NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2018

SUBJECT : PHYSICS 6091/01

DATE : 11 SEPTEMBER 2018

LEVEL : SECONDARY 4 EXPRESS

DURATION : 1 H

INSTRUCTIONS TO CANDIDATES:

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

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

INFORMATION FOR CANDIDATES:

Each correct answer will score one mark. Marks will not be deducted for wrong answers. Any rough working should be done in this booklet. Your total score for Paper 1 will be the number of correct answers given.

This paper consists of 14 printed pages, including the cover page.

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1 **Diagram I** shows the scale of a micrometer screw gauge when the gap is closed.

Diagram II shows the same micrometer screw gauge used to measure the diameter of a round pellet.

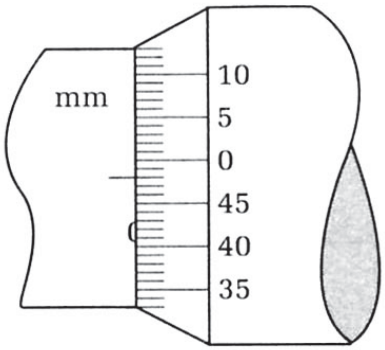


Diagram I

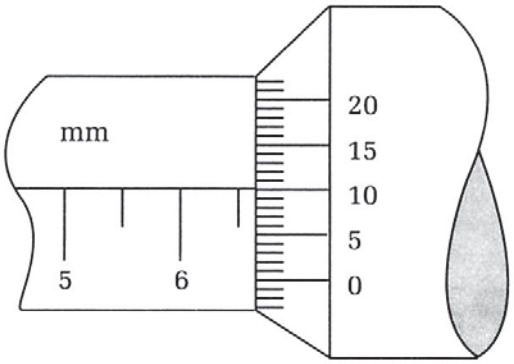


Diagram II

What is the diameter of the pellet?

A 6.58 mm
B 6.60 mm
C 6.62 mm
D 7.08 mm

2 How can the periodic time of a simple pendulum be significantly reduced?

A By increasing the mass of the pendulum.
B By decreasing the mass of the pendulum.
C By increasing the length of the pendulum.
D By decreasing the length of the pendulum.

3 Which of the following statement(s) concerning mass and weight is/are true?

I Mass is constant everywhere.
II Weight is a force that pulls towards the centre of the earth.
III Weight changes from place to place depending on the acceleration due to gravity.

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

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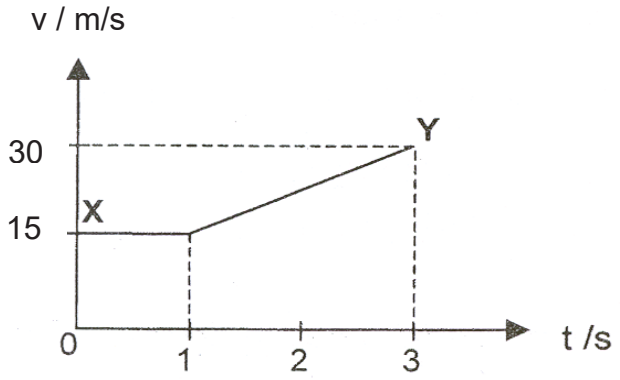
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4 The mass of a paper-clip is 0.50 g and the density of its material is 8.0 g/cm^3. The total volume of a number of paper-clips is 20 cm^3. How many paper-clips are there?

A 80
B 160
C 240
D 320

5 The diagram shows the speed-time graph of a runner.

What is the average speed of the runner between points **X** and **Y**?

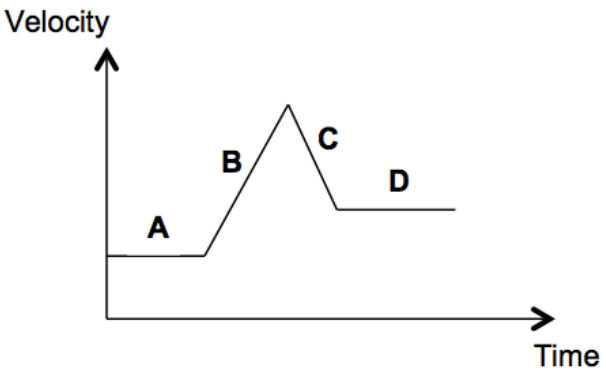


A 20.0 m/s
B 22.5 m/s
C 25.0 m/s
D 27.5 m/s

6 How will the acceleration due to gravity be affected if a heavy object is released from a higher position and its mass is halved?

	Higher Position	Halved its mass
A	No change	No change
B	No change	Decreases
C	Increases	Decreases
D	Increases	No change

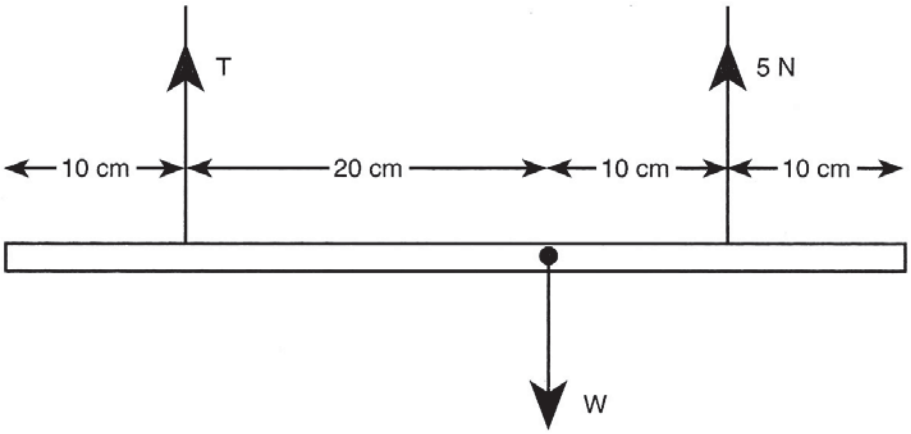
7 An object moves in a straight horizontal line under a single force. The magnitude and direction of the force change during the motion. The velocity-time graph of the object is shown. Which is the interval where the force did the most work on the object?



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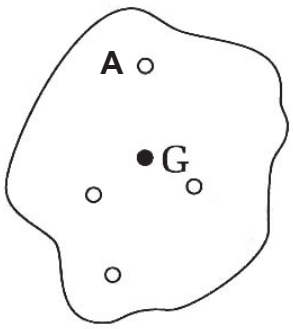
8 A non-uniform rod of unknown weight **W** is suspended by two strings as shown in the diagram. The tension in one of the strings is 5 N.

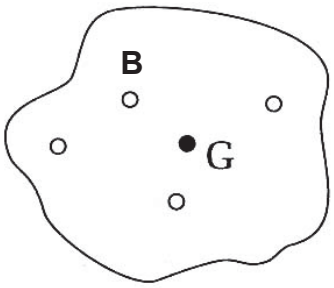


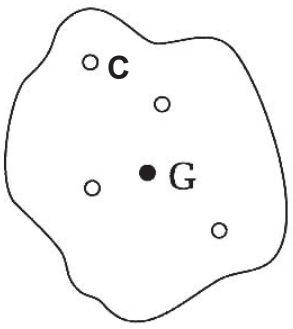
What is the tension **T** in the other string?

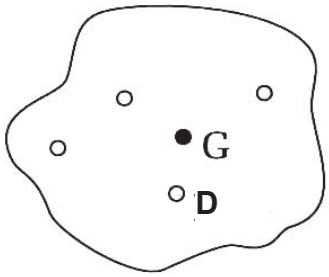
A 2.5 N
B 5.0 N
C 7.5 N
D 12.5 N

9 Four holes, **A**, **B**, **C** and **D** are made on a uniform lamina. The centre of gravity of the lamina is at **G**. Which one of the following shows correctly the lamina hanging freely about each of the holes?









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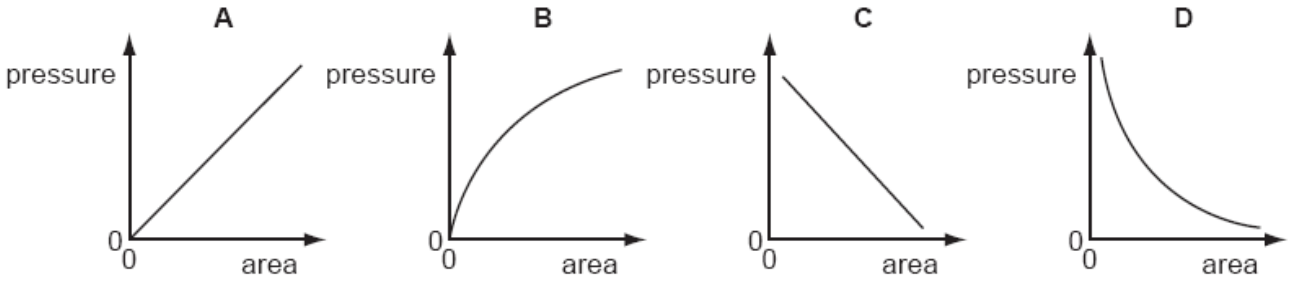
10 Which of the following involve(s) a change in energy of 100 J?

