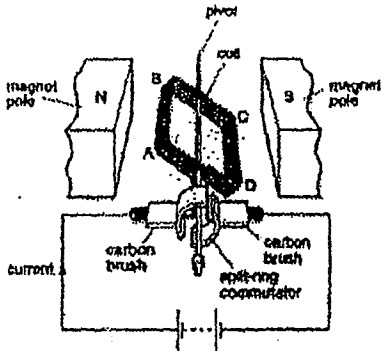
C



D



37 The diagram shows a simple d.c. motor.



Which of the following reverse(s) the direction of rotation of the motor?

	Direction of magnetic field	Direction of current
I	Maintain	Reverse
II	Reverse	Maintain
III	Reverse	Reverse

A I only
B II only
C I and II only
D I, II and III

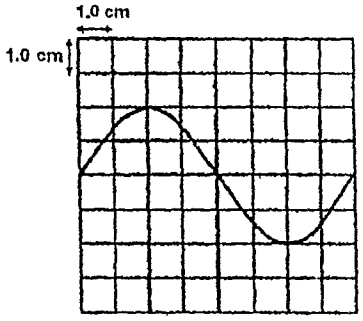
38 The voltage of a 220 V a.c. suppiy is stepped down by a transformer. The turns ratio of the transformer 1 : 18. When a radio is connected to the transformer, it draws a current of 500 mA from it. If the efficiency of the transformer is 80 %, find the power delivered by the power supply?

A 4.00 W
B 4.89 W
C 6.11 W
D 7.64 W

39 A generator produces 100 kW of power at a potential difference of 10 kV. The power is transmitted through cables of total resistance of 5 Ω. In order to reduce the power loss by 84%, the 10 kV potential difference is stepped up to a voltage **V**. What is the value of V?

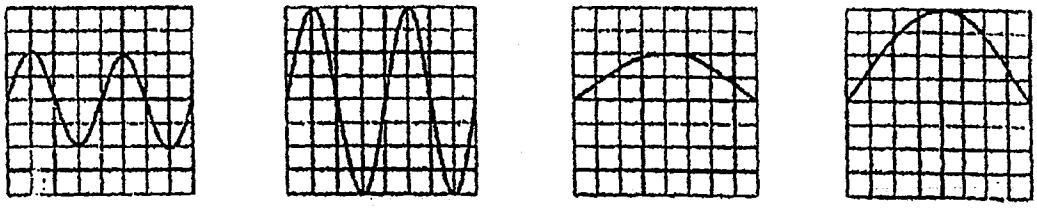
A 12.5 kV
B 20 kV
C 25 kV
D 50 kV

40 The diagram shows the trace of a signal on a CRO.



The time base of the CRO is set at 1.0 ms/cm.

If the time base setting is changed to 2.0 ms/cm with the Y gain remains unchanged, which one of the following shows the correct trace on the CRO?



A B C D

END OF PAPER

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2014

SUBJECT : PHYSICS 5059 DATE : 26 AUG 2014 (P2)
28 AUG 2014 (P1)

LEVEL : SECONDARY 4 EXPRESS DURATION :

PAPER 1 [40 marks] (DURATION: 1 HOUR)

1	2	3	4	5	6	7	8	9	10
D	A	D	D	C	A	C	D	C	B

11	12	13	14	15	16	17	18	19	20
C	D	D	D	D	C	B	A	A	D

21	22	23	24	25	26	27	28	29	30
D	B	B	C	D	B	B	D	B	D

31	32	33	34	35	36	37	38	39	40
A	C	B	C	C	D	C	D	C	A

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2014

SUBJECT : PHYSICS 5059 (PAPER 2) DATE : 26 AUG 2014

LEVEL : SECONDARY 4 EXPRESS DURATION : 1 H 45 MIN

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write your name, class and index number on the **Question Paper** in the spaces provided.
2. Answer **ALL** questions in **Section A** in the spaces provided.
3. Answer **ALL** questions in **Section B** in the spaces provided. Question 3 is an EITHER / OR QUESTION. **SELECT ONLY ONE PART OF THIS QUESTION**.
4. Throughout the paper, the **acceleration due to gravity on Earth** is taken as 10 N/kg **unless stated otherwise.**
5. Calculators may be used where necessary. **Give answers to TWO (2) or THREE (3) significant figures.**
6. **DO NOT DETACH** any sections from this paper.
7. Submit this paper at the end of the examination.

For Examiner's Use Only

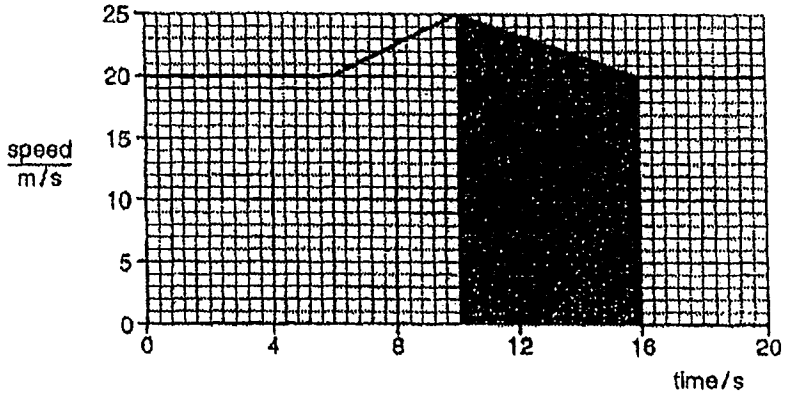
Section	A [50 m]	B [30 m]	P1 [40 m]	Total [120 m]	Grade	Target Grade
Score						

This question paper consists of 19 *printed pages.*

SECTION A : [50 marks]

Answer **ALL** *questions in this section. Show your working and write your answers in the space provided.*

1 A car is travelling on a straight road. It increases its speed to overtake a lorry and then returns to its original speed. The diagram shows the speed-time graph for the car.



