Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2015

PHYSICS **5059/01**

Paper 1 Multiple Choice **31 Aug 2015**

Monday 0800 - 0900 **1 hour**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid or tape.

There are **forty** questions in this section. 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 Answer Sheet.

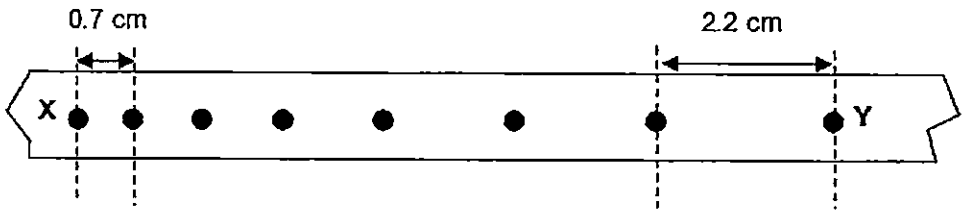
The use of an approved scientific calculator is expected, where appropriate.

Read the instructions on the Answer Sheet very carefully.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

1. Which of the following increases the period of a pendulum?

   A a smaller pendulum bob is used
   B a thicker string is used
   C the amplitude of oscillation is decreased
   D the length of string used is increased

2. The diagram shows part of a paper tape which is produced by a moving toy car under a ticker-tape timer of frequency 50 Hz.



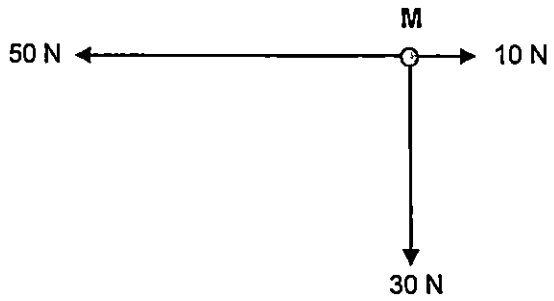
   Which of the following statements is **false**?

   A The acceleration of the car is 536 cm/s^2.
   B The time taken for the car to move from **X** to **Y** is 0.14 s.
   C The velocity of the car at **X** is 35 cm/s.
   D The velocity of the car at **Y** is 110 cm/s.

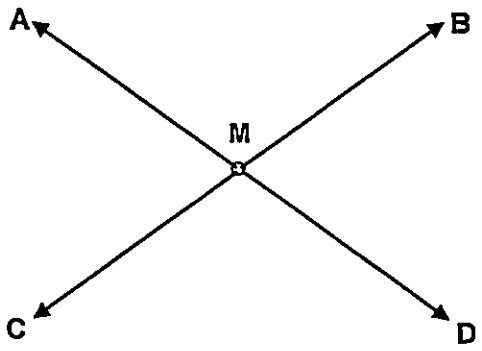
3. An object falls from rest through air and the air resistance acting on it increases. The object reaches terminal velocity after some time. Which quantity decreases until it reaches its terminal velocity?

   A acceleration **B** kinetic energy **C** speed **D** weight

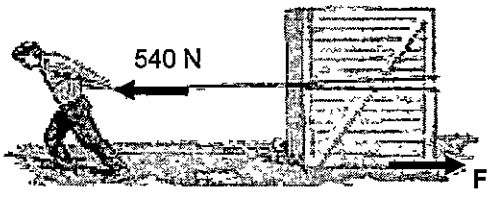
4. An object **M** has the following forces acting on it.



   Which of the following shows the direction of the resultant force acting on **M**?



5. A block of mass 60 kg is pulled across a rough surface by a 540 N force, against a friction force **F**.



The acceleration of the block is 6 m/s^2. What is the value of **F**?

A 90 N **B** 180 N **C** 360 N **D** 540 N

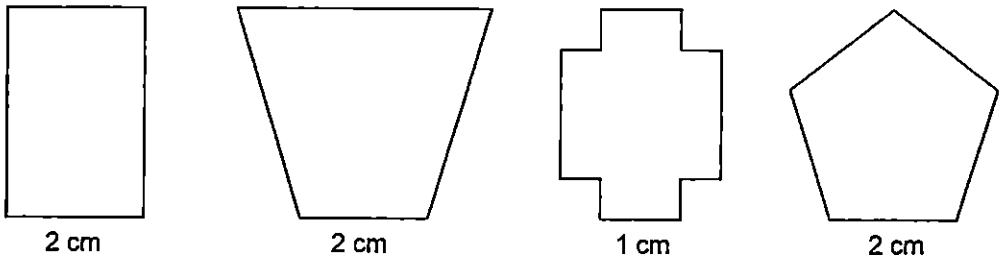
6. A student does an experiment to estimate the density of an irregular-shaped stone. Which of the following is needed?

A a measuring cylinder containing water
B a ruler and a measuring cylinder containing water
C an electronic balance and a measuring cylinder containing water
D an electronic balance and a ruler

7. Which of the following does **not** illustrate the effect of inertia?

A It is easier to slide a heavy box up a ramp to a certain height than to lift it vertically to the same height.
B When a bus starts to move, a person inside may be jerked backwards.
C If a pile of coins is placed on a table, the bottom one can be flicked away without disturbing the others.
D It is difficult to push a trolley full of shopping and especially difficult to stop it when it is moving

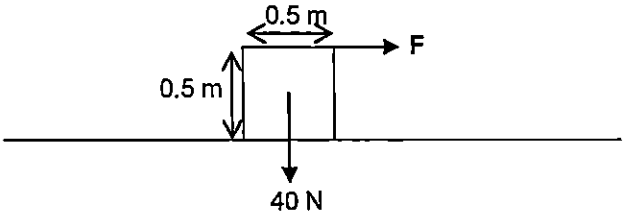
8. The diagrams show cross-sections of four solid objects.



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

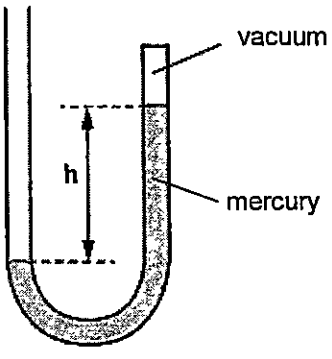
Which object is the most stable?

9. In the diagram shown, what is the force **F** needed to just tilt the cube weighing 40 N?



A 10 N **B** 20 N **C** 40 N **D** 80 N

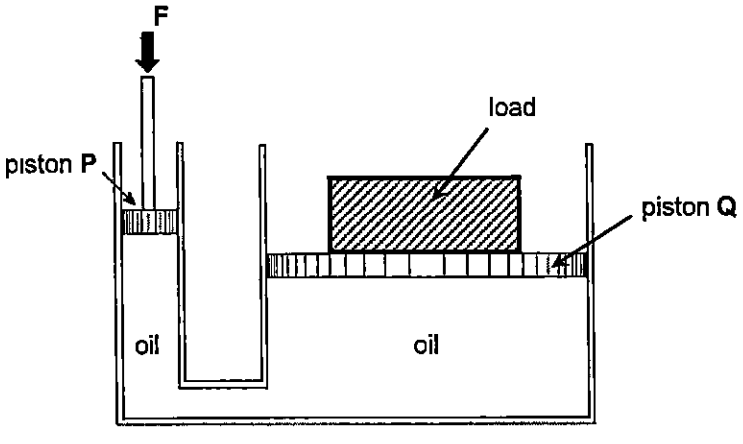
10. The diagram shows a manometer containing mercury that is sealed at one end.



What happens to the distance **h** when the manometer is taken to the top of a mountain?

A It decreases as atmospheric pressure decreases with height.
B It decreases as atmospheric pressure increases with height.
C It increases as atmospheric pressure decreases with height.
D It increases as atmospheric pressure increases with height.

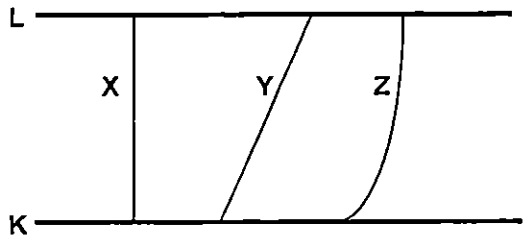
11. The diagram shows a simple hydraulic system.



Which of the following comparison is **true**?

A The force **F** is the same as the weight of the load.
B The force **F** is greater than the weight of the load.
C The pressure on piston **P** is the same as the pressure on piston **Q**.
D The pressure on piston **P** is smaller than the pressure on piston **Q**.

12. A load is to be lifted from level **K** to a higher level **L** along different paths labelled **X**, **Y** and **Z**.



Which of the following statements is **correct**?

A Path **X** requires the greatest amount of work as it is the shortest path.
B Path **Z** requires the greatest amount of work as it is the longest path.
C Paths **Y** and **Z** requires more work than path **X**.
D All paths require the same amount of work.

13. An object travelling on a horizontal surface at 20 m/s has 500 J of energy. After being accelerated, its kinetic energy is increased to 2000 J. What is its new speed?

A 40 m/s **B** 50 m/s **C** 60 m/s **D** 80 m/s

14. Some gas is heated in a sealed container. Which of the following does **not** increase?

A the average distance between gas molecules
B the average kinetic energy of gas molecules
C the force of collision between gas molecules and the container walls
D the number of collisions per unit time by gas molecules on the container walls

15. Which of the following best describes the molecules of a gas at room temperatures?

A close together and vibrating **B** close together and moving randomly
C far apart and stationary **D** far apart and moving randomly

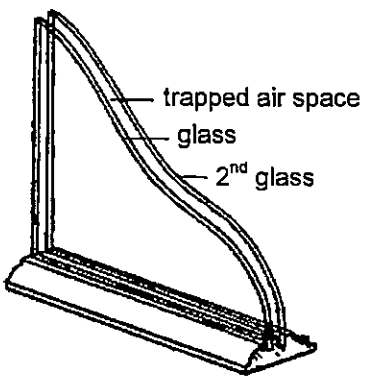
16. A new liquid was tested to decide whether it is suitable for use in a liquid-in-glass thermometer. Which of the following explains why this new liquid was subsequently rejected?