I A mass of 10 kg raised vertically by 100 cm.
II A mass of 2 kg increasing its speed from 10 m/s to 20 m/s.
III A charged particle of 5 C accelerated using a potential difference of 20 V.

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

11 A graph is plotted to show the relationship between the pressure exerted on the table and the base area of the block.

Which one of the following graph shows this relationship?

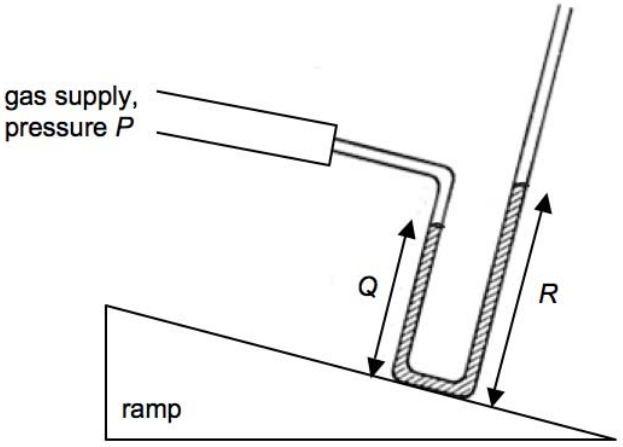


12 The atmospheric pressure is 100 kPa. What is the average force experienced at the bottom of the water tank with length 0.5 m, width 0.4 m and depth 0.6 m? (Density of water is 1000 kg/m^3.)

A 720 N
B 1200 N
C 12720 N
D 21200 N

13 A manometer is placed on a ramp connecting to a gas supply with pressure ***P***. The atmospheric pressure is ***H*** metres of mercury.

If the lengths ***Q*** and ***R*** are measured in metres, what is the pressure ***P*** in metres of mercury?

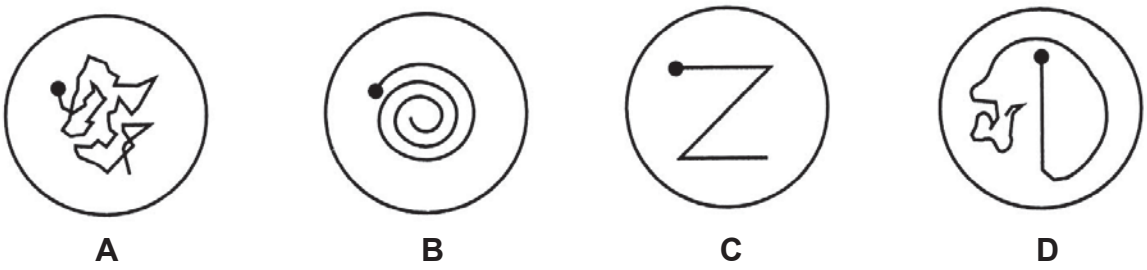


A Exactly ***R*** + ***H***
B Exactly ***R*** – ***Q*** + ***H***
C Lesser than ***R*** + ***H***
D Lesser than ***R*** – ***Q*** + ***H***

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14 Which one of the following diagrams best represents the observed paths of chalk powder suspended in still water?



A **B** **C** **D**

15 At room temperature, we feel that a metal lock is cooler than a wooden door.

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

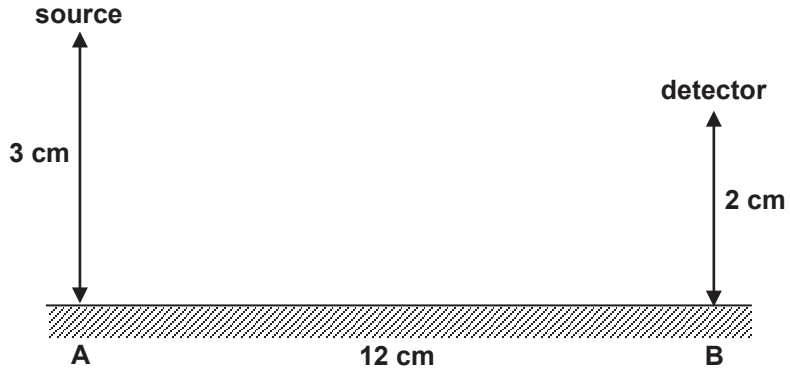
I The temperature of the metal block is lower.
II Metal is a better conductor of thermal energy than wood.
III The transfer of thermal energy in metal is faster than wood.

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

16 What mass of hot water at 80 °C must be mixed with water at room temperature of 30 °C in order to obtain 10 kg of water at 60 °C?

A 3.75 kg
B 4 kg
C 5 kg
D 6 kg

17 A point source of light is located 3 cm above a plane mirror and this reflected ray is detected 2 cm above the mirror at a horizontal displacement of 12 cm.



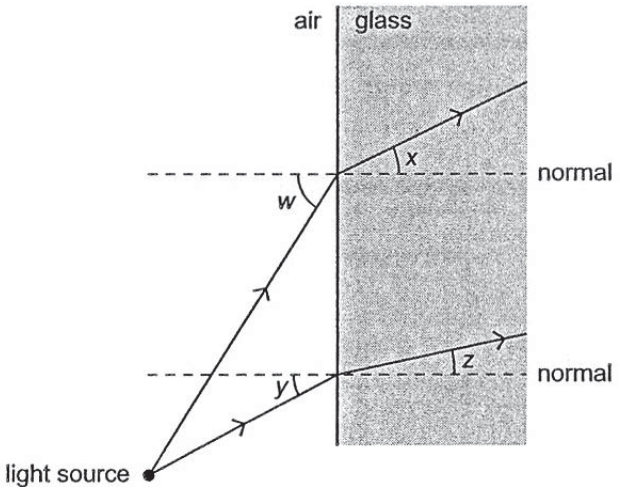
What is the distance between **A** and the point of incidence?

A 4 cm
B 6 cm
C 7.2 cm
D 8.5 cm

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18 The diagram shows two rays of light entering a glass block.



Which one of the following equations is correct?

A $\frac{w}{x} = \frac{y}{z}$

B $\frac{\sin w}{\sin x} = \frac{\sin y}{\sin z}$

C $w \times x = y \times z$

D $\sin w \times \sin x = \sin y \times \sin z$

19 If an object is placed 21 cm from a converging lens, the image formed is slightly smaller than the object. What is the approximate focal length of the lens ?

A 5 cm
B 10 cm
C 18 cm
D 20 cm

20 When a sound wave passes an air molecule in the direction shown, which diagram shows the correct movement of the air molecule?

direction of sound wave →

• air molecule

A •→

B ←•→

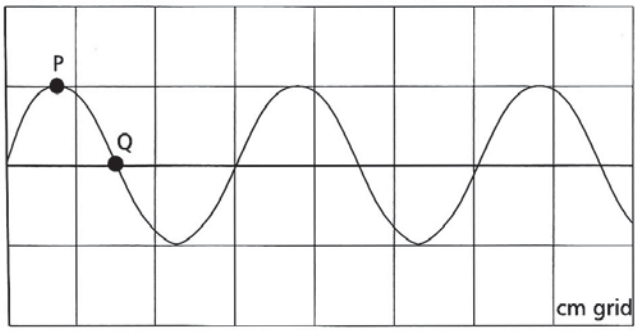
C ←•→

D ↕•

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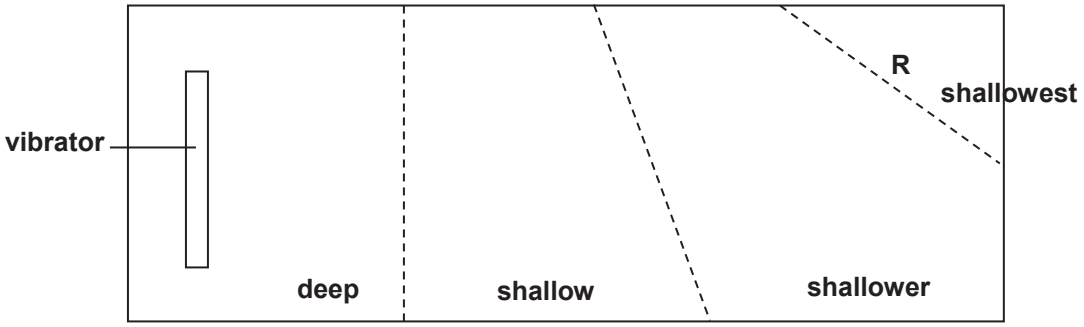
21 The diagram shows a snapshot of a travelling wave that is moving from left to right. The frequency of the wave shown is 30 Hz.