(a) Calculate the acceleration of the car as its speed increases.

[1]

(b) Describe what the shaded area in the diagram represents.

[2]

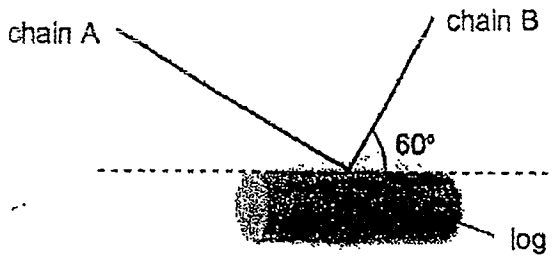
(c) (i) State what is meant by the ***average speed*** of the car.

[1]

(ii) The average speed of the car between time t = 6 s and t = 16 s is larger than that between t = 0 s and t = 20 s. Suggest why this is so.

[1]

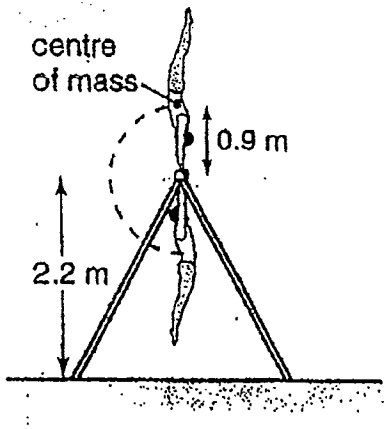
2 The diagram shows a log suspended by two chains in mid-air. The log and the chains lie in a vertical plane.



The log has a weight of 2000 N and the tension in chain B is 800 N.

Using a scale of 1 cm to 200 N, draw a labelled vector diagram to determine the tension in chain A.

3 In an olympic game, a man of mass 48 kg is trying to swing on a high bar. He is momentarily at rest at the top of the swing. At this position, his centre of mass is at a height of 0.9 m above the bar as shown in the diagram.



(a) Calculate his gravtitational potential energy at the top of the swing.

[1]

(b) Calculate his speed at the bottom of his swing.

[3]

(c) State **two** assumptions that are made in (b).

_____

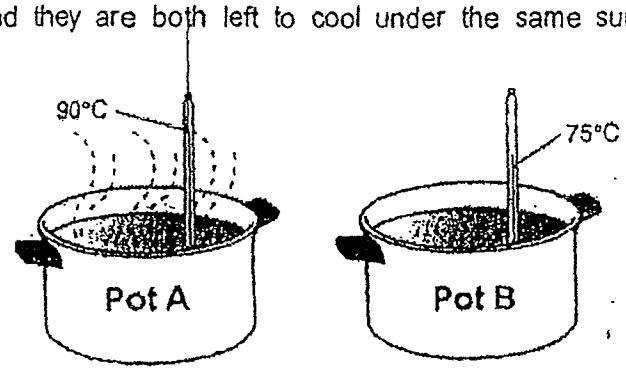
_____

_____

_____

[2]

4 The diagram shows two identical pots containing the same soup at different temperature, 90 °C and 75 °C. The mass of soup in both pots are the same and they are both left to cool under the same surrounding conditions.



(a) Explain why the following features of a pot are advantageous to cooking:

(i) The pot is made of metal.

[1]

(ii) The pot has low heat capacity.

[1]

(b) State and explain which pot will see a larger drop in temperature at the end of ten minutes.

[2]

(c) Would your answer in (b) differ if pot B is painted black? Explain.

[3]

5 A 2 kW heater is used to melt 1.5 kg of solid lead from a room temperature of 27 °C.

(a) The heater takes 29.25 s to heat the lead to its melting point of 327 °C. Calculate the specific heat capacity of lead.

[3]

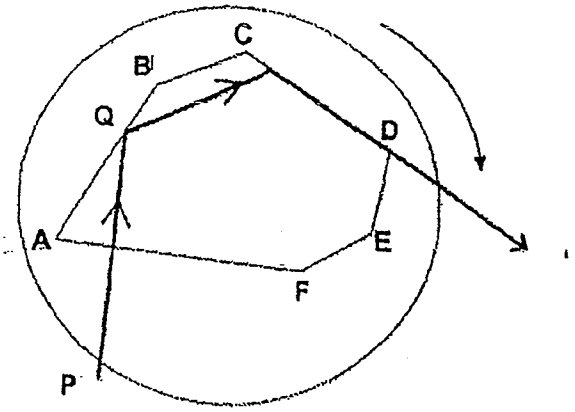
(b) Given that the specific latent heat of lead is 22.4 kJ/kg. Calculate the amount of time to further heat the lead until it is completely melted.

[2]

(c) Describe clearly the change in ***internal energy*** of the solid lead throughout the entire heating process.

[3]

6 The diagram, drawn to scale, shows a narrow beam of light **PQ** from a ray box being directed at the surface **AB** of an irregular shaped glass block **ABCDEF**. The glass block is fixed onto a circular turn-table that rotates about its centre.