A It boils at 55°C. **B** It expands linearly with temperature.
C It freezes at - 20°C. **D** It is a transparent liquid.

17. Two objects are placed in contact with each other. Which of the following statements is **correct**?

A Heat is transferred from the object with a greater amount of heat to the one with a lower amount of heat.
B Heat is transferred from the object with a greater mass to the one with a lower mass.
C Heat is transferred from the object with a greater specific heat capacity to the one with a lower specific heat capacity.
D Heat is transferred from the object with a greater temperature to the one with a lower temperature.

18. Double-glazed windows have trapped air between two panes of glass. They are used to prevent unnecessary loss of heat from inside the house during winter.



Which of the following is/are reduced by the double-gazed window?

A conduction
B convection
C radiation
D conduction and radiation

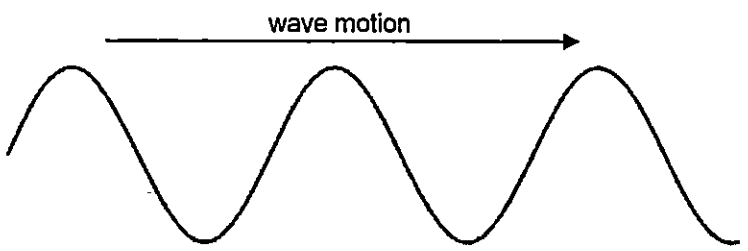
19. Energy is absorbed by ice to change its state from solid to liquid. During melting, what is this energy used for?

A to expand the ice particles
B to increase the temperature of the ice
C to strengthen the inter-molecular forces between the ice particles
D to weaken the inter-molecular forces between the ice particles

20. An ice tray contains 0.3 kg of water which has an initial temperature of 20°C. The ice tray and water are placed into a freezer that has a constant temperature of - 4°C. If the specific heat capacity of water is 4180 J/(kg°C), the specific latent heat of fusion of water is 3.34×10^5 J/kg and the specific heat capacity of ice is 2100 J/(kg°C), what is the energy that is needed to be removed in order to change the water into ice at - 4 °C?

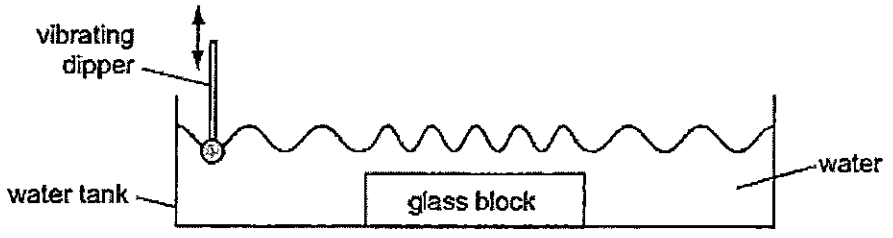
A 17.6 kJ **B** 27.6 kJ **C** 117.8 kJ **D** 127.8 kJ

21. A transverse wave of amplitude **A** and wavelength λ is travelling along a piece of rope. Which of the following statements is **correct**?



A A rope particle moves a distance of **A** in one wave period.
B A rope particle moves a distance of λ in one wave period.
C The wave moves a distance of **A** in one wave period.
D The wave moves a distance of λ in one wave period.

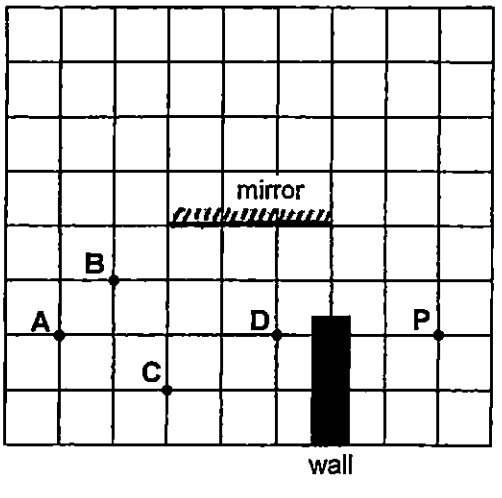
22. A ripple tank is used to show wave behaviour. The dipper vibrates up and down at a constant frequency.



What happens to the speed and frequency of the wave as it reaches the glass block?

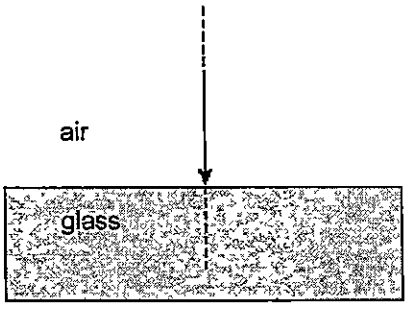
	speed	frequency
A	decreases	decreases
B	increases	decreases
C	decreases	remains the same
D	increases	remains the same

23. The figure shows the top view of an empty room with a vertical plane mirror at the middle. Rachel stands at point **P** and looks into the mirror.



Which object cannot be seen by Rachel in the mirror?

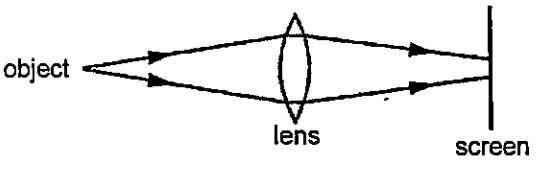
24. A ray of light enters from air into a glass block perpendicularly as shown.



Which of the following is correct?

	angle of incidence	the speed and direction of the light ray as it passes into the glass
A	0°	only speed changes
B	0°	both speed and direction change
C	90°	only direction changes
D	90°	only speed changes

25. A converging lens forms a blurred image of an object on a screen.



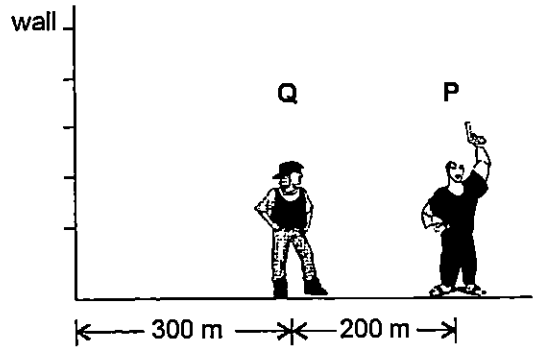
How can the image be made sharp and in focus on the screen?

A by moving the object closer to the lens and screen
B by moving the screen closer to the lens and object
C by using a dimmer object at the same position
D by using a lens of shorter focal length at the same position

26. Which of the following devices does **not** make use of electromagnetic waves in its operation?

A a camera
B a loudspeaker
C a remote controller
D a sun-tan machine

27. Two men, **P** and **Q**, stand in a straight line at different distances from a wall as shown.



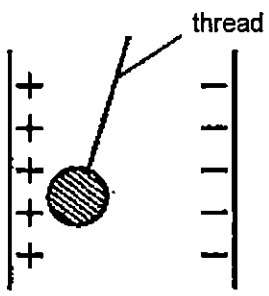
P fires a starting pistol and **Q** sees the gun-flash and hears the shot 0.67 s later. How long after **P** fires the shot will **Q** hear the echo from the wall?

A 1.0 s **B** 1.7 s **C** 2.0 s **D** 2.7 s

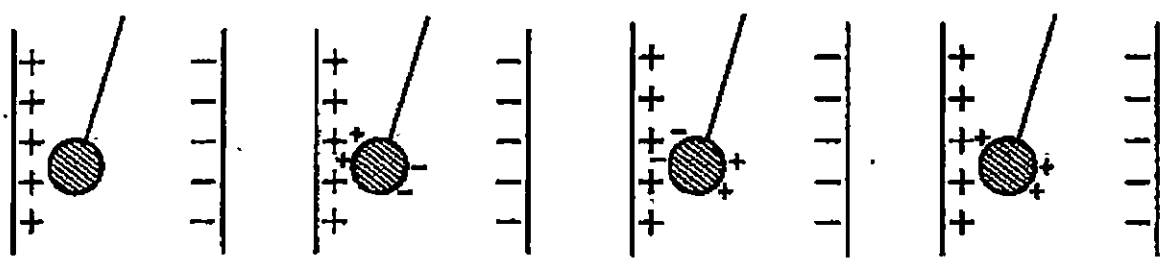
28. How are the regions of compressions and rarefactions of a sound wave in air formed?

A The air molecules gain energy as the sound wave passes by.
B The air molecules vibrate perpendicularly to the direction of the sound wave.
C The movement of air molecules produces pressure fluctuations.
D The sound wave undergoes refraction as it travels from one medium to another.

29. A light uncharged conducting ball is moved towards a positively charged plate.



Which diagram correctly shows the charges on the ball just after it has touched the positively charged plate?



