2016 PRELIMINARY EXAMINATION 2
Secondary Four Express

NAME

CLASS **REG. NO**

PHYSICS

5059/01

Paper 1 Multiple Choice

16 Sept 2016
1 hour

Additional Materials: Multiple Choice Answer Sheet
Setter: Mdm Teo Joo Keng

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and register number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on 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 Answer Sheet.

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.

.....
Parent's signature/ Date

1 A micrometer has a zero error as shown in Fig 1.1 and this same instrument is used to measure an object with a reading as shown in Fig 1.2.
What is the actual measurement of the object?

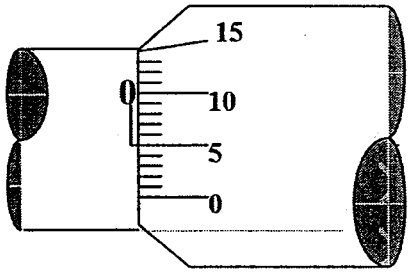


Fig. 1.1

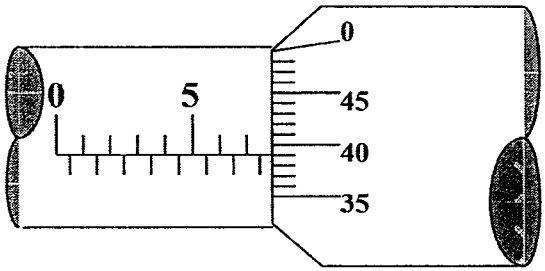


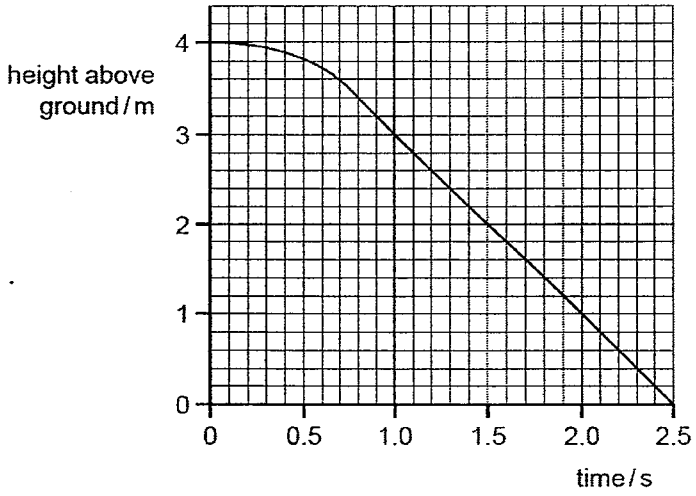
Fig. 1.2

A 7.84 mm
B 7.89 mm
C 7.94 mm
D 8.39 mm

2 The following shows the order of magnitude of the sizes of common objects.
Which one of the following is **incorrectly** matched to the estimated size?

	Object	Size
A	Diameter of an atom	0.1 nm
B	Width of finger nail	0.01 m
C	Height of Mt. Everest	8.85 km
D	Diameter of Earth	0.128 Mm

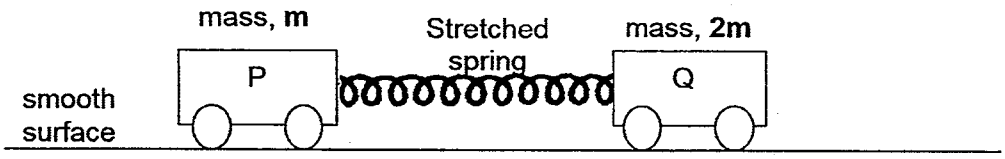
3 The graph shows how the height of an object above the ground changes with time.



What is the terminal velocity of the object?

A 1.0 ms^{-1}
B 1.3 ms^{-1}
C 1.6 ms^{-1}
D 2.0 ms^{-1}

4 Trolley P and trolley Q are connected by a stretched spring. Trolley P has half the mass of trolley Q. When the trolleys are released, the acceleration of trolley P is 4.0 ms^{-1} to the right.



What is the initial acceleration of the trolley Q?