Taking each grid to be 1 cm × 1 cm, which of the following correctly states the amplitude and the speed of the wave?

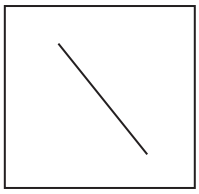
	Amplitude / mm	Speed / m/s
A	10	0.9
B	10	1.8
C	20	2.7
D	20	3.6

22 A ripple tank is set up so that there are different levels of water as shown in the diagram.

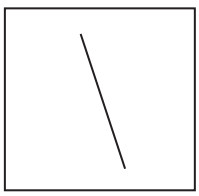


If the vibrator produces straight waves, which one of the following diagrams correctly shows a ripple approaching the region **R**?

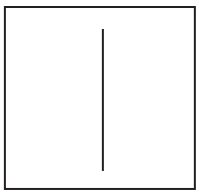
A



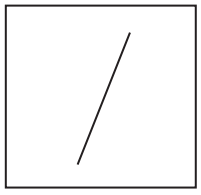
B



C



D



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23 Which one of the following statements about the visible spectrum is **not true**?

A Light from the sun does not produce a pure spectrum.
B The visible spectrum includes infra-red and ultra-violet rays.
C A rainbow is actually a spectrum caused by the dispersion of light from water droplets.
D It is seen when white light passing through a prism is dispersed into its component colours.

24 A tennis player hits a ball hard and hears an echo from a wall 0.4 s later. The speed of sound in air is 330 m/s. How far away is the player from the wall?

A 66 m
B 132 m
C 264 m
D 825 m

25 Which of the following is/are application(s) of ultrasound?

I Prenatal scanning of foetus
II Cleaning of surgical instruments
III Using a microphone during lecture

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

26 **Figure I** shows two metallic spheres **X** and **Y** placed in contact. A positively charged rod **Z** is then brought near them.

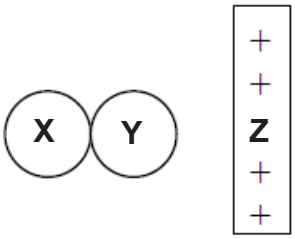


Figure I

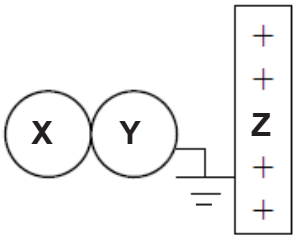


Figure II

If **Y** is earthed without removing **Z** as shown in **Figure II**, which one of the following statements is correct?

A Both **X** and **Y** will be negatively charged.
B Both **X** and **Y** will be positively charged.
C **X** will be positively charged and **Y** will carry no charge.
D **X** will carry no charge and **Y** will be negatively charged.

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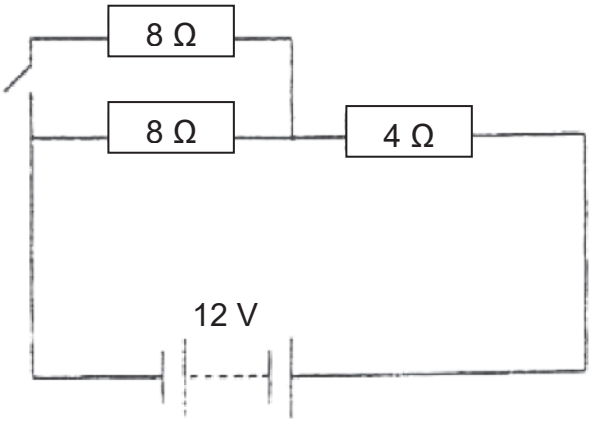
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27 A battery drives 30 C of charge round a circuit. The total work done is 600 J. What is the electromotive force of the battery?

A 0.05 V
B 5 V
C 20 V
D 300 V

28 Resistors of 8 Ω and 4 Ω are connected in series to a 12 V supply as shown in the circuit.

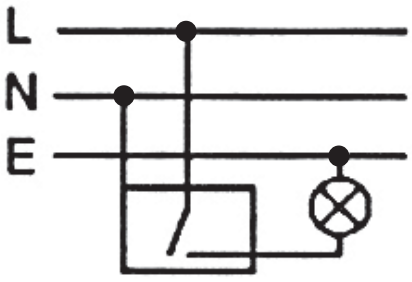
What is the effect of closing the switch on the current drawn from the supply and the potential difference across the 4 Ω?



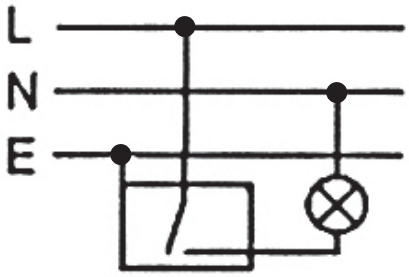
	Current	Potential Difference
A	Decreases by 0.5 A	Decreases by 2 V
B	Unchanged	Increases by 2 V
C	Increases by 0.5 A	Increases by 2 V
D	Increases by 0.5 A	Increases by 4 V

29 Which one of the following diagrams shows the correct connections for a switch and lamp in a lighting circuit? (Key: L – Live, N – Neutral, E – Earth and □ – metal casing)

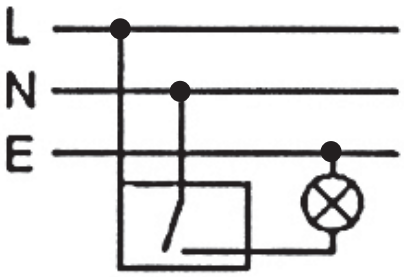
A



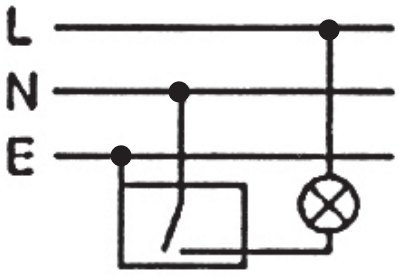
B



C



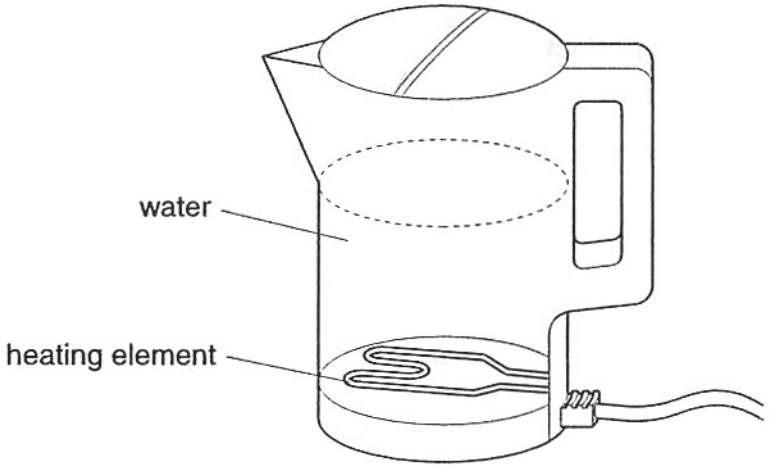
D



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30 An electric kettle, labelled '220 V, 1 kW' is fitted with a plug containing a 13 A fuse.



It is connected to a 220 V mains supply. The water in it takes a few minutes to boil. When the plug is connected to a 110 V mains supply

A the kettle does not work.
B the fuse in the plug blows.
C the water takes a longer time to boil.
D the heating element of the kettle melts.

31 An electrical heater is used to determine the specific heat capacity of a metal and the following readings are obtained:

mass of metal:	2 kg
time for which heat is supplied:	20 s
temperature rise of metal:	10 °C

It is found that the specific heat capacity of the metal is 720 J/(kg°C).

Assuming that 20% of the energy supplied by the heater is lost to the surrounding, what is the power rating of the heater?

A 720 W
B 864 W
C 900 W
D 14400 W

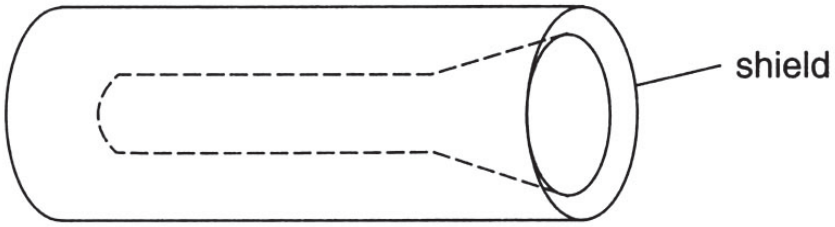
32 The best way to demagnetise a magnet is to

A throw it on the ground several times.
B place it along the E-W axis and hammer it.
C place it in a solenoid carrying direct-current and slowly pulling it out.
D place it in a solenoid carrying alternating-current and slowly pulling it out.