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

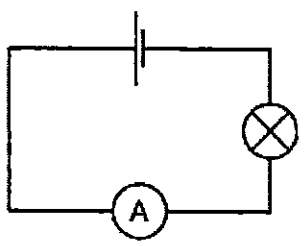
30. A student carried out an investigation to increase the size of current flowing through copper rods. He tried the following methods:

(1) allowing more charges to flow through a rod per second
(2) using a longer rod while maintaining the potential difference across the rod
(3) using a rod of larger cross-sectional area while maintaining the potential difference across the rod

Which of the following methods will work?

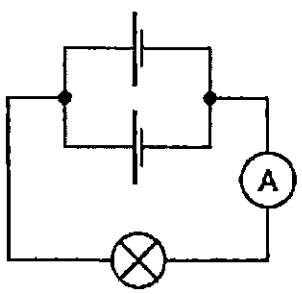
A (1) only
B (3) only
C (1) and (3) only
D (2) and (3) only

31. In the setup shown, the reading on the ammeter is 1 A.

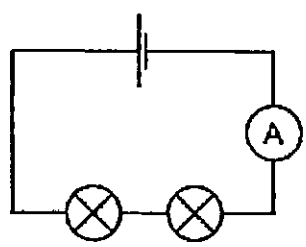


If identical lamps and cells are used, in which of the following circuits will the reading on the ammeter be 2 A?

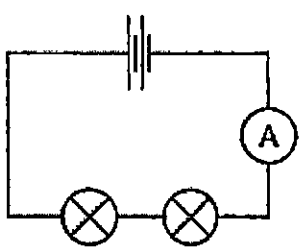
A



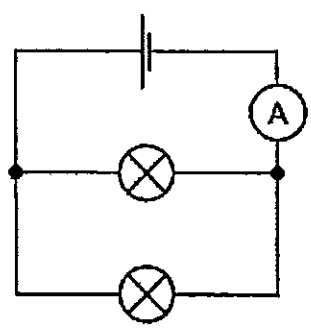
B



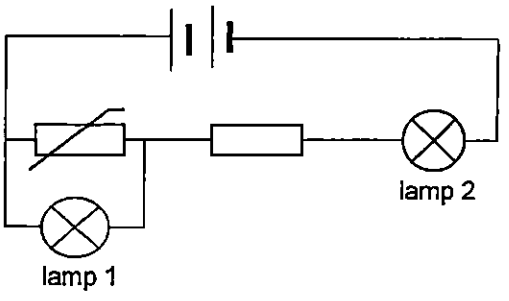
C



D



32. The diagram shows a thermistor circuit. The resistance of the thermistor decreases as the temperature increases.



What are the effects on the thermistor and the lamps when the temperature of the thermistor increases?

	potential difference across thermistor	brightness of lamp 1	brightness of lamp 2
A	decreases	decreases	decreases
B	decreases	decreases	increases
C	decreases	remains the same	decreases
D	increases	remains the same	remains the same

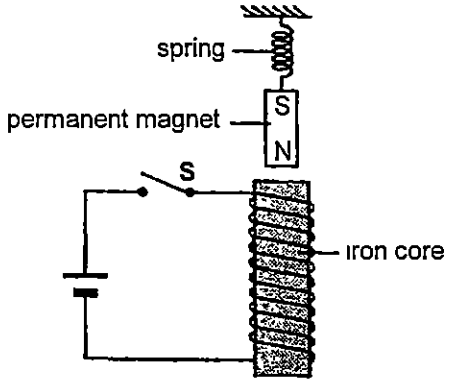
33. A heater, which is to be used on a 240 V mains circuit, has a 5 A fuse in its plug. Which of the following is the most powerful heater that can be used with this fuse?

A 50 W **B** 300 W **C** 900 W **D** 1500 W

34. Which of the following best explains why energy from solar cells is preferred as compared to energy from the mains supply?

A No habitats are destroyed during the installation of solar cells.
B No polluting gases are given off during energy generation.
C Less cost is involved during the installation of the solar cells.
D Less radioactive waste products is produced.

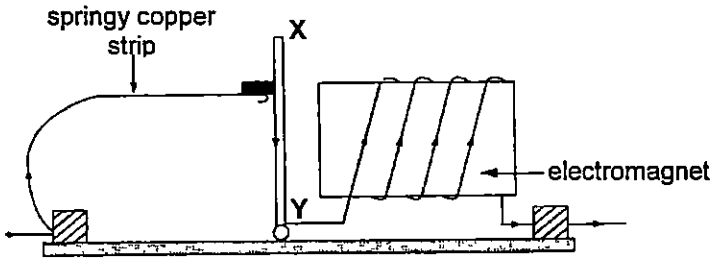
35. The diagram shows a permanent magnet suspended from a spring placed right on top of an electromagnet



What will happen to the permanent magnet once the switch **S** is closed?

A The magnet is pulled downwards.
B The magnet is pushed upwards.
C The magnet oscillates vertically up and down.
D The magnet remains stationary.

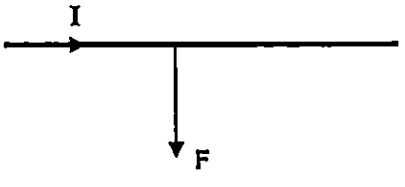
36. The diagram shows a model circuit breaker. If the current flowing in the circuit is excessive, the electromagnet attracts the metal bar **XY** to break the circuit.



Which of the following statements about the circuit breaker is **incorrect**?

A Placing a piece of soft iron inside the electromagnet will affect its strength.
B The circuit breaker works with both alternating and direct currents.
C The material used to make the bar **XY** is copper.
D The material used to make the coil of the electromagnet is copper.

37. The diagram shows a straight wire carrying a current **I** in a uniform magnetic field. The force **F** acting on the wire is indicated by an arrow but the magnetic field is not shown.



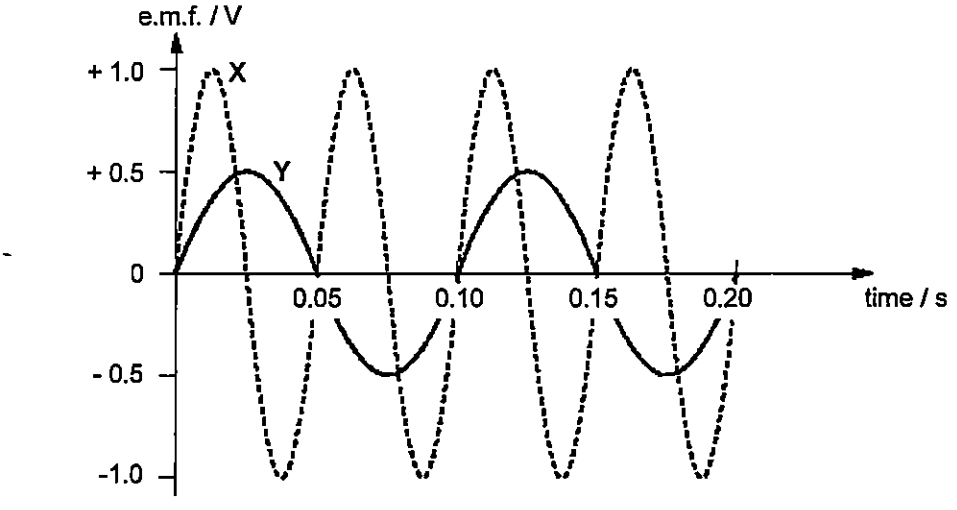
Which of the following best describes the direction of the magnetic field?

A to the left **B** upwards **C** into the page **D** out of the page

38. What is the purpose of the split ring commutator in a d.c. motor?

A to control the speed of rotation of the coil
B to enable the coil to turn continuously
C to increase the number of magnetic field lines passing through the coil
D to reverse the direction of the induced current every half-cycle

39. Graph **X** shows how the e.m.f. output of an a.c. generator varies with time. Graph **Y** shows the output from the same generator after a modification has been made to the generator.



What was the modification made to produce the graph Y?

A The area of the coil was doubled.
B The number of turns in the coil was halved.
C The speed of rotation of the coil was halved.
D The strength of the magnet was halved.

40. A student wants to obtain 12 V from a 240 V power supply. What type of transformer should the student use?

A step-down transformer with a 1000 turn primary coil and a 50 turn secondary coil
B step-down transformer with a 2000 turn primary coil and a 400 turn secondary coil
C step-up transformer with a 100 turn primary coil and a 2000 turn secondary coil
D step-up transformer with a 400 turn primary coil and a 2000 turn secondary coil

End of Paper

Answers to Prelim 2015 4E Pure Physics Paper 1

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

Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2015

PHYSICS **5059/02**

Paper 2 Theory **24 August 2015**
Monday 1130 – 1315 **1 hour 45 minutes**

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question **12** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.
The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

Section A [50 marks]
Answer **all** questions.

1 Fig. 1.1 shows how a simple ride in a water theme park works. The loaded carriage starts from rest at A, which is at the top of the track and rolls down the track until it reaches X which is 12 m below A. Beyond X, the track becomes horizontal and the carriage decelerates as it passes through a trough containing water.