A 8.0 ms^{-2} **B** 6.0 ms^{-2}
C 4.0 ms^{-2} **D** 2.0 ms^{-2}

5 A force of 30 N pushes an object of mass 2.0 kg along a rough horizontal surface with an acceleration of 7.5 ms^{-2}.

What is the friction acting on the object?

A 5.0 N
B 10 N
C 15 N
D 20 N

6 A train pulls a carriage at constant speed along a straight track.

The chain between the train and the carriage breaks. If the driving force of the train remain constant, what will happen to the carriage and the train?

	Carriage	Train
A	Slows down	Speed remains constant
B	Slows down	Speeds up
C	Stops immediately	Speed remains constant
D	Stops immediately	Speeds up

7 Which of the following statements about *inertia* is true?

A Inertia is a force that a body at rest will encounter that prevents it from starting to move.
B A body will have inertia even if placed in a vacuum.
C The inertia of a body keeps the body moving at constant velocity.
D A body has inertia because of frictional forces acting on it.

8 Archimedes has to test which of the three crowns P, Q and R was pure gold, pure silver or a mixture of gold and silver. They were of the same mass. However, he found that the volumes were not the same when he put them into a container of water.

The table below shows the information of each crown.

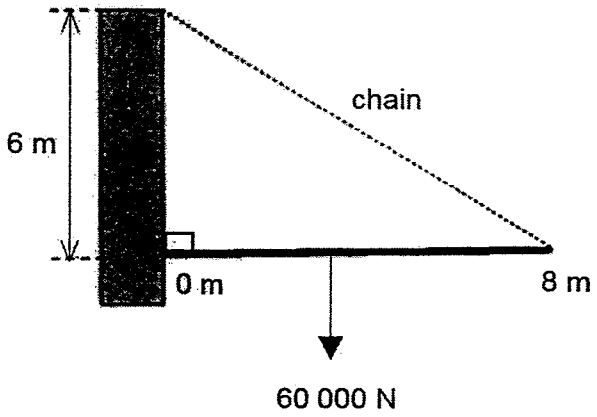
	Crown P	Crown Q	Crown R
Mass / g	3750	3750	3750
Volume / cm^3	357	194	315

Given that gold is denser than silver, which of the following correctly matches each crown with its material?

	Crown P	Crown Q	Crown R
A	Gold	Silver	Mixture
B	Silver	Gold	Mixture
C	Gold	Mixture	Silver
D	Silver	Mixture	Gold

9 An 8.0 m long uniform hanging bridge weighing 60 000 N is being hung horizontally by the hinges at the 0.0 m mark and the chain at the 8.0 m mark as shown in the diagram below.

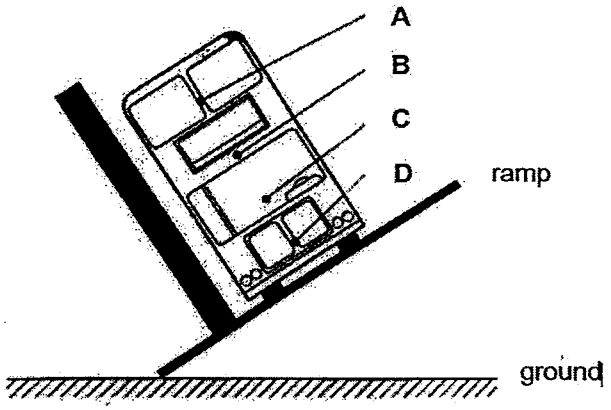
Given that the maximum tension that the chain can withstand is 80 000 N and a car weighing 40 000 N is crossing the bridge from the 0 m mark towards the 8.0 m mark, what is the maximum distance the car can travel along the bridge before the chain give way?



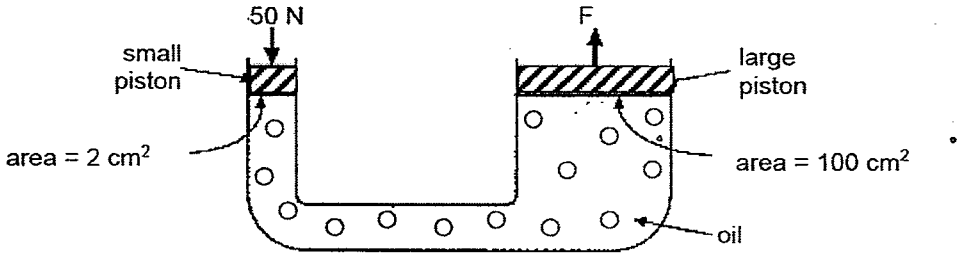
A 2.4 m
B 3.6 m
D 4.8 m
D 6.0 m

10 The stability of a bus is tested by tilted it on a ramp. The diagram shows a bus that is just about to topple over.

Where is the centre of mass of the bus?