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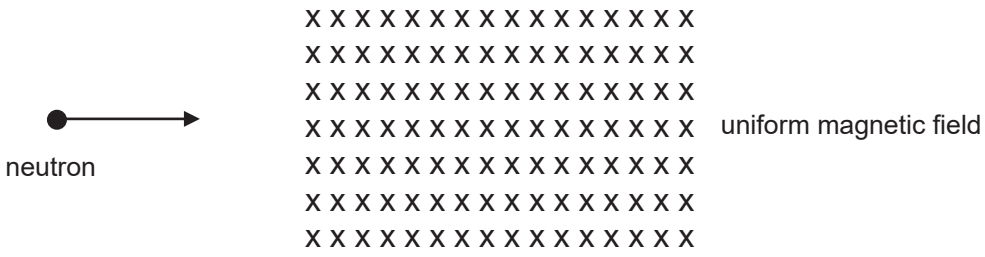
33 The diagram shows a shield designed to protect a cathode-ray tube from the effects of external magnetic fields.



Which one of the following is used to make the shield?

A Steel
B Copper
C Mica
D Soft iron

34 A neutron enters a uniform magnetic field perpendicularly as shown in the diagram.



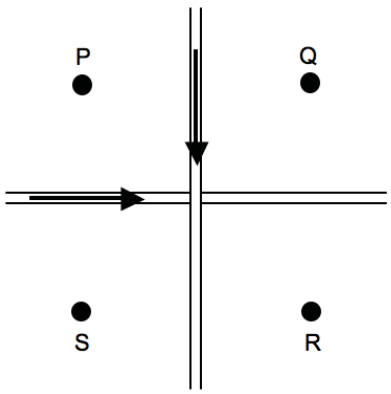
The path that is traced out will be _____ because _____ .

A straight; there is no force acting
B circular; the force is always forward
C spiral; the force is always perpendicular to its motion
D parabolic; the force is always perpendicular to its motion

35 Two long insulated wires carrying **equal** currents are placed perpendicular to each other as shown.

The points **P**, **Q**, **R** and **S** are all at equal distances from the wires.

At which point(s) is/are the resulting magnetic field **zero**?



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

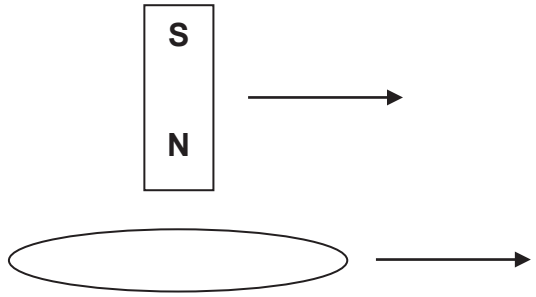
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36 Which part of a simple d.c. motor reverses the direction of current through the coil every half-cycle?

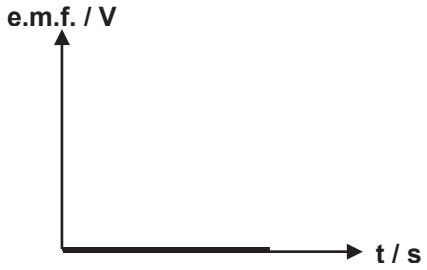
A The armature
B The brushes
C The split-ring commutator
D The slip rings

37 A bar magnet is held above a loop of wire in the position shown below. Both the loop and magnet are moved sideways with the same uniform speed.

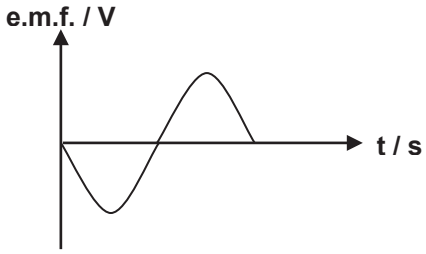


Which of the following graphs ***best*** represents the variation of the magnitude of the e.m.f. induced in the loop?

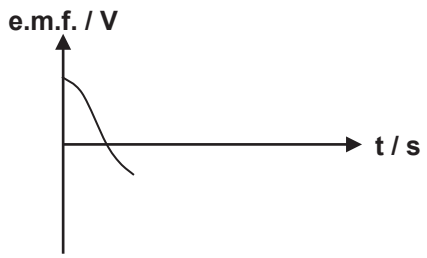
A



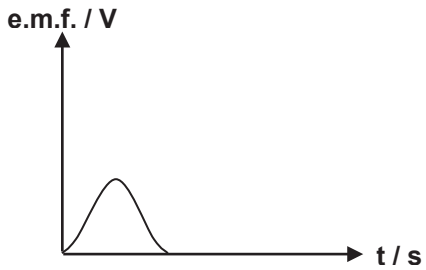
B



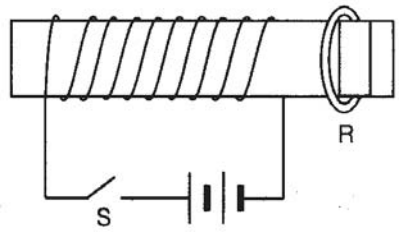
C



D



38 The diagram shows an insulated copper wire coiled around a soft iron rod. A copper ring **R** is placed at one end of the rod. What will happen to the copper ring **R** when the switch **S** is closed?



A The ring becomes heated up.
B The ring becomes magnetized.
C The ring will be attracted to the coil.
D The ring will be repelled from the coil.

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39 **Diagram I** shows the oscilloscope trace produced by an input of 2 V at 50 Hz.

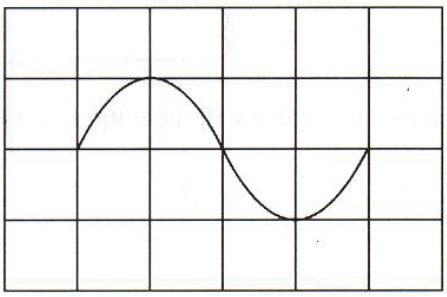


Diagram I

Diagram II shows the trace from a different input on the same oscilloscope.

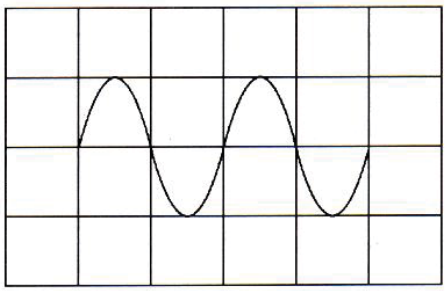


Diagram II

What is the value of the new input?

A 1 V at 50 Hz
B 2 V at 25 Hz
C 2 V at 100 Hz
D 4 V at 50 Hz

40 Which pairs of quantities are **not** proportional?

A Change in temperature and quantity of heat supplied to an object
B Speed and time for an object falling freely from rest through a vacuum
C Current and potential difference for a light bulb when temperature rises
D Resultant force acting on an object along a straight line and its acceleration

END OF PAPER

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NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2018

SUBJECT : **PHYSICS 6091/02**

DATE : **20 AUGUST 2018**

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. This paper consists of **Two (2) Sections**: **Section A** and **Section B**.
2. **Section A:** Answer **ALL** questions. Write your answers in the spaces provided.
3. **Section B:** Answer **ALL** questions.
   Question **11** is **EITHER / OR QUESTION**. **SELECT ONLY ONE PART OF THIS QUESTION**.
4. Calculators may be used where necessary.
5. **DO NOT DETACH** any sections from this paper.

INFORMATION FOR CANDIDATES:

Throughout the paper, the acceleration due to gravity on Earth is taken as 10 N/kg **unless stated otherwise**.

The number of marks is given in brackets [ ] at the end of each question.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

PAPER 1	/ 40
PAPER 2	
SECTION A :	/ 50
SECTION B :	
Question 9	/ 10
Question 10	/ 10
Question 11 E/O	/ 10
TOTAL	/ 120
80% Weightage (Paper 1 & 2)	
20% Weightage (Paper 3)	
GRADE	
TARGET GRADE	

Parent's Signature: _____

This paper consists of _18_ printed pages, including the cover page.

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SECTION A : [50 marks]

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

1 **Diagram I** shows a gate which closes automatically after use.