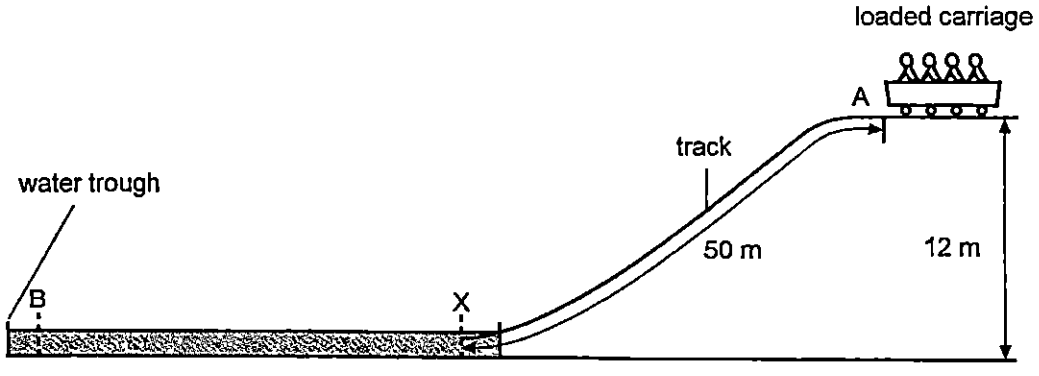


Fig. 1.1

The mass of the loaded carriage is 800 kg.
The carriage is moving at a horizontal speed of 8 m/s at X.
Take gravitational field strength to be 10 N/kg.

(a) Describe the energy changes that take place as the loaded carriage moves from A to X, and from X to B in Fig. 1.1.

.....

.....

..... [2]

(b) Calculate the efficiency of the carriage when it moves from A to X.

efficiency = ... [2]

(c) The carriage comes to rest at B five seconds after passing X. Determine the average retarding force exerted by the water on the carriage.

retarding force = ... [2]

2 Fig. 2.1 shows a section through a vertical locker door with a horizontal hinge along its lower edge. C_1 is the position of the centre of gravity (CG) of the door, and the door opens in the direction indicated. Fig. 2.2 shows the door with a piece of wood, P, attached to it so that the door is less likely to fall open. The new position of the CG of the door and the wood is C_2. The door is 8.0 cm thick.

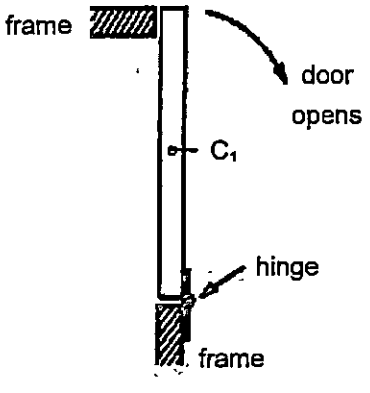


Fig. 2.1

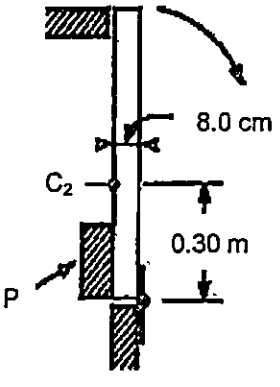


Fig. 2.2

(a) Suggest one reason why the door is less likely to fall open with wood P attached to it.

.....

.....

.....

..... [2]

(b) The combined weight of the door and the wood P is 35 N.
Calculate the moment holding the door closed when it is in the vertical position shown in Fig. 2.2.

moment = ... [2]

(c) Calculate the loss in gravitational potential energy E_p of the door and the wood P as it swings from the vertical position shown in Fig. 2.2 to the horizontal position.

loss in E_p = ... [2]

3 Fig. 3.1 shows a section of a solar heating system which helps to provide hot water for a house.

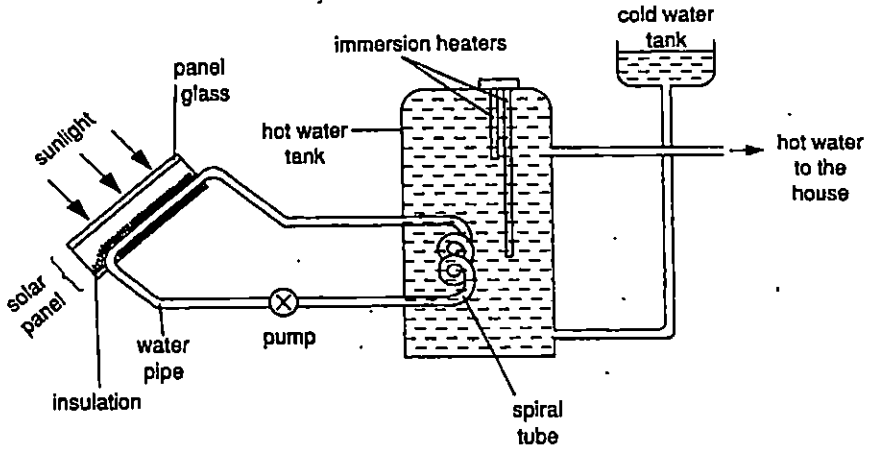


Fig. 3.1

It consists of a solar panel placed outdoor on a roof. Connected to this panel are water pipes. Heat from the Sun warms the water in these pipes which is then pumped to a hot water tank inside the house. Inside the hot water tank, the hot water transfers its heat, becomes cooled and circulates back to the solar panel.

Explain the purpose of the following features:

(a) the solar panel is covered with a sheet of glass,

.....

..... [1]

(b) there is an insulation for the water pipe in the solar panel, and

.....

..... [1]

(c) the water pipe in the hot water tank is spiral and painted black.

.....

.....

.....

..... [2]

4 A sound wave in air (not drawn to scale) is illustrated in Fig. 4.1. The wave has frequency 2000 Hz and speed 320 m/s.

Fig. 4.1

Points A, B, C and D are at the centres of regions of compression.

(a) Describe what happens to the air molecules and the air pressure as one complete sound wave moves past a point.

air molecules: .....

.....

air pressure: .....

..... [2]

(b) Explain what is meant by *frequency* of a wave.

....

.... [1]

(c) Calculate the distance between the points A and D.

distance = ... [2]

(d) The time taken for 1 oscillation in another sound wave is 3.0 ms. Calculate the frequency of the wave.

frequency = ... [1]

5 Fig. 5.1 shows a positively charged glass rod being lowered into a metal can. The base of the can is an insulator.

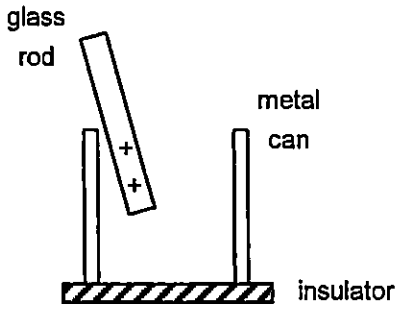


Fig. 5.1

(a) Indicate on Fig. 5.1 the charge distribution on the metal can when the rod is lowered into the can. [1]

(b) The side of the can is then connected to a galvanometer and then to a water tap which is grounded as shown in Fig. 5.2.

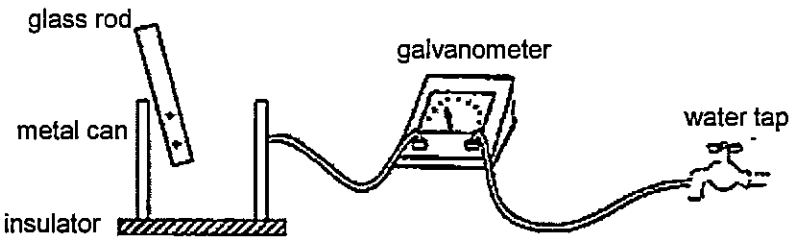


Fig. 5.2

Explain why the galvanometer shows a momentary deflection.

.....

..... [1]

(c) Suggest, giving a reason, how the result of the experiment will change, if any, if the glass rod is replaced by a similarly charged metal rod held in the hand of a student.

.....

.....

.....

..... [2]

6 Singapore has one of the highest lightning strike rates in the world. An average lightning strike transfers a charge of 5.0 C and releases as much energy as a 100 W lamp switched on for a duration of 5.5×10^6 s. There are, on average, at least 190 lightning strikes in Singapore per year.

(a) Determine the total energy released by all the lighting strikes in Singapore in each year.

energy = ... [2]

(b) Calculate the average electromotive force (e.m.f.) of a lighting strike.

e.m.f. = ... [2]

(c) Apart from a lightning conductor, state the name of one device that uses electrostatic charging.

..... [1]

7 A circuit is set up as shown in Fig. 7.1. The bulb has a rating of '3.5 V, 0.35 W'.

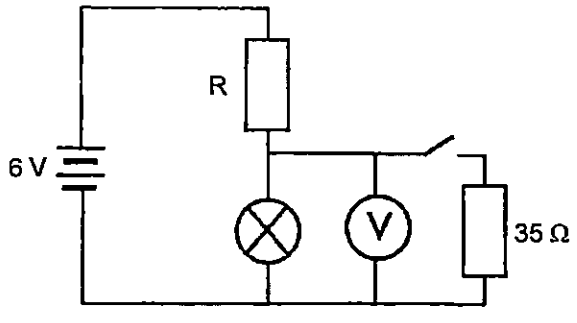


Fig. 7.1

(a) State what is meant by the rating of '3.5 V, 0.35 W'.

.....

..... [1]

(b) When the switch is open, the bulb shows normal brightness.

(i) Calculate the overall current in the circuit.

current = ... [2]

(ii) Calculate the value of R.

R = ... [2]

(c) The switch is then closed. The resistance of the light bulb is 35 Ω.
Calculate the new voltmeter reading.

voltmeter reading = ... [3]

8 An electric iron which consists of two heating elements, a 100 Ω and a 50 Ω resistor, is shown in Fig. 8.1. The heating elements can be connected to the electrical mains supply of 240 V in various ways so that the heating power can be varied.