11 The diagram below shows the principle of a hydraulic car jack.



When a force of 50 N is applied on the small piston, what is the force exerted by the oil at the large piston?

A 2.5 N
B 25 N
C 250 N
D 25 N

12 A diver deep underwater exhales an air bubble. The air bubble is observed to increase in size as it rises to the surface. Which of the following explanations may be used to describe this phenomenon?

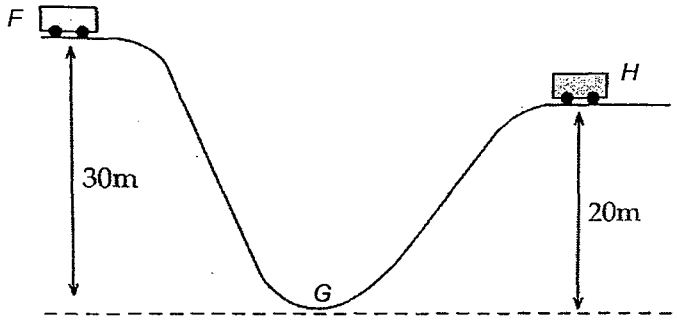
1 The volume increases because the pressure underwater decreases with decreasing depth.
2 The volume increases because while there is no pressure underwater, there is atmospheric pressure at the surface of the water.
3 The pressure is constant regardless of depth because the temperature of the water is lower with greater depth.

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

13 A battery supplies 500 J electrical energy to a motor. The motor drags an object horizontally for 50 m, along a floor with a frictional force of 2.0 N. What is the maximum efficiency of the motor?

A 10 %
B 20 %
C 80 %
D 90 %

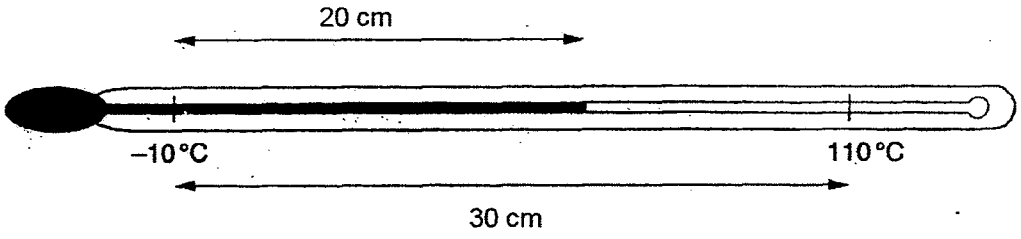
14 A trolley moves from point *F* with a velocity of 10 ms^{-1} and goes past points *G* and *H*.



If the resistive forces are negligible, what is the speed of the trolley at *H*?

A 11.1 ms^{-1}
B 12.2 ms^{-1}
C 17.3 ms^{-1}
D 32.2 ms^{-1}

15 The diagram shows a mercury-in-glass thermometer. The distance between the -10°C and the 110°C markings is 30 cm.



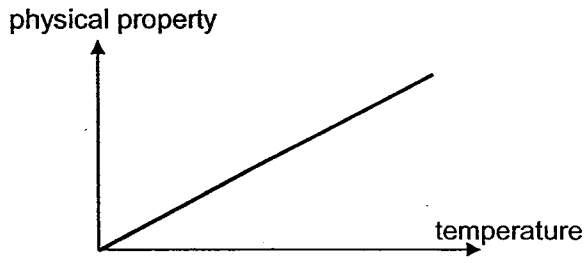
What is the temperature indicated by the length of the mercury thread?