(a) Using the diagram, by measuring appropriate angles, determine the refractive index of the glass block.

[2]

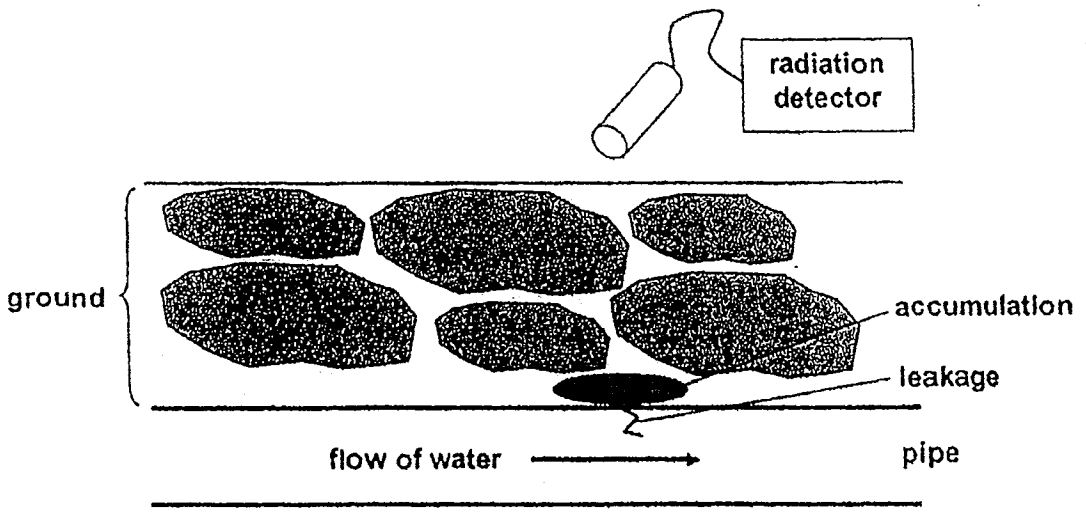
(b) Explain why the beam of light **PQ** does not emerge from the surface **AB** of the glass block shown in the diagram.

[3]

(c) When the turn-table is rotated in a clockwise direction to a new position, it is observed that the beam of light emerges from the surface **AB** of the glass block. Determine the minimum angle of rotation required in order for the beam of light to emerge from the surface **AB**.

[1]

7 (a) Gamma rays are used to detect leakages in underground pipes that are used to carry water. To locate a leak, a small amount of the radioactive material that gives off gamma rays is put into one end of the pipe. A radiation detector is moved along the ground above the pipe as shown in the diagram.



The reading on the detector increases when above a leak as there will be an accumulation of the radioactive material in the ground around the leak.

Explain the properties of gamma rays that enable them to detect flaws in underground pipes.

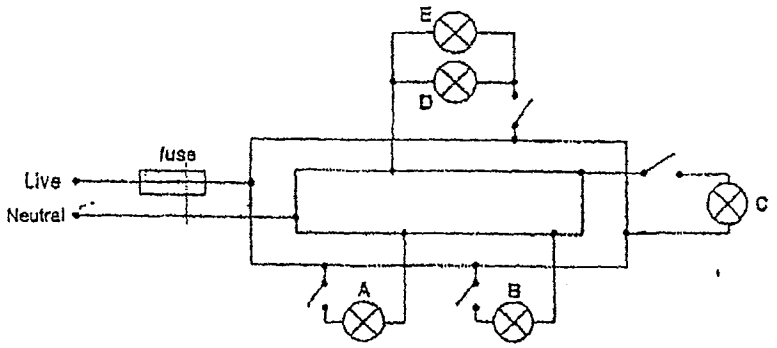
[2]

(b) Gamma rays are also dangerous to living cells and tissues as they can cause ionisation.

Explain what is meant by ionisation, and why gamma rays are dangerous when they pass through living cells and tissues.

[2]

8 The diagram shows part of a lighting circuit with lamps A, B, C, D and E connected to a power supply of 240 V. With this connection, if any lamp fails, the rest of the lamps will not be affected.



(a) Give one **other** advantage of connecting the lamps in this manner.

_____

_____ [1]

(b) State and explain which lamp is wired incorrectly.

_____

_____ [2]

(c) Lamps **A**, **B** and **C** have '240 V, 60 W' marked on them and lamps **D** and **E** are marked '240 V, 100 W'.

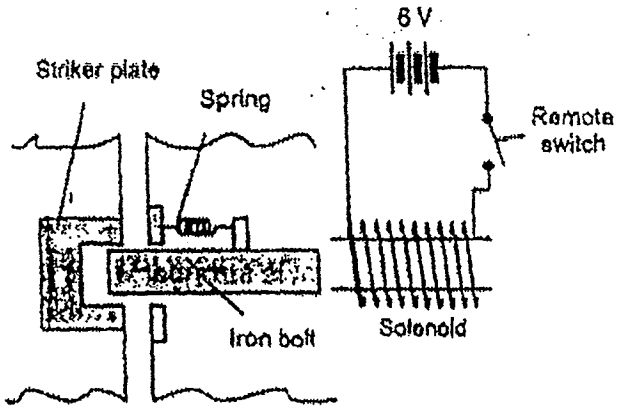
(i) When all the lamps are switched on, calculate the total power consumption of the lamps.