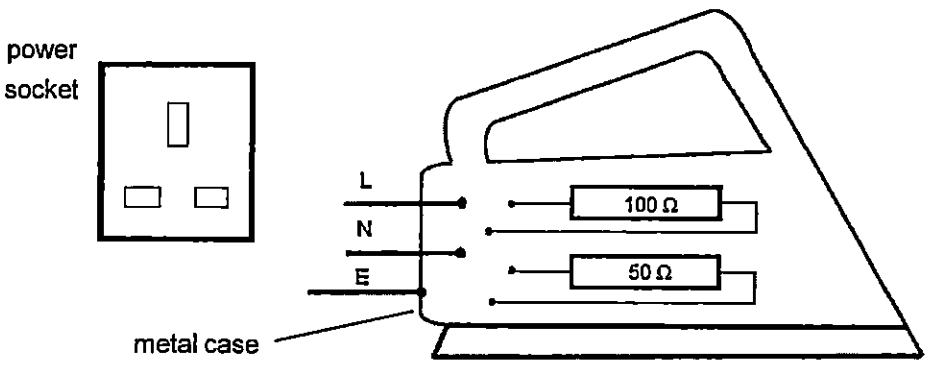


Fig. 8.1

(a) Complete the circuit in Fig. 8.1 to show

(i) how the Live (**L**), Neutral (**N**) and Earth (**E**) wires should be connected to the power socket, [1]

(ii) how the heating elements can be connected to give the highest heating power. [1]

(b) The live wire (L) in Fig. 8.1 becomes loose and touches the metal case.
Explain why a person who later touches the case feels no shock and is not harmed.

.....

.....

.....

..... [2]

(c) Another electric kettle is doubly insulated and unlike the kettle in Fig. 8.1, there is no wire connected to its case. Explain why this kettle is safe to use.

.....

.....

..... [1]

9 Fig. 9.1 shows the quality control setup of a factory producing magnets. Newly produced permanent magnets which are positioned on a conveyor belt are moved under a detecting device. The device consists of a coil of wire, wound on a soft-iron core and connected to a sensitive voltmeter.

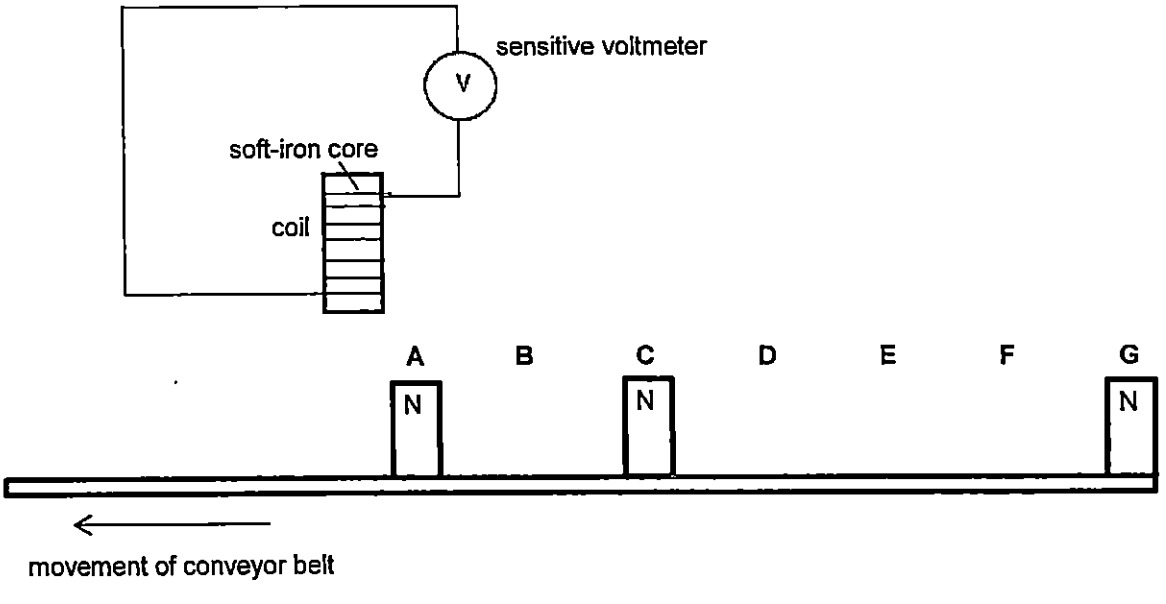


Fig. 9.1

As the conveyor belt moves along at constant speed, voltage pulses are recorded by the meter. These pulses are sent to a cathode ray oscilloscope (C.R.O.) and they are displayed in Fig. 9.2. The letters correspond to the positions on the belt as each magnet passes under the coil.

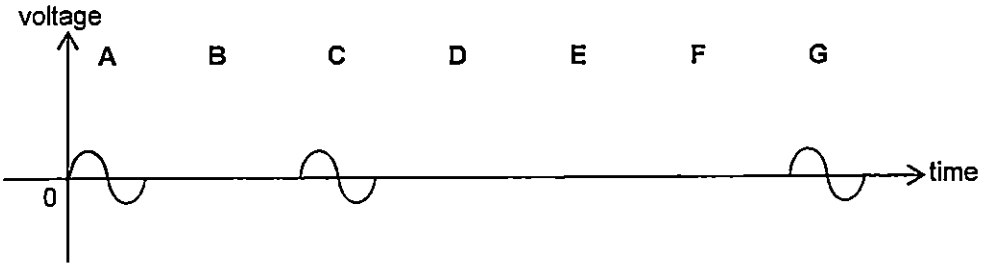


Fig. 9.2

(a) Explain why the pulses occur in Fig. 9.2.

.....

.....

..... [2]

(b) Explain the purpose of the soft-iron core inside the coil in Fig. 9.1.

.....

..... [1]

(c) On Fig. 9.2, draw the pulses if the belt is made to move slightly faster. [2]

(d) In Fig. 9.3 and Fig. 9.4, the sensitive voltmeter is replaced by an ammeter.
Fig. 9.3 shows a magnet moving towards the soft iron core, and Fig. 9.4 shows the same magnet moving away from the iron core.

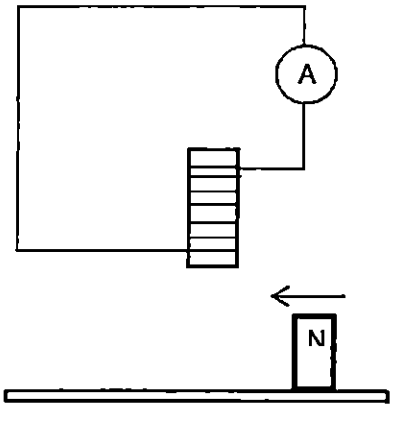


Fig. 9.3

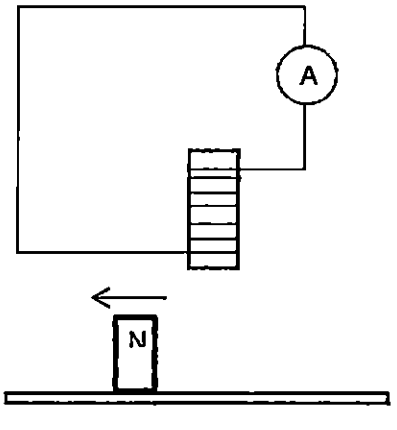


Fig. 9.4

Indicate the direction of the current in the coils in both figures. [1]

Section B [30 marks]

Answer **all** questions. Question **12** has a choice of parts to answer.

10 (a) A ray of light is passed from air into a semi-circular glass block as shown in Fig. 10.1.

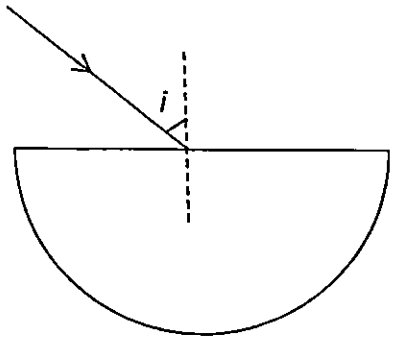


Fig. 10.1

The solid line in Fig. 10.2 shows how the angle of incidence, *i*, varies with the angle of refraction, *r*.
The solid line in Fig. 10.3 shows how the sine of angle of incidence (sin *i*) varies with the sine of the angle of refraction (sin *r*).

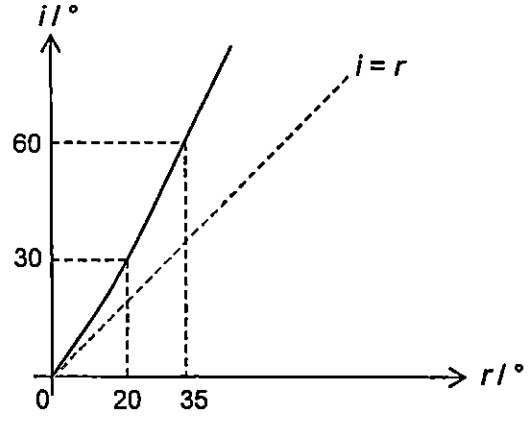


Fig. 10.2

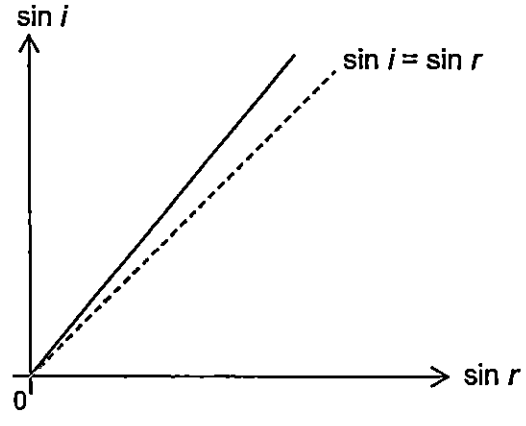


Fig. 10.3

(i) Use the graph in Fig. 10.2 to explain how the light ray travels through the glass block.