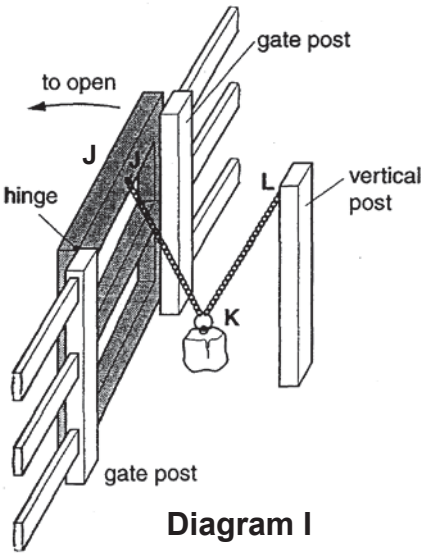


Diagram I

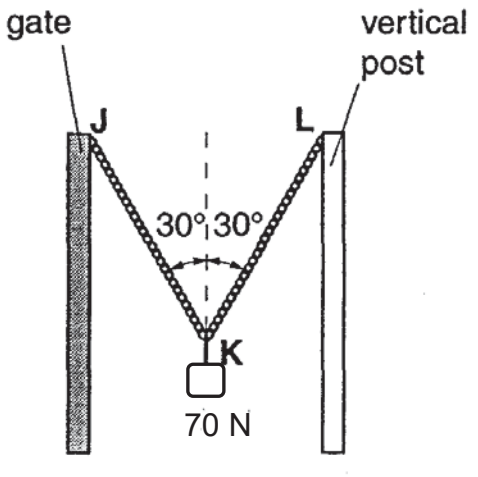


Diagram II

A heavy stone is attached by chains **JK** and **KL** to the top bar of the gate and to the top of a nearby vertical post. Opening the gate raises the stone. When the gate is released, the force exerted by the chains **JK** and **KL** closes the gate.

(a) **Diagram II** shows the instant when the gate is closed and each chain is at 30˚ to the vertical. The plane containing the chains and the stone is at right angles to the gate. By means of a scaled vector diagram, determine the tension in cable **JK** if the weight of the stone is 70 N. You are to indicate the scale used.

Scale used = ... Tension in cable **JK** = ... **[4]**

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(b) **Diagram III** shows the top view of the gate.

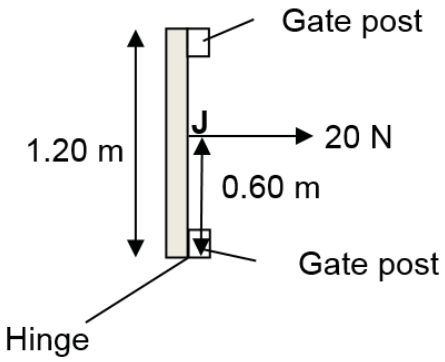


Diagram III

Due to the tension in chain **JK**, there is a horizontal force of 20 N that holds the gate closed as shown in the diagram. A force **F** is applied to the gate to open it.

(i) By means of an arrow, indicate in **Diagram III**, where the force **F** should be applied so that its magnitude is a minimum. Label the force as **F**. **[1]**

(ii) Calculate this minimum force **F** in **(b)(i)** needed to just open the gate.

Minimum force **F** = ... **[2]**

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2 **(a)** Define ***work*** and give the name and symbol for an SI unit in which it is measured.

.....

.....

Unit of work: ..... Symbol: ..... **[2]**

(b) To push-start a car on a winter's morning (its battery is flat), two people each pushes with a force of 295 N. After pushing for 15 m, the car's engine starts. If at the moment, its kinetic energy is 7400 J, calculate

(i) the work done by the push of the people on the car, and

Work done = ... **[2]**

(ii) the average frictional forces on the car.

Average frictional forces = ... **[3]**

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3 **(a)** **(i)** It is observed that solids have fixed shape while liquids do not. Using the property of molecules, explain the observation.

.....

.....

.....

..... **[2]**

(ii) What property of molecules makes gases fill all the space available to them?

.....

..... **[1]**

(b) Explain how molecules escape from the surface of an evaporating liquid.

.....

.....

.....

..... **[2]**

(c) Explain how evaporation affects the internal energy of the liquid.

.....

.....

.....

..... **[2]**

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4 The wavelength of four electromagnetic waves including infrared wave is given in the following table.

Type of Wave	Wavelength
Infrared wave	0.18 mm
A	0.5 μm
B	10 cm
C	1100 m

(a) Which of the waves, **A**, **B** or **C** is visible light?

.....

[1]

(b) A TV station broadcasts its programmes at 5×10^3 kHz.

(i) Name the electromagnetic wave used for the broadcast.

.....

[1]

(ii) Calculate the wavelength of the wave.

Wavelength = ...

[2]

(c) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space. Why would an X-ray telescope based on Earth **not** be able to detect X-rays emitted from distant stars?

.....

.....

[1]

(d) State one similar properties of all electromagnetic waves.

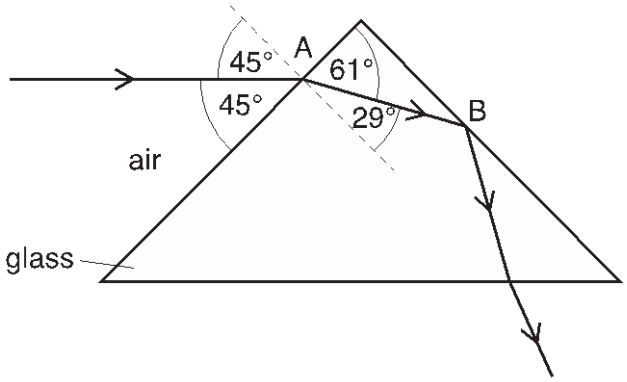
.....

.....

[1]

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5 The diagram shows the path of a ray of blue light as it passes through a glass prism.



(a) Using the angles shown in the diagram, calculate the refractive index of the glass.

Refractive index = ... **[2]**

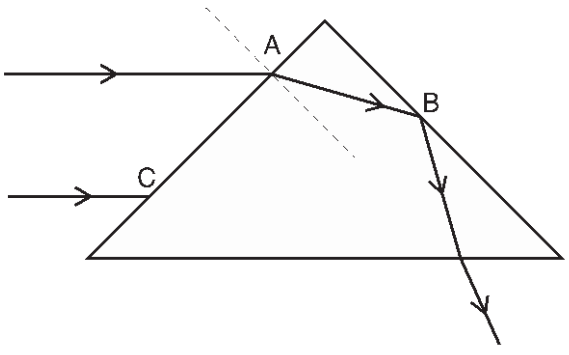
(b) Explain why the ray does not emerge from the prism at **B**.

.....

.....

..... **[2]**

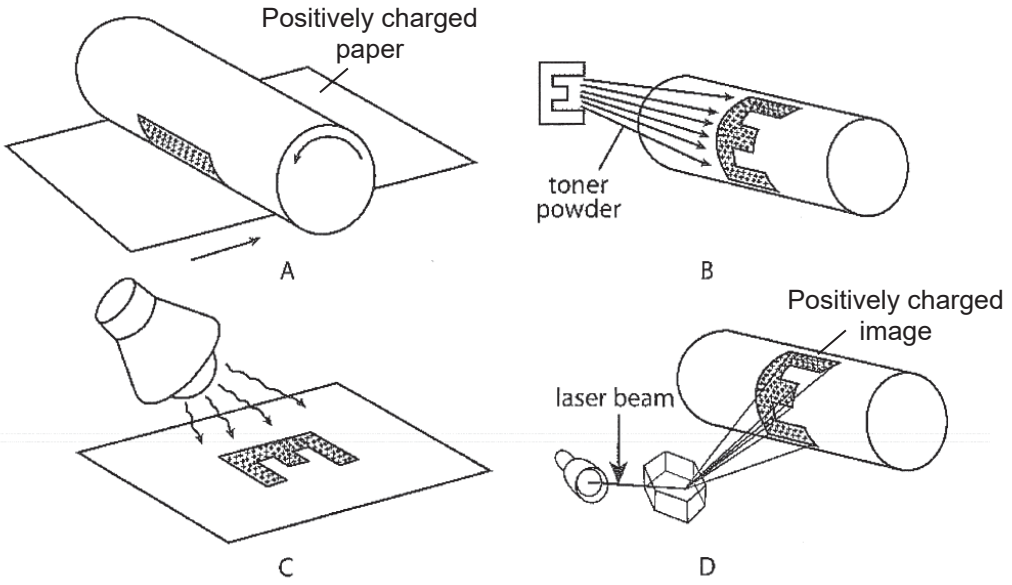
(c) In the following diagram, a second ray of blue light strikes the glass prism at **C**. This ray is parallel to the ray that strikes the glass prism at **A**. In this diagram, continue the path of the second ray through and out of the glass prism.



[2]

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6 The diagram shows four stages on how a photocopier works.



The four stages are labelled from **A** to **D** but are not arranged in order.

The following table shows the first stage with a brief description on what happens during this stage within the photocopier.

Stage	Brief Description of the stage
D	Light is shone on a document and the white areas reflect light onto the drum which is positively charged. Areas on the drum that are struck by the light are discharged and leaves a positively charged image on the drum.

(a) Complete the table by

(i) arranging the other stages in correct order. **[1]**

(ii) providing a brief description of each stage. **[3]**

(b) Explain why the paper in stage **A** is more positively charged than the image formed in stage **D**.