[1]

(ii) Hence, find the total cost of using all the lamps for 130 minutes if there is a charge of 28 cents for each kWh of electrical energy use.

[2]

9 The diagram shows a type of electromagnetic lock which can be operated from a remote switch. When the switch is closed, the iron bolt moves to the right and out of the striker plate, allowing the door to be opened.



(a) Explain why the iron bolt moves to the right and into the solenoid when the switch is closed.

_____

_____

_____ [2]

(b) What is the purpose of the spring?

_____

_____ [1]

(c) When the battery has been in use for some time, its voltage falls to 4.5 V. Explain why the lock may not work correctly?

_____

_____ [2]

SECTION B : [30 marks]

Each question is worth **10 marks.** *Answer* **ALL** *questions in this section.* **Question 3** *is an* **EITHER / OR QUESTION.** ***SELECT ONLY ONE PART OF THIS QUESTION****. Show your working and write your answers in the spaces provided.*

1 **Figure 1** shows an experiment used to find the centre of gravity of a man. The man, with a mass of 62 kg, lies flat on a uniform plank of mass 15 kg. The plank, with the man lying on it, is placed on a brick and a bathroom scale.

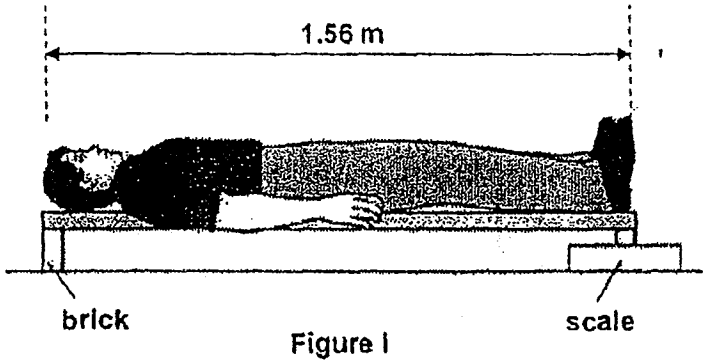


Figure 1

The man is 1.56 m tall and the length of the plank is also 1.56 m long.

(a) Identify and label all the forces acting on the system. [3]

(b) The reading on bathroom scale is 30 kg. Using this information, determine how far the centre of gravity of the man from his toes.

[3]

(c) If the brick is replaced by another bathroom scale, find the reading on the scale.

[2]

(d) If the man gets up to sit in an upright position on the plank with his feet still aligned to the scale as shown in **Figure II**, explain how the reading on the scale would change as compared to the reading in **(b)**.

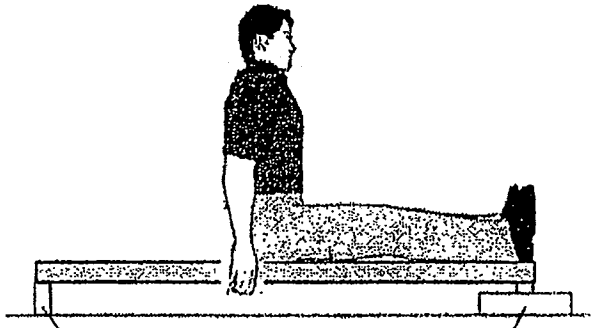
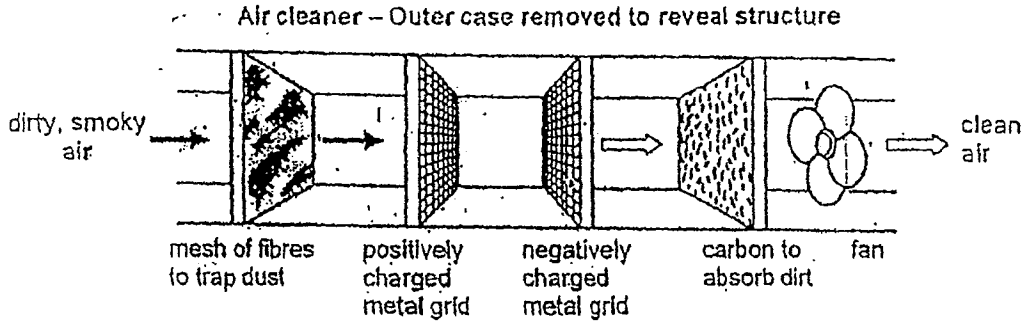


Figure II

[2]

2 An electrostatic air cleaner is a device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulate matter such as dust and smoke from the air stream. During hazy conditions, the air cleaner is used to keep the air in the room free of smoke particles.

The diagram shows the different parts of the air cleaner.



(a) Describe the motion of the smoke particles in the air.

[1]

(b) What causes the smoke particles to move in the manner described in (a)?

[1]

(c) Describe how the cleaner works to remove particles of smoke (some of which are positively charged and some of which are negatively charged) from the air.

[4]

(d) In practice, there is a battery connected between the two charged grids. Explain why this is needed.

_____

_____

_____

_____ [2]

(e) It was found that the inner wall of the air cleaner, which is made of plastic, would become charged after some time. Describe how the plastic inner wall could be discharged.