.....

.....

..... [2]

(ii) Explain why the graph in Fig. 10.3 is a straight line passing through the origin.

.....

.....

..... [2]

(b) The ray of light is now reversed, i.e. it travels from the same glass block into air as shown in Fig. 10.4.

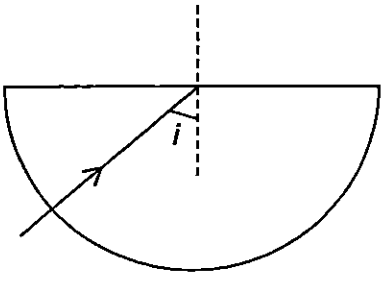


Fig. 10.4

The angle of incidence *i* and angle of refraction *r* are recorded as shown in Fig. 10.5.

i / °	10	20	25	31	35	39	41
r / °	15	30	40	50	60	70	80

Fig. 10.5

(i) Use the data in Fig. 10.5 to explain why the critical angle for glass is more than 41°.

.....

.....

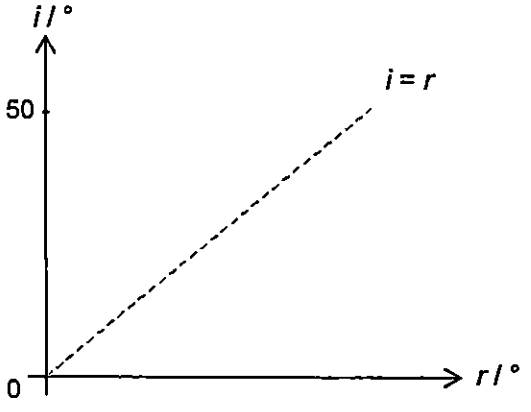
.....

..... [2]

(ii) Determine the critical angle for glass to 2 significant figures.

critical angle = ... [2]

(iii) Using information in Fig. 10.5 and your answer in b(ii), sketch a graph to show how i varies with r for $0° \leq i < 50°$ on Fig. 10.6.



[2]

Fig. 10.6

11 **(a)** A town is supplied with electrical energy from a power station some distance away by power cables as shown in Fig. 11.1.

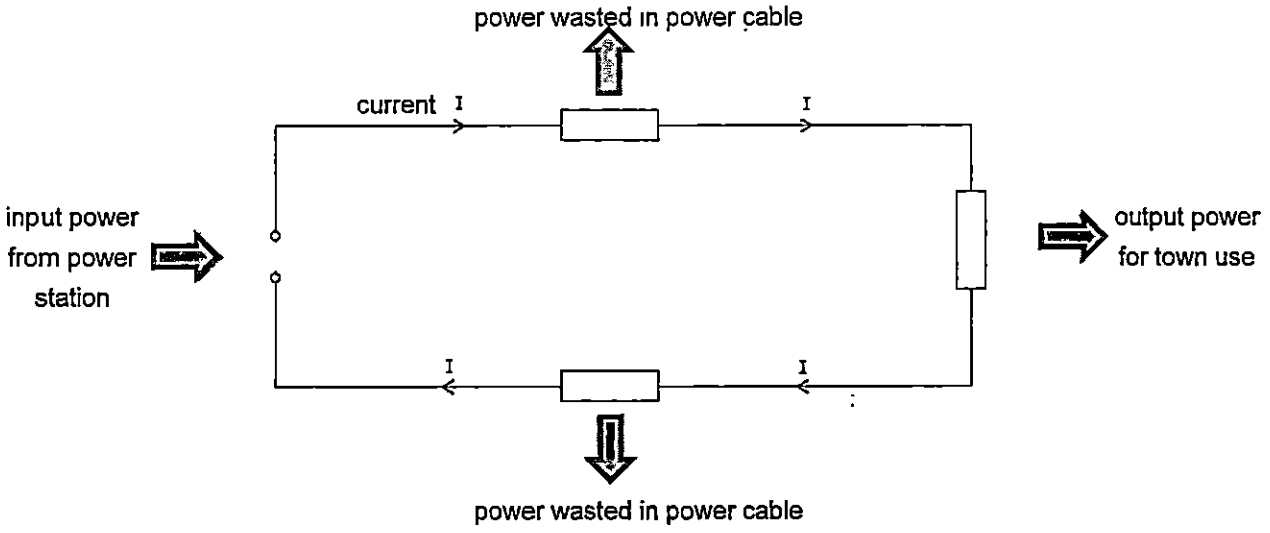


Fig. 11.1

The input power from the power station is 80 kW, at 770 V. The total resistance of the cables is 5.0 Ω. Calculate

(i) the current I in the cables,

current I = ... [1]

(ii) the power loss in the cables,

power loss = ... [2]

(iii) the voltage supplied to the town.

voltage = ... [2]

(b) Fig. 11.2 shows another way of supplying electrical energy to the town using transformers. In order for a voltage of 250 V to be received at the town, a step-down transformer of turns ratio 1/40 is used to convert the high voltage power supply transmitted over a long distance.

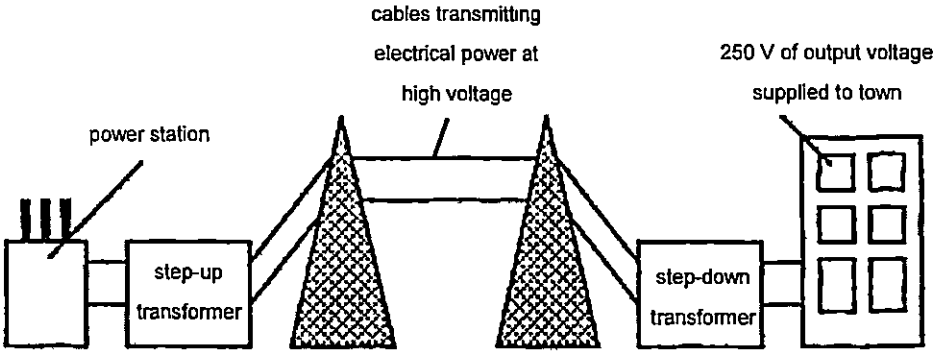


Fig. 11.2

(i) Explain why a high voltage is used to transmit the electrical power from the power station to the step-down transformer.

.....

.....

.....

..... [2]

(ii) Explain why the power cables used have to be quite thick.

.....

..... [1]

(iii) Calculate the voltage supplied to the primary coil of the step-down transformer.

voltage = ... [2]

EITHER

12 Fig. 12.1 shows a stone being projected vertically upwards from a point A at the top of a building and it reaches the highest point B.
The velocity-time graph for its 8.0 s of motion is shown in Fig. 12.2.

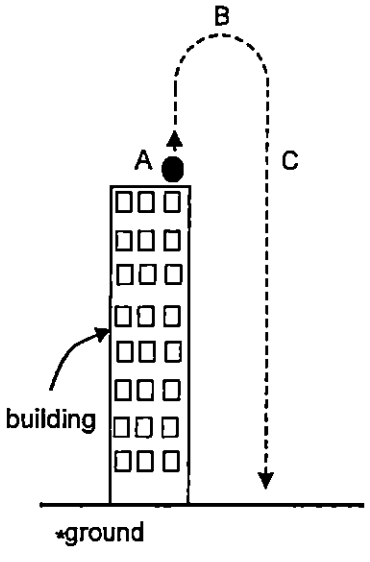


Fig. 12.1

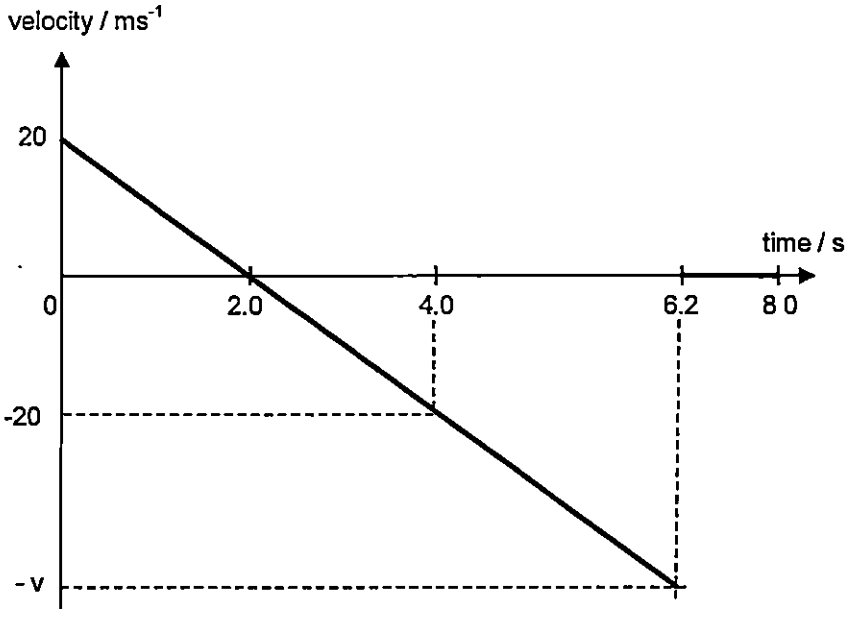


Fig. 12.2

The weight of the stone is 5.0 N. The acceleration due to gravity is 10 m/s^2.

(a) Explain how Fig. 12.2 shows that the stone is moving in opposite direction after a period of time.