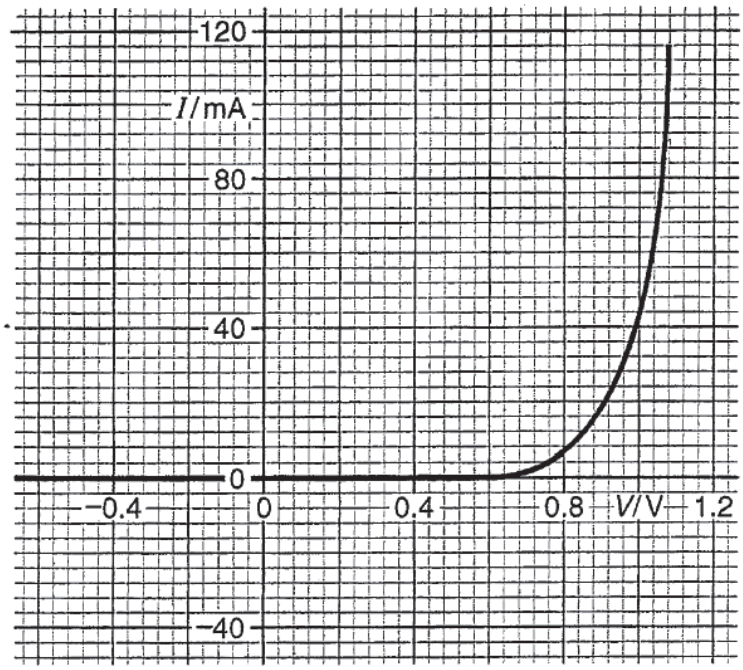
.....

..... **[1]**

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7 The graph shows how the current **I** in a diode varies with the potential difference **V** across it.



(a) Describe how **I** varies with **V** when

(i) **V** is negative,

.....

[1]

(ii) **V** is positive.

.....

.....

[2]

(b) Calculate the resistance of the diode when **V** is 1.0 V.

Resistance = ... **[2]**

(c) A student states “when **V** is negative, the resistance is zero”. State with a reason whether you agree with the student.

.....

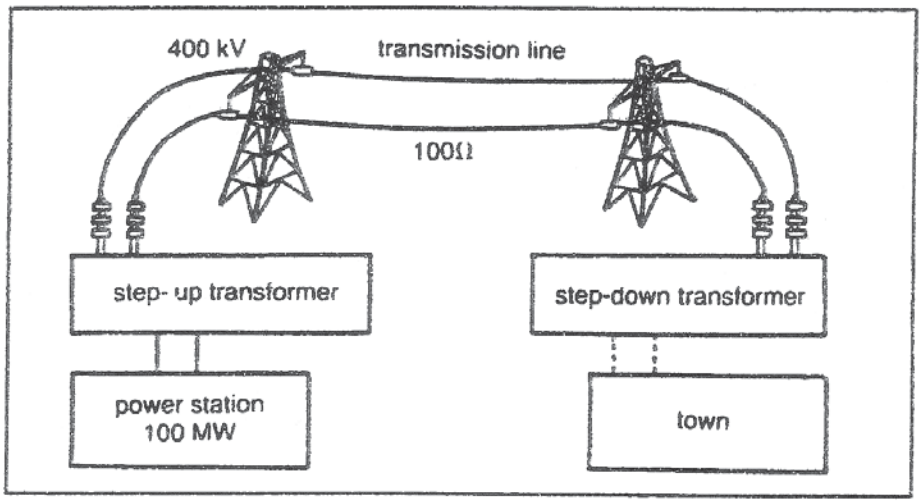
.....

[1]

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8 The diagram shows a power station, which generates 100 MW of power.



The voltage is stepped up to 400 kV and the national grid transmits the power over a large distance. The voltage is then stepped down before the power is used by industries and homes in a town.

(a) Given that 100 MW is fed into the line at 400 kV, calculate the current flowing in the transmission line.

Current = ... **[2]**

(b) Calculate the power loss along the transmission line given that the total resistance of the line is 100 Ω.

Power = ... **[2]**

(c) How would you modify the circuit so that the power loss in the circuit can be reduced? Explain your answer.

.....

.....

..... **[2]**

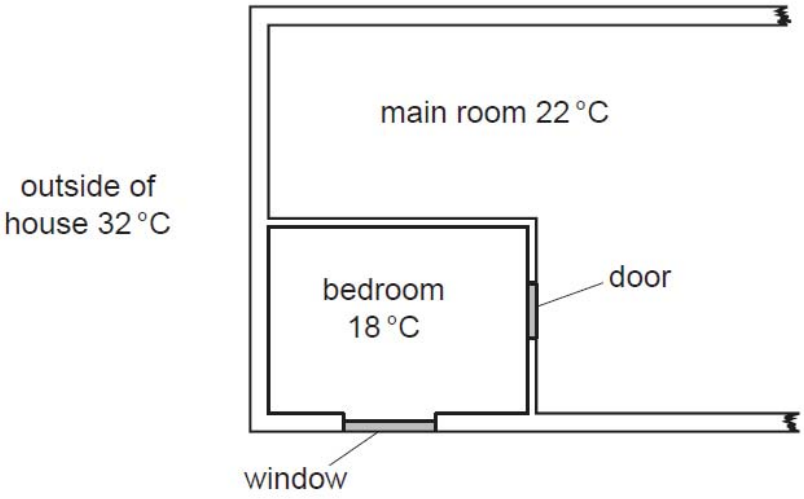
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SECTION B : [30 marks]

Each question is worth **10 marks**. *Answer* **ALL** *questions in this section.* **Question 11** *is an* **EITHER / OR QUESTION**. ***SELECT ONLY ONE PART OF THIS QUESTION***. *Show your working and write your answers in the spaces provided.*

9 The diagram shows the plan of a bedroom and part of the main room of a house. Other rooms are not shown.



The temperatures of the main room, the bedroom and the outside of the house are shown.

The following table shows all the thermal energy inputs to the bedroom in one hour.

Thermal energy input to bedroom	Energy / J
Through the door and walls from main room	4.5×10^4
Through the walls from outside of house	2.3×10^6
Through the window	1.1×10^6
From the person sleeping in bedroom	2.0×10^5

(a) Explain why more thermal energy enters the bedroom from the outside of the house than from the main room.

.....

..... **[1]**

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(b) An air conditioner keeps the temperature constant in the bedroom by removing energy.

Identify a suitable location of the air conditioner in the bedroom and explain how it cools the bedroom efficiently.

.....

.....

.....

.....

..... **[3]**

(c) The inside wall of the bedroom radiates thermal energy. Explain how the colour of the inside wall affects the amount of energy radiated.

.....

.....

.....

..... **[2]**

(d) **(i)** What is the rate of thermal energy removed by the air conditioner if the temperature of the room is to be maintained at 18 ˚C?

Rate = ... **[3]**

(ii) State an assumption made in the calculation for **d(i)**.

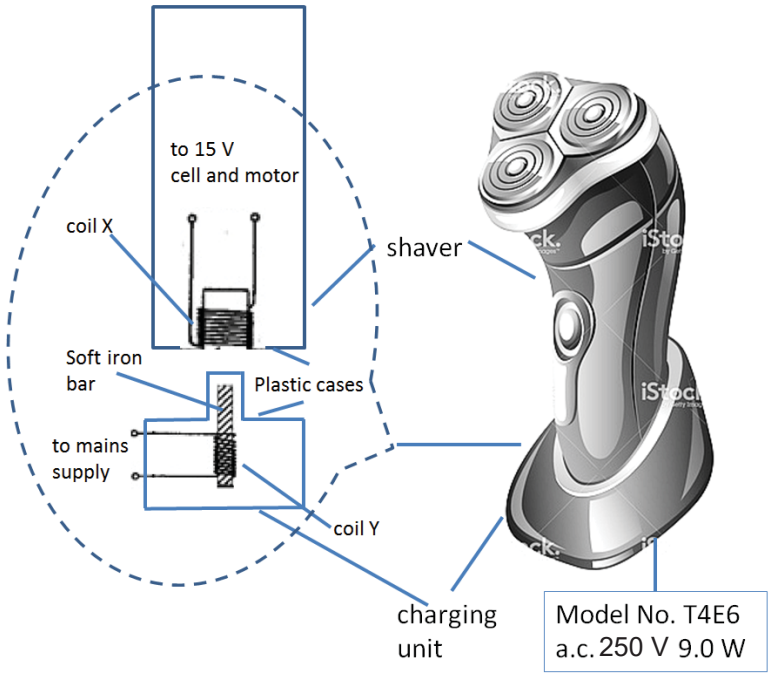
.....

..... **[1]**

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10 The diagram shows an electric shaver.



It consists of the shaver and a charging unit. Both the shaver and the charging unit are completely covered by plastic cases and there is no metal contact between them. Inside the shaver, there is a 15 V rechargeable cell for driving a motor.

(a) When the shaver is in operation, the current flowing through the motor is 0.36 A. Calculate the power consumed by the motor.

Power = ... **[2]**

(b) When the energy stored in the cell is used up, the shaver is placed on the charging unit to recharge the cell. The charging unit is connected to the mains supply and its label is shown in the diagram.