_____

_____

_____

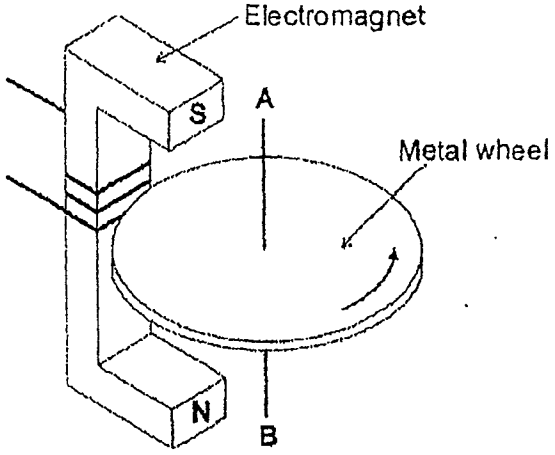
_____ [2]

3 EITHER

When the magnetic field inside a conductor changes, a current will be produced in the conductor. An application of this is the formation of eddy currents which is used in the braking of trains.

During braking, the metal wheels are exposed to a magnetic field from an electromagnet placed along the rails, generating eddy currents in the wheels. The magnetic interaction between the applied field and the eddy currents acts to slow down the wheels.

The diagram shows a model of a braking system consisting of an electromagnet and a rotating metal wheel. The metal wheel rotates about the axis **AB**. When the electromagnet is switched on, it acts as a brake on the wheel.



(a) On the diagram, draw a magnetic line of force produced by the electromagnet. Indicate the direction of this field. [1]

(b) (i) Describe how a current is produced in the rotating wheel when the electromagnet is switched on.

_____

_____

_____

_____

_____ [2]

(ii) Hence, explain why the metal wheel slows down.

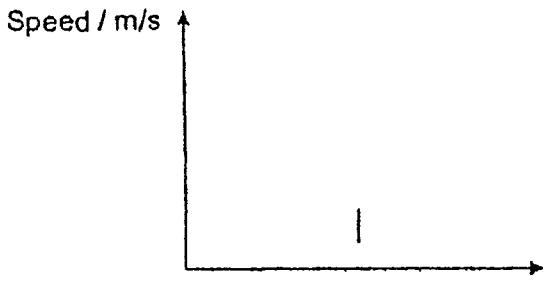
[3]

(c) State the energy conversion that takes place in the wheel during the braking process.

[2]

(d) As the wheel slows down, the braking effect of the electromagnet decreases.

(i) On the axes below, sketch a graph of the speed of the wheel against time after the electromagnet is switched on.



[1]

(ii) Suggest an advantage of using eddy currents as a braking system.

[1]

3 OR

Figure 1 shows an anemometer, a device for measuring the speed and force of the wind.

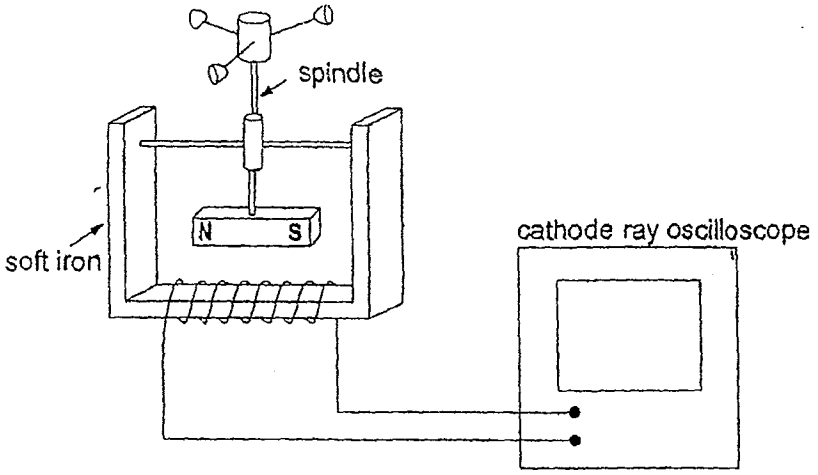


Figure 1

When the wind blows, the spindle rotates and the cathode-ray oscilloscope registers a reading. The rubber cups take 0.25 s to make one complete revolution.

(a) Explain why an alternating e.m.f. is produced in the oscilloscope when the spindle rotates.

[3]

(b) The peak voltage of the induced e.m.f. is 2 V.

(i) On **Figure II**, sketch the graph produced in the oscilloscope when the spindle rotates given that the input sensitivity of the oscilloscope is 0.50 V/div and the time-base is set at 0.050 s/div.

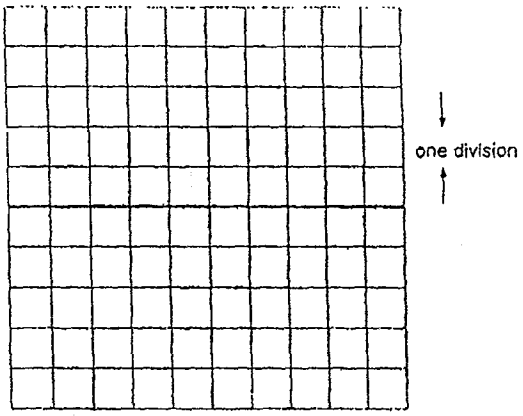


Figure II [1]

(ii) On the time axis of your graph in **(b)(i)**, mark the instant when the magnet is in the position shown in **Figure I**. Label it as **A**. [1]

(c) The set-up was modified as shown in **Figure III**.