.....

.....

..... [1]

(b) State the assumption made in order to obtain the straight line graph in Fig. 12.2.

.....

..... [1]

(c) State the magnitude of the acceleration of the stone at the positions:

A: ..... B: ..... C: ..... [1]

(d) Determine the change in velocity of the stone in the first four seconds of the motion.

.... [1]

(e) State the resultant force acting on the stone at point B. .... [1]

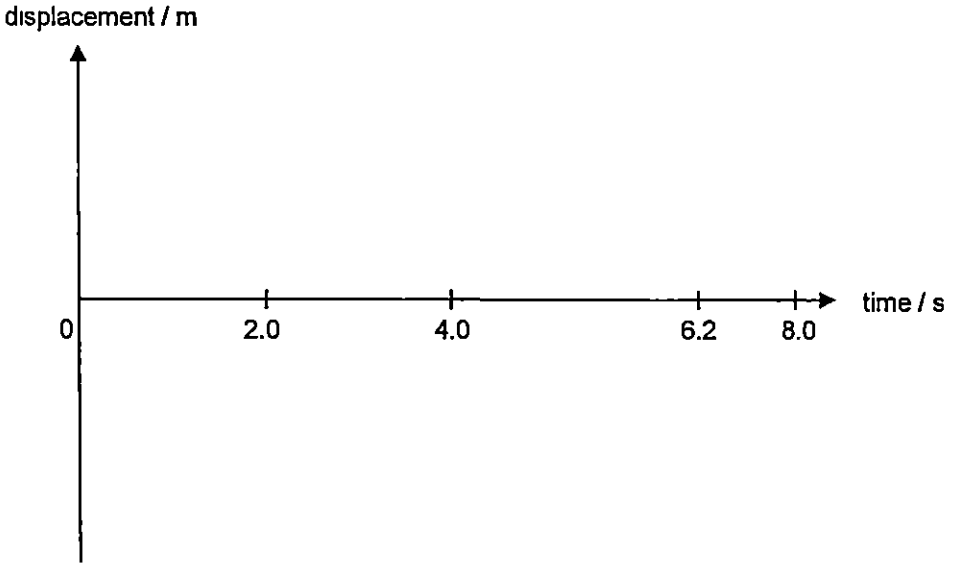
(f) Describe what v represents in Fig. 12.2.

.... [1]

(g) Determine the height of the building.

height = ... [2]

(h) Sketch the displacement-time graph in Fig. 12.3 for the stone from time = 0 to 8.0 s.



[2]

Fig. 12.3

OR

12 Fig. 12.4 shows a rectangular block of wood of cross-sectional area A and thickness t floating horizontally in a liquid. The block floats when its lower face is at a depth d in the liquid of density ρ.

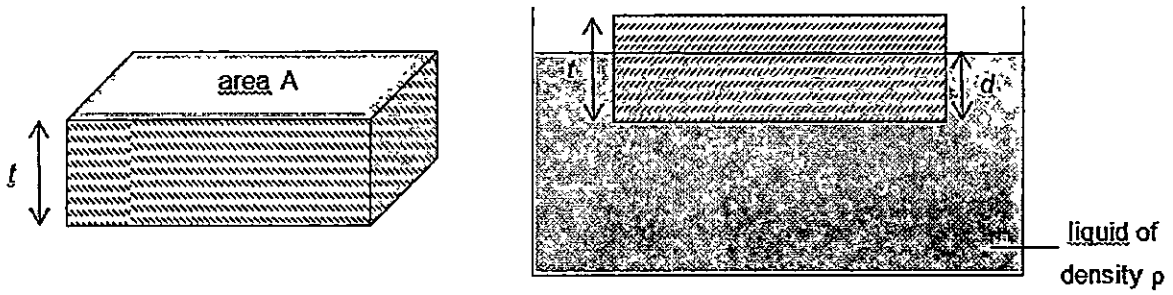


Fig. 12.4

(a) Write an expression for the pressure P acting on the lower surface of the block due to the liquid.

..... [1]

(b) Show that the force F acting on the lower surface of the block is related to the volume V of the block in the liquid by the expression: $F = V \rho g$ where g is the acceleration due to gravity.

[2]

(c) When the temperature of the liquid is increased, both the internal energy of the liquid molecules and the pressure acting on the lower surface of the block by the liquid increase.

(i) State what is meant by the internal energy of the liquid molecules.

.....

..... [1]

(ii) Using ideas about molecules, explain why the pressure acting on the lower surface of the block increases when the temperature of the liquid increases.

.....

.....

.....

..... [2]

(d) The wooden block is submerged in the liquid by a rope tied to a sinker as shown in Fig. 12.5.

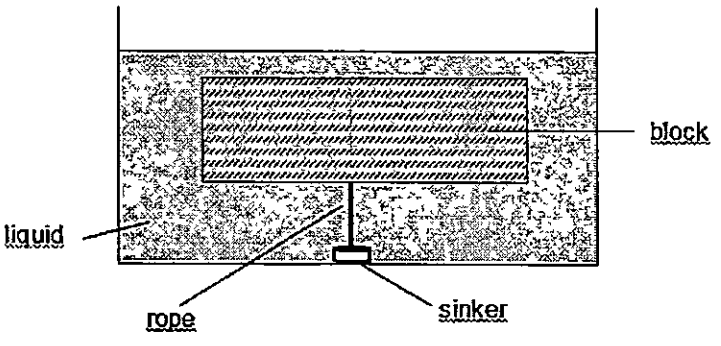


Fig. 12.5

The volume and mass of the block is 6.5×10^{-2} m^3 and 30 kg respectively. The density of the liquid is 1.1×10^3 kgm^{-3}. The acceleration due to gravity is 10 m/s^2.

(i) State the forces acting on the block.

.....

..... [2]

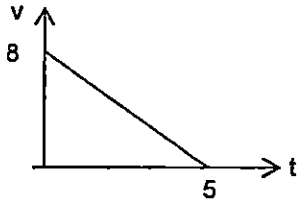
(ii) Using the expression in (b), determine the tension of the rope.

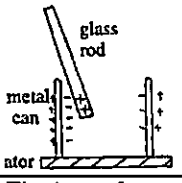
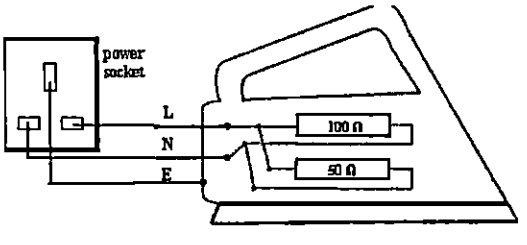
tension = ... [2]

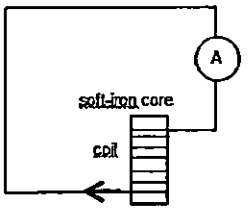
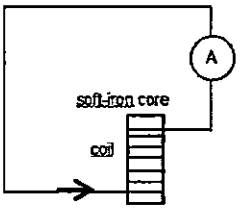
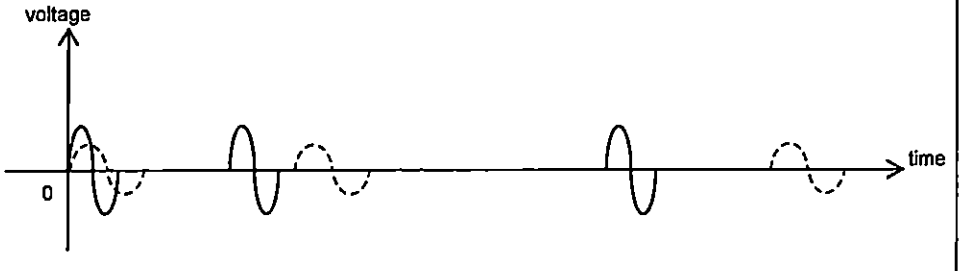
END OF PAPER

Preliminary Examination 2015
5059 Sec 4 Pure Physics (Marking Scheme)

Paper 2: Section A: Structured Questions [50 marks]