A 57°C
B 67°C
C 70°C
D 80°C

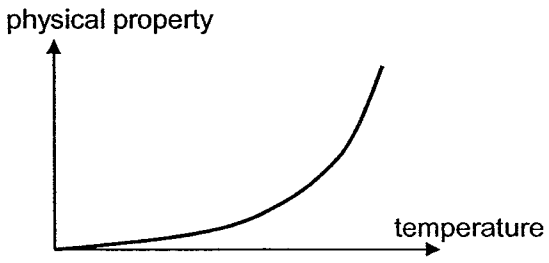
16 The relationship between the physical property of four different substances and temperature are plotted.

Which of the four substances is not suitable to be used to measure temperature?

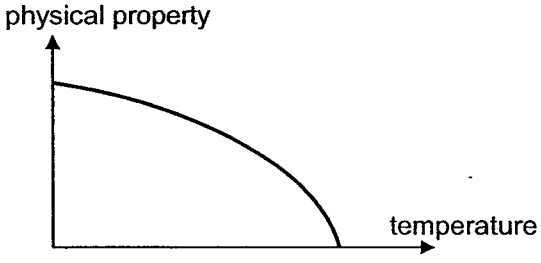
A



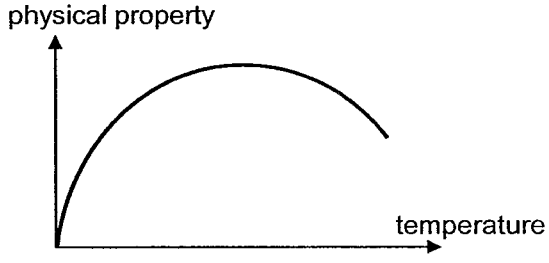
B



C



D



17 Brownian motion is observed in smoke particles.

Which of the following statements are correct?

1 It is due to the bombardment of air molecules.
2 It is faster if the particles are smaller.
3 It is faster if the temperature of the air is lower.
4 It is at random.

A 1 and 2 only
B 1, 2 and 4 only
C 1, 3 and 4 only
D 1, 2, 3 and 4

18 A gas is cooled in a rigid sealed container. Which quantity does not change?

A The average speed of the gas particles.
B The average force exerted on the walls of the container by the gas particles.
C The average distance between the gas particles.
D The frequency of collisions on the walls of the container by the gas particles.

19 A wooden chair and a metal chair are at the same temperature. However, a student who sat on both chairs commented that the wooden chair felt warmer than the metal chair.

Which of the following is the reason for this?

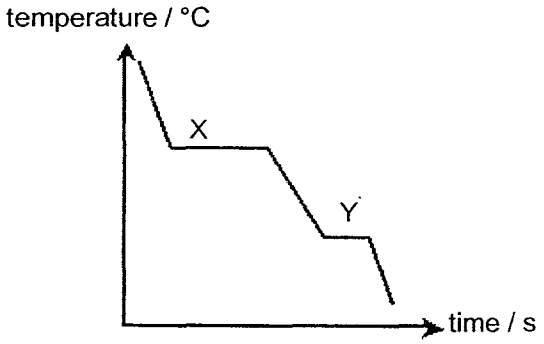
A Metal is a better conductor of heat.
B Metal is a better insulator of heat.
C Metal is a better emitter of radiation.
D Metal has a smoother surface.

20 A gas stove is used to boil some water in a metal pan.

Which row describes how thermal energy is transferred through the metal pan and throughout the water?

	Metal pan	Water
A	Molecular vibration and electron diffusion	Molecular vibration and electron diffusion
B	Molecular vibration and electron diffusion	Bulk movement of the molecules
C	Bulk movement of the molecules	Molecular vibration and electron diffusion
D	Bulk movement of the molecules	Bulk movement of the molecules

21 The graph in the following diagram shows how the temperature of a substance initially in the gaseous state varies with time.



Which pair correctly states the processes X and Y?