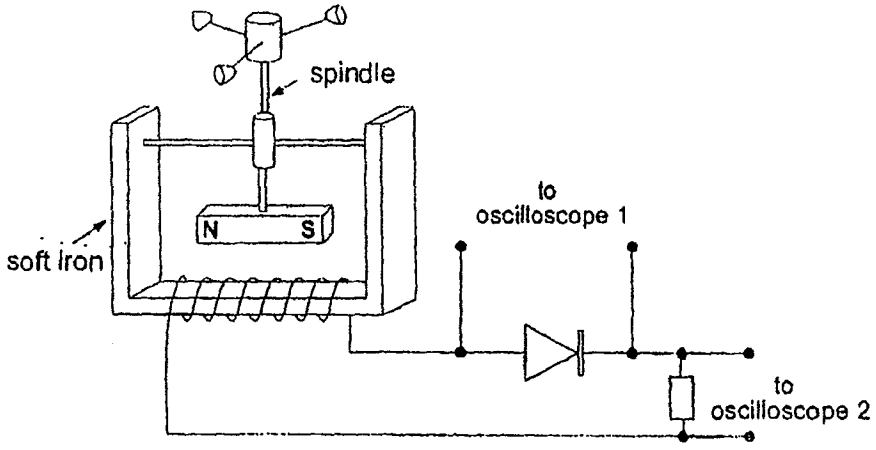
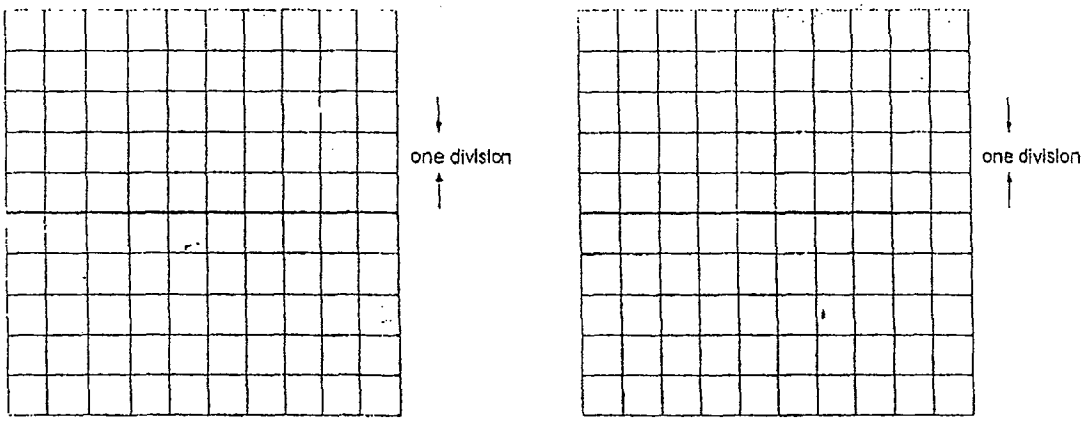


Figure III

On **Figure IV**, sketch the graph shown on oscilloscope **1** and oscilloscope **2**.



oscilloscope 1 **Figure IV** oscilloscope 2 [2]

(d) Describe the use of a transformer to step up a voltage of 2 V to 6 V.

In your account,

- give a labelled diagram of the apparatus,
- explain how the transformer produces an output voltage,
- suggest suitable values for the number of turns in each coil.

Diagram:

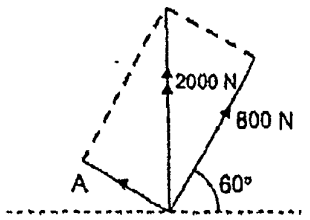
[3]

END OF PAPER

PAPER 2 (DURATION: 1 HOUR 45 MIN)

Section A [50 marks]

QN	Suggested Answers	Sub Ttl	T
1a	$a = \frac{v-u}{t} = \frac{25-20}{10-6} = 1.25$ m/s^2 [1] No marks awarded for wrong units.	1	5
1b	The shaded area represents the distance travelled [1] by the car from 10 s to 16 s, when the car was decelerating constantly. State 10 s to 16 s or decelerating constantly [1]	2	
1ci	The average speed of the car is the total distance travelled by the car in the 20 s, divided by the total time taken.	1	
1cii	As the speed between t = 6 s and t = 16 s was always more than 20 m/s but for between t = 0 s and t = 20 s, the car was travelling at a slower constant speed of 20 m/s for half of the time [1].	1	

QN	Suggested Answers	Sub Ttl	Tt
2	 Parallelogram accurately drawn [1] Resultant force of 2000 N drawn vertically [1] Tension in A = 1340 N (± 60N) [1] **Deduct 1 m for missing labels or arrows on forces.**	3	3

QN	Suggested Answers	Sub Ttl	Ttl
3a	GPE = mgh = 48 × 10 × (2.2 + 0.9) = 1488 J = 1490 J (to 3 sf) [1]	1	6
3b	Lost in GPE = Gain in KE 1488 – (48 × 10 × (2.2 – 0.9)) = ½ × 48 × v^2 [1 + 1] v = 6.0 m/s [1]	3	
3c	No work is done against friction [1] between his hand and the bar. No energy is lost to the surrounding [1].	2	

QN	Suggested Answers	Sub Ttl	Ttl
4ai	Metal is a good conductor of heat [1] and thus the food can be heated up faster.	1	7
4aii	With lower heat capacity, a smaller amount of heat is required to raise the temperature of the pot by 1 °C [1]. Hence, the pot can heat up faster. If student state pot can heat up faster [½]	1	
4b	Pot A [1] will see a larger drop in temperature as there is greater difference in temperature [1] with the surroundings. More heat will be lost by radiation.	2	
4c	Not able to determine [1]. However, when pot B is painted black, it will lose more heat than before as black is a good radiator of heat [1] and hence it will have a larger drop in temperature than before [1].	3	