Calculate the energy, in joules, drawn by the charging unit from the mains supply in one hour.

Energy = ... **[2]**

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(c) To charge the rechargeable cell, the shaver will be placed on the charging unit. At the bottom of the shaver is coil **X**, which is connected to the 15 V rechargeable cell. Another coil **Y** is located inside the charging unit with a soft-iron bar fixed inside it. When the shaver is placed on the charging unit, the soft-iron bar lies inside coil **X**.

(i) Explain how an electromotive force (e.m.f.) is produced in the shaver to recharge the cell.

.....

.....

.....

.....

..... **[3]**

(ii) An output voltage of 30 V a.c. is produced at coil **X** to charge the cell. Calculate the number of turns in coil **X** if there is 11000 turns in coil **Y**.

Number of turns = ... **[2]**

(d) The charging unit is connected to the mains with a two-pin plug. State a reason that explains why it is safe to use a two-pin plug.

.....

.....

..... **[1]**

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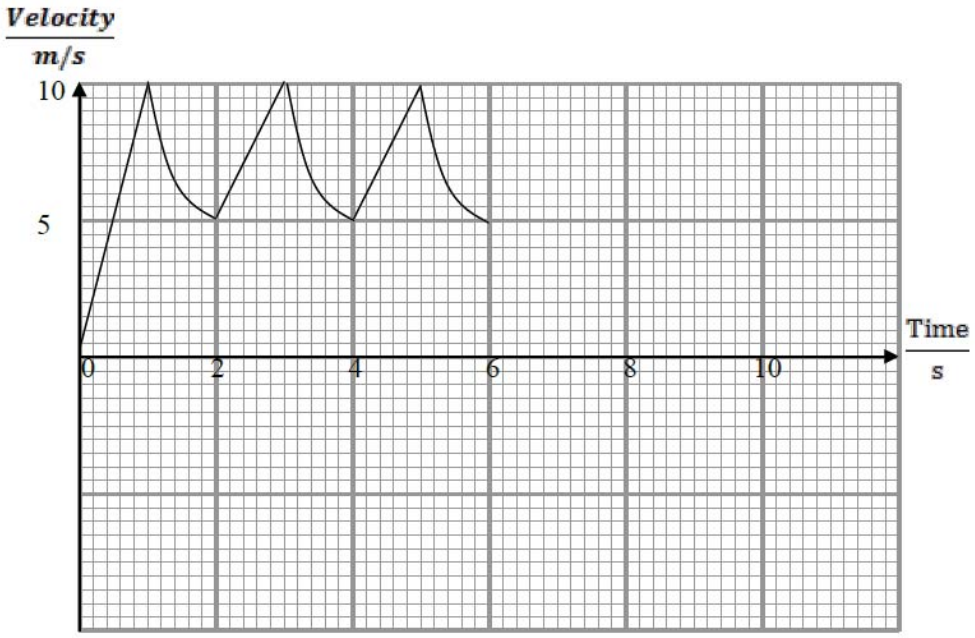
11 EITHER

The diagram shows a boy of mass 32 kg riding on a skate scooter.



He pushes off with his rear foot momentarily, cruises for a while and then pushes off with rear foot again. The cycle is repeated. There is presence of resistive forces.

The following graph shows how the velocity of the boy changes over the first 6.0 s of his journey.



(a) Describe the boy's acceleration over the first 2.0 s of his journey.

.....

.....

.....

..... **[2]**

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(b) Which part of the graph shows that there is presence of resistive forces? Explain your answer.

.....

..... **[2]**

(c) At 0.50 s, calculate

(i) the total displacement of the boy,

Total displacement = ... **[1]**

(ii) the acceleration of the boy

Acceleration = ... **[1]**

(iii) the forward driving force applied by the boy if the total resistive force acting on him is 4.5 N.

Forward driving force = ... **[3]**

(d) State the other force that is part of an action-reaction pair with the forward driving force calculated in **c(iii)**.

.....

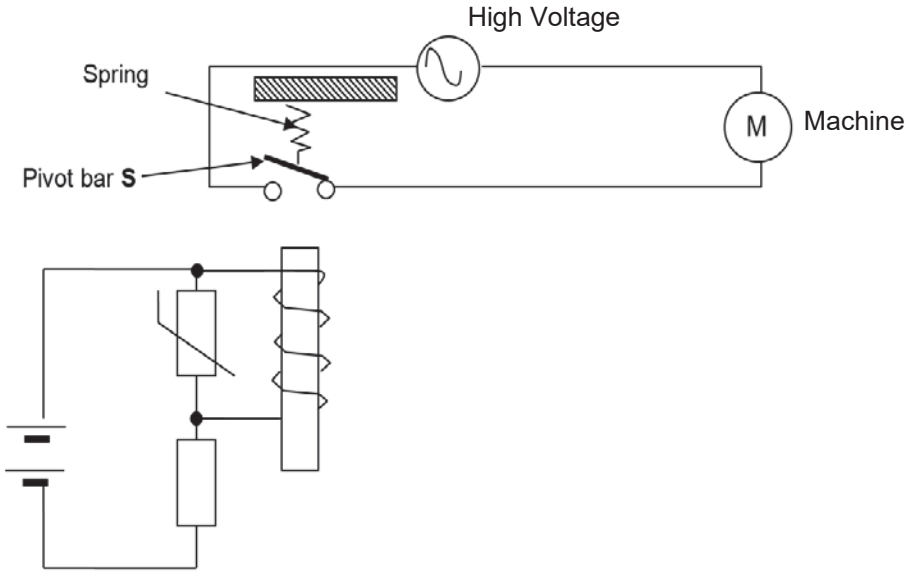
..... **[1]**

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11 OR

The diagram shows a magnetic relay used to operate the switch of a machine in a factory.



(a) Explain how the magnetic relay works when the temperature around the thermistor **decreases**.

.....

.....

.....

.....

..... **[3]**

(b) **(i)** In the diagram, indicate the **N-pole** of the electromagnet. **[1]**

(ii) Suggest a suitable material for the pivot bar **S**. Give a reason for your choice.

.....

.....

..... **[2]**

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(c) **(i)** Explain clearly the advantage of using a magnetic relay to operate the machine

.....

.....

..... **[2]**

(ii) The machine operates at '1000 V, 5 A' and runs an average of 12 hours daily. Calculate the cost of operating the machine in a month (30 days) if each unit of electricity costs $0.29.

Cost = ... **[2]**

END OF PAPER

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ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2018

SUBJECT : **PHYSICS 6091**

DATE : **20 AUG 2018 (P2)**
11 SEPT 2018 (P1)

LEVEL : **SECONDARY 4 EXPRESS**

DURATION :

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

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

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

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

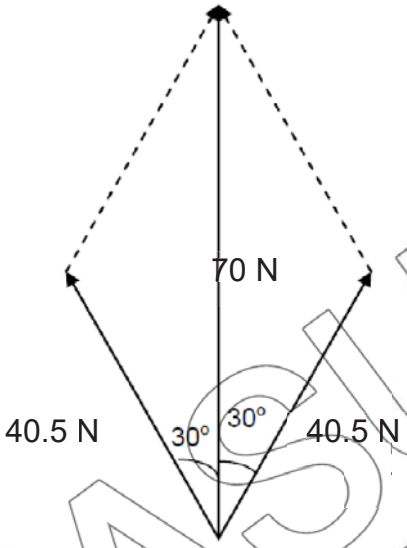
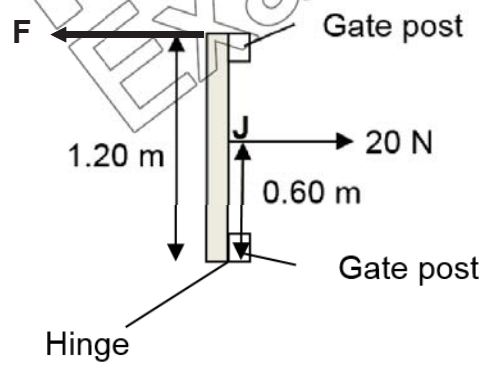
31	32	33	34	35	36	37	38	39	40
C	**D**	**D**	**A**	**C**	**C**	**A**	**D**	**C**	**C**

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PAPER 2 (DURATION: 1 HOUR 45 MIN)

Section A [50 marks]

QN	Suggested Answers	Sub Ttl	Ttl
1a	 Suitable scale [1] Shape of vector diagram [1] Labelling forces [1] Tension in cable JK = 40.5 ± 4.0 N [1]	**4(M)**	**7**
1bi	 **Diagram III**	**1(E)**	
1bii	Taking moments about hinge, Total clockwise moments = Total anti-clockwise moments 20 × 0.60 = F × 1.20 [1] F = 10 N [1]	**2 (M)**	