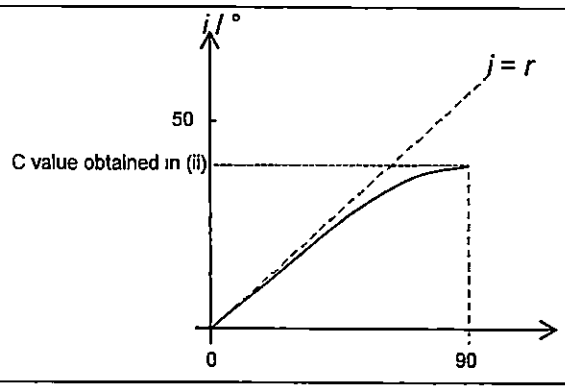
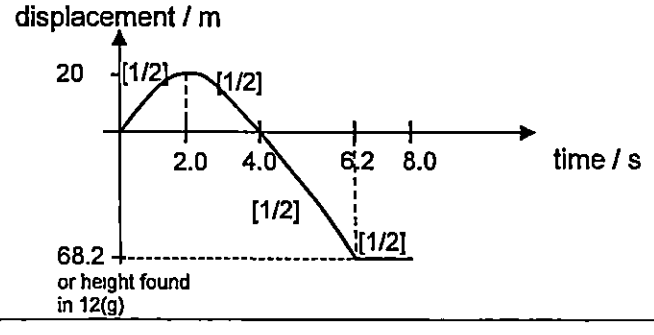
Qn	Suggested Answer	Marks
1(a)	From A to X, GPE of the loaded carriage is converted to KE of the carriage, thermal and sound energies. From X to B, the KE of the carriage is converted to thermal and sound energies	[0.5,0.5] [0.5,0.5]
(b)	efficiency = energy converted to useful output / total energy input x 100% = ½ mv^2 / mgh x 100% = ½ x 8^2 / (10 x 12) x 100% = 27%	 [1] [1]
(c)	 acceleration = (v – u) / t = (0 – 8) / 5 = - 8/5 = - 1.6 m/s^2 resultant force = ma = 800 x (- 1 6) = - 1280 N retarding force = 1280 N **Alternatively,** work done against water resistance = Loss in KE F x d = ½ mv^2 F x ½ (5 x 8) = ½ 800 x 8^2 retarding force, F = 1280 N	 [1] ecf[0.5] [0.5] or [1] [1]
2(a)	With the addition of wood P, CG of the door and wood (C_2) becomes lower. The lower the CG, the more stable an object is. or C_2 becomes further away from the hinge than before. / the perpendicular distance from the line of action of the weight to the hinge is now larger. The anti-clockwise moment that keeps the door closed has become larger than before.	[1] [1] or [1] [1]
(b)	moment = F x d = 35 x 0.080 = 2.8 Nm (or 280 Ncm)	[1,1]
(c)	loss in E_p = (mg)h = 35 x (0.30 – 0.08) = 7.7 J ≈ 11 J	[1,1]
3(a)	Glass allows infrared rays into solar panel but prevents it from leaving / heat is trapped in the solar panel.	[0.5,0.5]
(b)	It reduces heat loss from the water in the pipe by conduction to the solar panel when the Sun is not shinning.	[0.5,0.5]
(c)	Spiral increase surface area to allow more heat to be transferred to water by conduction / radiation. Black is a good emitter of infra-red radiation. These increase rate of radiation to water / enable water to be heated up quickly.	[0.5,0.5] [0.5] [0.5]
4(a)	Air molecule: As a sound wave moves past a point, the air molecules move from left to right (or vice versa or parallel to the direction of the wave) and back **to its original position.** Air pressure: The air pressure increases and then decreases (or vice versa) before returning **to its original pressure.** (deduct ½ mark if 'original position' or 'original pressure' is not mentioned)	[0.5] [0.5] [0.5] [0.5]

(b)	The number of complete waves generated in one second.	[1]
(c)	Wavelength = speed / frequency = 320 / 2000 = 0.16 m Distance between A and D = 3 x wavelengths = 3 x 0 16 = 0 48 m	[1] ecf[1]
(d)	Frequency = 1 / period = 1 / (3 x 10^{-3}) = 333 Hz	[1]
5(a)	 Total number of positive and negative charges on each side of the metal can should be equal.	[1]
(b)	Electrons from ground (or water tap) moves through the galvanometer to metal can.	[1]
(c)	As metal rod is a good conductor of electricity, it will be discharged when held in the hand of a student. No charges will be induced in the metal can and no deflection is shown in the galvanometer	[0.5,0.5] [0.5,0.5]
6(a)	Energy released by 100 W lamp = Pt = 100 x (5.5 x 10^{6}) J = 5.5 x 10^{8} J Total energy, E = 190 x E = 190 x 5.5 x 10^{8} = 1.05 x 10^{11} J	[1] [1]
(b)	E.m.f. = E / Q = 5.5 x 10^{8} / 5 0 = 1.1 x 10^{8} V	[1,1]
(c)	Ink jet printer / Photocopier / Electrostatic spray painting / Electrostatic precipitator	[1]
7(a)	It means when a p.d. of 3.5 V is connected across the bulb, 0.35 J of energy is dissipated by the bulb in each second (or 0.35 W of power is released by the bulb).	[0.5,0.5]
(bi)	I = P / V = 0.35 / 3.5 = 0.10 A	[1,1]
(ii)	R = V / I = (6 – 3.5) / 0.10 = 25 Ω	ecf[1,1]
(c)	1 / Resistance for parallel connection = 1 / 35 + 1 / 35 ⇨ Resistance for parallel connection = 17.5 Ω Voltmeter reading, V = IR = total current in circuit x resistance for parallel connection = [6 / (17.5 + 25)] x 17.5 = 2.47 V ≈ 2.5 V Alternatively, Voltmeter reading, V = R1 / (R1 + R2) x V = [17.5 /(17.5 + 25)] x 6 = 2.47 V ≈ 2.5 V	[1] ecf[1] [1] ecf[1] [1]
8(a) (i), (ii)	L, N & E wires are correctly connected to the power socket [1]. The 100Ω and 50Ω resistors are connected in parallel [1]. 	[2]

(b)	When the live wire touches the metal case, the earth wire will carry the large current to earth. This large current will melt the fuse and break the circuit. A person who later touches the metal case will not experience an electric shock.	[1] [1]
(c)	The case is made of poor conductor of electricity. When the wire insulation is damaged such that the live wire touches the case (or when there is an electrical fault), the case will be not be 'live'. Hence, anyone who touches it will not get an electric shock.	[0.5, 0.5]
9(a)	As the magnets move past the coil, the coil experiences changing magnetic field as the field lines cut the coil. An e.m.f. is induced in the circuit which is displayed as voltage pulses by the C.R.O.	[1] [1]
(b)	To concentrate the magnetic field in the coil so as to increase the magnitude of the induced e.m f. [Do not accept 'it can be easily magnetized'.]	[0.5, 0.5]
(d)	 Fig. 9 3  Fig. 9.4 • Correct current direction for Fig. 9 3 – [0.5] • Current direction in Fig. 9 4 is opposite of Fig. 9 3 – [0 5]	[1]
(c)	 Magnitude of the induced e.m.f. increases / The periodic time reduces / The time between each generated pulse decreases. (All 3 correct – 2 marks; 2 correct only – 1 mark; 1 correct – 0 mark)	[2]

Section B [30 marks]

10(ai)	The graph shows that i is greater than r. Hence, the light ray bends towards the normal as it enters glass.	[1,1]
(ii)	The graph is a straight line passing through the origin because the ratio sin i / sin r is constant. This ratio is constant because it is the refractive index of glass which is a constant.	[1] [1]
(bi)	The data shows that i increases with r, and r is only 81° at i = 41°. Since critical angle is the value of i when r = 90°, the critical for glass has to be more than 41°.	[1] [1]
(ii)	n = sin r / sin i = 1 / sin C (use i and r from Fig. 10.5) eg. sin 30° / sin 20° = 1 / sin C => C = 43° accept 41° ≤ C ≤ 43°	[1] [1]

(iii)	 • shape of graph – [1] • graph starts at (0,0) and ends at (90,C) - [1] [deduct ½ mark if the value of C is not marked on the axis]	[2]
11(ai)	P = VI => 80 000 = 770 x I => I = 104 A	[1]
(ii)	Power loss = I^2R = 104^2 x 5.0 = 54 080 W ≈ 54 000 W	ecf[1,1]
(iii)	Voltage drop = IR = 104 x 5 0 = 520 V Voltage supplied to town = 770 – 520 = 250 V Alternatively, Useful power = 80 000 – 54 000 = 26 000 W Voltage supplied to town, V = P / I = 26 000 / 104 = 250 V	ecf[1] ecf[1]
(bi)	As Power = Voltage x Current, when a high voltage is used, electrical current transmitted will be lower. This results in less electrical power loss from cables since power loss = $(current)^2$ x resistance of the cables.	[0.5,0.5] [0.5,0.5]
(ii)	Thick cables have lower resistance than thinner cables, and can carry large amount of current with less heat loss.	[0.5,0.5]
(iii)	Ns / Np = Vs / Vp => 1 / 40 = 250 / Vp Vp = 10 000 V	[1] [1]
	Either	
12(a)	After 2s, the velocity changes from positive to negative.	[0.5,0.5]
(b)	The assumption is that there is no air resistance acting on the stone or the acceleration of the stone is constant throughout the motion.	[1]
(c)	Acceleration at A, B and C = 10 m/s^2 (3 correct answers – [1], 2 correct answers – [0.5], 1 correct answer – [0])	[1]
(d)	20 – (– 20) = 40 m/s or – 20 – 20 = – 40 m/s	[1]
(e)	resultant force = weight of stone = 5.0 N	[1]
(f)	v represents the velocity of the stone just before hitting the ground.	[1]
(g)	v / 20 = (6.2 – 2.0) / (4.0 – 2.0) v = 42 m/s height = area under the graph from 4.0s to 6.2s = ½ x (6.2 – 4.0) x (20 + 42) = 68.2 m	 [1] [1]
(h)		[2]

	OR	
12(a)	$P = d\rho g$	[1]
(b)	$F = P \times A = (d\rho g) \times A = (A d)\rho g = V\rho g$	[1,1]
(ci)	It is the potential energy and kinetic energy of the molecules.	[1]
(ii)	An increase in temperature increases the kinetic energy and the speed of the liquid molecules. This increases the frequency of collision / number of molecules colliding with the lower surface of the block and hence a larger force is exerted per unit area of the surface i.e. pressure increases.	[0.5,0.5] [0.5] [0.5]
(di)	Tension in the string, weight of the block, upthrust by the liquid (or upward force on the block by the liquid) (3 correct answers – [2], 2 correct answers – [1], 1 correct answer – [0.5])	[2]
(ii)	F = tension + weight of block tension = F - weight of block $= (6.5 \times 10^{-2} \times 1.1 \times 10^{3} \times 10) - (30 \times 10)$ $= 415$ N	 [1] [1]

THE END