QN	Suggested Answers	Sub Ttl	Ttl
5a	Q = Pt = 2000 × 29.25 = 58 500 J [1] Q = mcΔθ 58500 = 1.5 × c × (327 – 27) [1] c = 58500 / (1.5 × 300) = 130 J/(kg K) [1]	3	8
5b	Q = ml = 1.5 × 22400 = 33600 J [1] t = 33600 ÷ 2000 = 16.8 s [1]	2	
5c	When the solid lead is heated from 27 °C to 327 °C, the atoms vibrates more vigorously and hence its kinetic energy increases [1]. At melting point, the temperature remains constant and hence the kinetic energy remains constant [1]. However, the energy supplied is used to overcome the intermolecular forces between the atoms and hence its potential energy increase [1].	3	

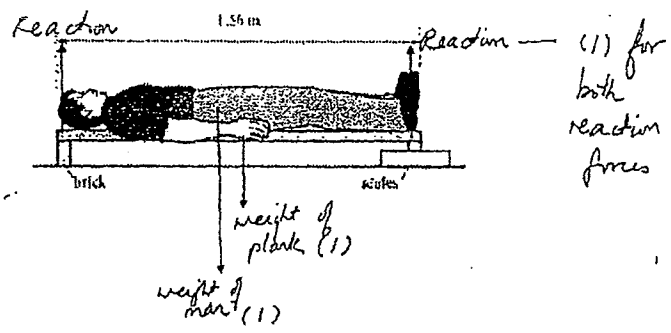
QN	Suggested Answers	Sub Ttl	Ttl
6a	Critical angle = 33° (measured from diagram, accept 32°) [1] $\sin C = \frac{1}{\eta}$ $\eta = \frac{1}{\sin 33°} = 1.84$ [1] If 32°, $\eta = \frac{1}{\sin 32°} = 1.89$	2	6
6b	The light beam is travelling from an optically denser to an optically less dense medium [1] at an incident angle greater than the critical angle [1] of the glass block. Hence, the light beam undergoes total internal reflection [1] and does not emerge from surface AB.	3	
6c	Currently, incident angle at surface AB = 62° (accept 63°) Therefore, minimum angle of rotation = 62° – 33° = 29° [1] Students' answer may vary due to the measured angles.	1	

QN	Suggested Answers	Sub Ttl	Ttl
7a	Gamma rays have high frequency [1] and hence are highly penetrative [1] and thus able to be detected by the radiation detector placed above the ground.	2	4
7b	When electrons are removed from atoms or molecules, ions are formed. This process is called ionisation [1]. When exposed to gamma rays, the ionising radiation can damage the biological molecules in living cells and tissues thus lead to abnormal patterns of cell division [1].	2	

QN	Suggested Answers	Sub Ttl	Ttl
8a	The lamps are connected in parallel to the source and hence each lamp will have the maximum voltage [1] applied across it. Thus, the lamps will light up with maximum brightness.	1	6
8b	C. [1] The switch of lamp C is connected at the neutral wire instead of the live wire [1]. It will still be 'live' even when the switch is off.	2	
8ci	Total power consumption = 60 × 3 + 100 × 2 = 380 W [1]	1	
8cii	P = E/t E = (380/1000 × 130/60)= 0.823 kWh [1] Total cost = 0.823 x 0.28 = $ 0.23 [1]	2	

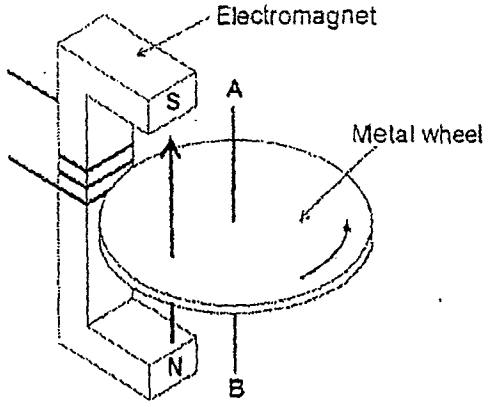
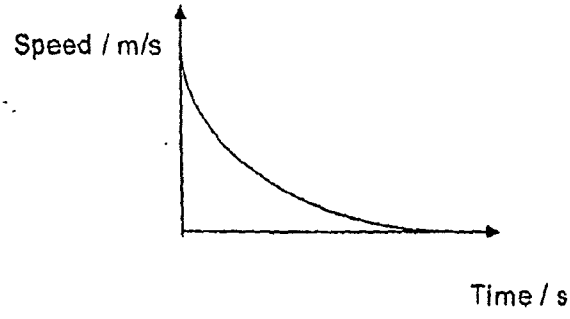
QN	Suggested Answers	Sub Ttl	T
9a	When the switch is closed, the current flows through the solenoid and it becomes an electromagnet [1]. The electromagnet will attract [1] the iron bolt.	2	
9b	The purpose of the spring is to pull the iron bolt back [1] to the original position.	1	
9c	When a lower voltage battery is used, the current flowing through the solenoid is smaller and hence the strength of the electromagnet becomes weaker [1]. The force of attraction exerted on the iron is smaller than [1] the force exerted by the spring. Hence, the iron bolt may not be attracted into the solenoid and the door cannot be opened.	2	