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QN	Suggested Answers	Sub Ttl	Ttl
2a	Work is the energy transferred [1] when a force moved an object over a distance in the direction of the force. Unit of work: Joules Symbol: J [1]	**2 (E)**	**7**
2bi	WD = Force × distance moved = (2 × 295) × 15 [1] [2 × 295] = 8850 J [1]	**2 (M)**	
2bii	WD against Friction = 8850 – 7400 = 1450 J [1] WD = Force × distance moved 1450 = F × 15 [1] F = 96.7 N [1] Average frictional forces = 96.7 N	**3 (D)**	

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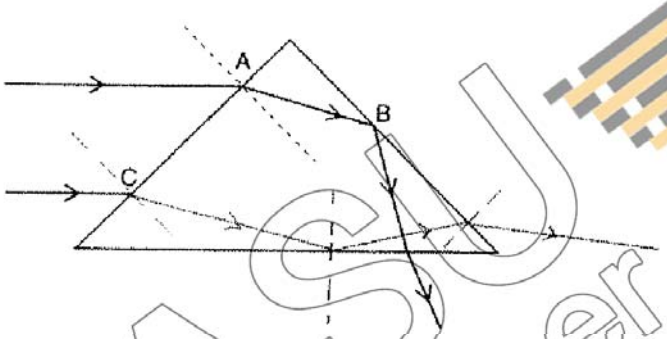
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QN	Suggested Answers	Sub Ttl	Ttl
3ai	Solids have fixed shape as the molecules are vibrating about their fixed position. [1] Liquids do not have fixed shape as the molecules are able to slide past one another. [1]	**2 (M)**	**7**
3aii	The weak intermolecular force between the gas molecules.	**1 (E)**	
3b	The molecules are at constant random motion and they collide with [1] one another. At times, some molecules gained enough energy to break the intermolecular bonds [1] between them and escape to the surrounding as vapour.	**2 (E)**	
3c	During evaporation, some molecules with more energy escape from the surface of the liquid. The remaining molecules has less kinetic energy [1]. Thus the internal energy of the liquid will decrease [1].	**2 (M)**	

QN	Suggested Answers	Sub Ttl	Ttl
4a	A [1]	**1 (E)**	**6**
4bi	Radiowaves [1]	**1 (E)**	
4bii	$v = f\lambda$ $3 \times 10^8 = 5 \times 10^6 \times \lambda$ [1] [½ m for v and ½ for f] $\lambda = 60$ m [1]	**2 (M)**	
4c	X-rays are absorbed by the Earth's atmosphere. [1]	**1 (M)**	
4d	Any of the following: They are transverse waves. They travel at the same speed of 3×10^8 m/s in vacuum. They do not require a medium to travel. They do not carry any charge. They are not affected by electric field.	**1 (E)**	

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QN	Suggested Answers	Sub Ttl	Ttl
5a	$\eta = \frac{\sin i}{\sin r}$ $= \frac{\sin 45°}{\sin 29°}$ [1] = 1.46 (3sf)[1]	**2 (E)**	**6**
5b	Light is travelling from optically denser medium (glass) to an optically less dense medium (air) and the angle of incidence is greater than the critical angle [1], total internal reflection takes place [1].	**2 (M)**	
5c	 Refraction at C with ray parallel to AB [1] TIR and refraction [1] Normal should be drawn at the surfaces [deduct ½ m if both not done]	**2 (D)**	

QN	Suggested Answers	Sub Ttl	Ttl
6ai	**DBAC**	**1 (M)**	**5**
6aii	B: Negatively charged toner particles are then attracted to [1] the positively charged image. A: The toner is transferred/attracted to [1] the paper when the drum rolls on the positively charged paper. C: Heat is applied to the toner powder [1] to fix the image onto the paper.	**3 (D)**	
6b	So that the negatively charged toner is attracted to the paper instead of sticking to the drum.	**1 (D)**	

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QN	Suggested Answers	Sub Ttl	Ttl
7ai	When V is negative, the current I is zero. [1]	**1 (E)**	**6**
7aii	When V is between 0 V to 0.6 V, the current is zero. [1] When V is greater than 0.6 V, the current I varies from 0 mA to 116 mA. [1]	**2 (D)**	
7b	From the graph, when V is 1.00 V, I is 44 mA. Resistance of the diode, R = V/I = 1.00 / 44 x 10^{-3} [1] = 22.7 Ω [1]	**2 (M)**	
7c	No. When V is negative and I is zero, it means that the resistance must be very high [1] such that no current can pass through.	**1 (M)**	

QN	Suggested Answers	Sub Ttl	Ttl
8a	$I = \frac{P}{V}$ $= \frac{100,000,000}{400,000}$ [1] $= 250A$ [1]	**2 (E)**	**6**
8b	$P_{loss} = I^2R$ $= 250^2 \times 100$ [1] $= 6.25MW$ [1]	**2 (M)**	
8c	Step up the voltage to more than 400 kV [1] to reduce the current flowing through the transmission line. As power loss in the circuit is I^2R [1], with reduced current, power loss is reduced.	**2 (D)**	

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Section B [30 marks]

QN	Suggested Answers	Sub Ttl	Ttl
9a	There is greater temperature difference of 14 °C between outside the house and the bedroom than that between the main room and the bedroom which is a temperature difference of 4 °C.	**1 (M)**	**10**
9b	It needs to be placed at the top [½] of the bedroom. The air around the air conditioner will be cooled, becomes more dense and sinks to the bottom of the room. [1] The warmer air, being less dense, will rise to the top of the room to be cooled. [1] A convection current is created [½] which helps to cool the room efficiently.	**3 (S)**	
9c	The inside wall of the bedroom should be painted white [1]. White is a poor emitter of radiant heat [1].	**2 (M)**	
9di	In 1 hour, total heat entering the bedroom = $4.5 \times 10^4 + 2.3 \times 10^6 + 1.1 \times 10^6 + 2.0 \times 10^5$ [1] = 4.05×10^6 J [1] Rate of thermal energy removed by the air conditioner = 4.05×10^6 J / 60 s = 6.75×10^5 W [1]	**3 (D)**	
9dii	Any reasonable assumption: • There is no heat entering the room other than what is stated. • The window and door is kept closed throughout. • The temperature outside the bedroom remains as stated.	**1 (D)**	

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QN	Suggested Answers	Sub Ttl	Ttl
10a	Power consumed by the motor = VI = 15 × 0.36 [1] = 5.4 W [1]	**2 (E)**	**10**
10b	E = Pt = 9 × 1 × 60 × 60 [1] = 32400 J [1]	**2 (E)**	
10ci	When the charging unit is connected to the mains supply, an alternating current flows through coil Y [1]. This alternating current will produce a changing magnetic field [1]. According to Faraday's law, this changing magnetic field linking [1] coil X will produce an e.m.f. in coil X which will produce an induced current to recharge the cell.	**3 (D)**	
10cii	Vs / Vp = Ns / Np 30 / 250 = Ns / 11000 [1] Ns = 1430 turns [1]	**2 (M)**	
10d	The charging unit has double-insulation [1] or has completely insulated plastic.	**1 (S)**	

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Either

QN	Suggested Answers	Sub Ttl	Ttl
11a	From 0 s to 1.0 s: Positive uniform/constant acceleration [1] From 1.0 s to 2.0 s: Negative and non-uniform acceleration. [1]	**2 (M)**	**10**
11b	From 1.0 s to 2.0 s, 3.0 s to 4.0 s and 5.0 s to 6.0s (the part when the boy is cruising) [1]. During these timings, the boy is slowing down [1] showing that there is presence of resistive forces like friction and air resistance to oppose his motion.	**2 (M)**	
11ci	Total displacement = ½ × 0.50 × 5 = 1.25 m [1]	**1 (M)**	
11cii	Acceleration = (v – u)/t = (5 – 0)/0.50 = 10 m/s^2 [1]	**1 (M)**	
11cii	Resultant Force = ma = 32 × 10 = 300 N [1] F – 4.5 = 300 [1] F = 304.5 N = 305 N (to 3 sf) [1]	**3 (D)**	
11d	The force applied by the boy on the ground. [1]	**1 (M)**	

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Or

QN	Suggested Answers	Sub Ttl	Ttl
11a	When the temperature of the thermistor decreases, its resistance increases. The voltage across the thermistor increases and causes a larger current to flow through the solenoid. The electromagnet becomes strongly magnetised and attracts S to close the switch.	**3 (M)**	**10**
11bi	Top of the iron core is N-pole. [1]	**1 (M)**	
11bii	Iron [1] It can be magnetised and demagnetised easily. [1]	**2 (E)**	
11ci	The magnetic relay prevents the user from direct contact with high voltage of power supply. [1] Hence, it prevents/minimises the risk of electric shock. [1]	**2 (M)**	
11cii	Total energy used = 1000 × 5 ÷ 1000 × 12 × 30 = 1800 kWh [1] Cost of energy = 1800 × $0.29 = $522 [1]	**2 (M)**	

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