Section B [30 marks]

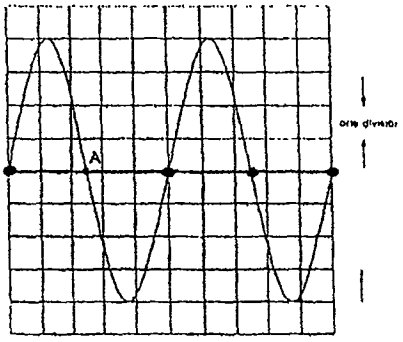
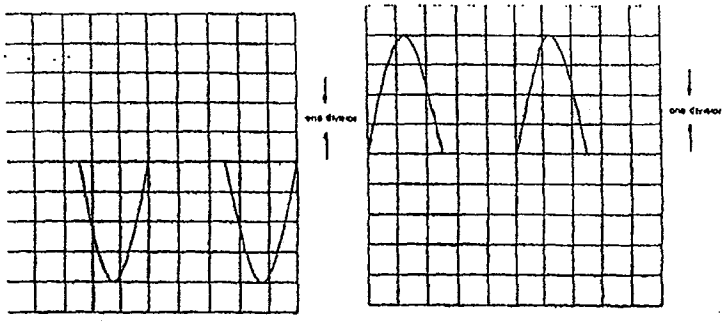
QN	Suggested Answers	Sub Ttl	T
1a		3	1
1b	Taking moments about the brick, Total clockwise moments = Total anti-clockwise moments 150 x 0.78 + 620 x d = 300 x 1.56 [1] d = 0.57 m [1] c.g. from toes = 0.99 m [1]	3	
1c	Total upward force = Total downward force R + 300 = 620 + 150 [1] R = 470 N [1]	2	
1d	As he sits up, the c.g. will be closer to the scale [1] and hence the scale's reading will increase. [1]	2	

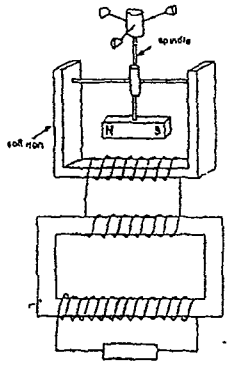
QN	Suggested Answers	Sub Ttl
2a	The smoke particles are moving continuously and randomly at high speeds [1]. Or The smoke particles move in a haphazard manner [1].	1
2b	The smoke particles are collided by the invisible fast-moving air particles moving continuously and randomly [1] and change direction after each collision, thus moving randomly.	1
2c	As unlike charges attracts [1], the positively charged grid attracts the negatively charged particles [1] and the negatively charged grid attracts the positively charged particles [1]. Rotating fan creates a pressure difference [1] for the air to flow so that the smoke particles can flow from the room to the outside of the room.	4
2d	As the grids are constantly discharged by the smoke particles they attract [1], the battery is used to continuously charge them up [1].	2
2e	The inner non-conducting walls could be discharged by placing a flame above each section of the wall [1]. The intense heat causes the air surrounding the walls to ionize [1], discharging the wall.	2

Either

QN	Suggested Answers	Sub Ttl
3a		1
3bi	When the electromagnet is switched on, the rotating wheel will cut the magnetic field lines [1] between its poles, producing a change in magnetic flux linking the wheel [1]. This produces an induced current in the rotating wheel.	2
3bii	By Lenz's Law, the induced current flows in a way such that its magnetic effect opposes the motion or change that produces it [1]. Hence, an opposing magnetic force produced [1] will act against the motion of the rotating wheel [1], causing the wheel to decelerate or slow down.	3
3c	Kinetic energy of the wheel is converted to electrical energy [1], which is in turn converted to thermal energy [1].	2
3di		1
3dii	It does not involve physical contact, so wear and tear is minimized. The braking effect decreases as the wheel slows down, so the braking process is smooth. Either one of the above [1].	1

Or

QN	Suggested Answers	Sub Ttl
3a	When the magnet rotates, the changing magnetic field through the soft iron core causes a change in magnetic flux linking the coil [1]. Thus an e.m.f is induced across the coil. As the N-pole of the magnet approaches the left arm of the soft iron, by Lenz' Law, the induced current in the coil will produce a magnetic field to oppose the change in magnetic flux [1]. Thus the left of the coil will be a North pole. As the N-pole of the magnet moves away from A, the induced current in the coil will generate a magnetic field with a South pole at the left of coil. The induced e.m.f is opposite to [1] that when the magnet moves towards the coil, which results in an alternating e.m.f..	3
3bi 3bii	 Graph [1] Labelling of A [1] (Note: A can be at any of the above positions)	2
3c	 Oscilloscope 1 [1] Oscilloscope 2 [1]	2

3d	 Drawing [1] Procedure: • Wound the coil from the anemometer around laminated soft iron core. Wound another coil (the secondary coil) on the soft iron core. Using the formula $\frac{V_s}{V_p}=\frac{N_s}{N_p}$, since the input voltage is 2 V, the number of turns in the primary coil and secondary coil will be 8 and 24 respectively [1]. • As the magnet turns the alternating voltage supply in the primary coil sets up a constantly changing magnetic field, which is linked to the secondary coil through the secondary coil. Thus there is a rate of change of magnetic flux linkage in the secondary coil. By Faraday's Law, this produces an induced emf across the secondary coil [1].	3