	X	Y
A	Condensation	Freezing
B	Condensation	Melting
C	Boiling	Freezing
D	Boiling	Melting

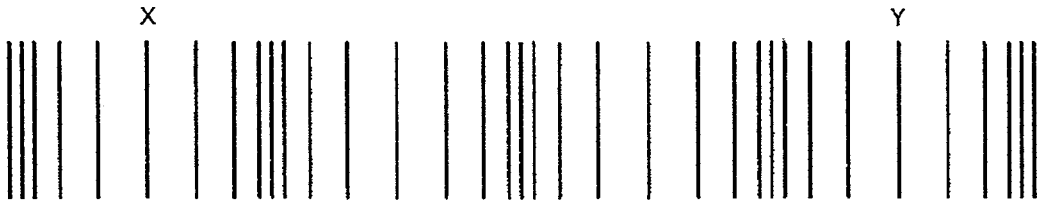
22 A pupil adds 37 g of ice at 0 °C to 100 g of water at 30 °C. The final temperature of water and melted ice is 0 °C. No heat is lost to, or gained from, the surroundings.

The specific heat capacity of water is 4.2 J/(g °C).

What is the specific latent heat of ice?

A 47 J/g
B 341 J/g
C 4700 J/g
D 12600 J/g

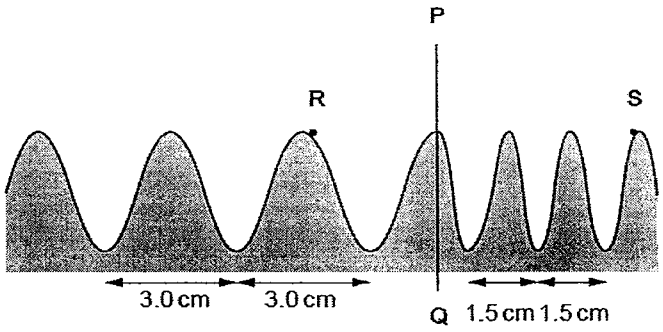
23 A series of compressions and rarefactions of a sound wave is shown below. The sound has a frequency of 1600 Hz and a speed of 320 m/s.



What is the distance between X and Y?

A 0.20 m
B 0.40 m
C 0.60 m
D 1.20 m

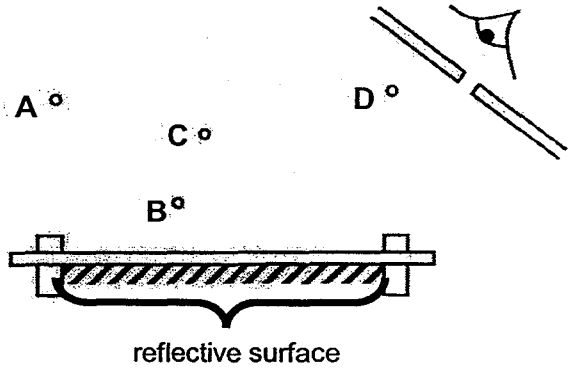
24 The diagram shows a water wave in a ripple tank.



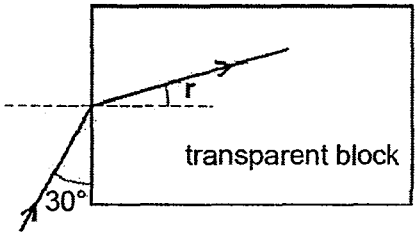
The wave has a speed of 12 cm/s at R. The wave crosses a boundary PQ where the distance between crests changes from 3.0 cm to 1.5 cm. What is the velocity of the wave at point S?

A 3.0 cm/s
B 6.0 cm/s
C 12 cm/s
D 24 cm/s

25 A dance instructor tries to observe four dancers through a small glass panel on the door of a dance studio. Whose image in the mirror **cannot** be seen by the instructor?



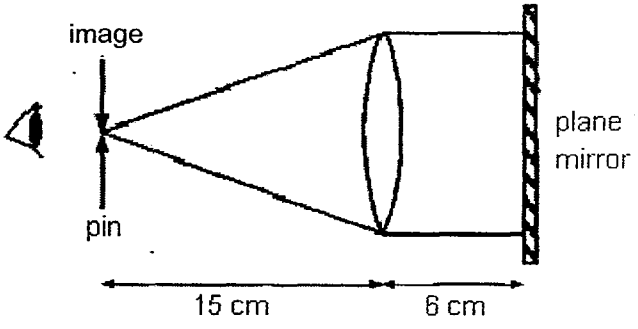
26 A ray of light meets the face of a transparent block at an angle of 30° as shown below.



The critical angle of the block is 21°. What is the angle of refraction ***r*** inside the block?

A 10° **B** 18°
C 20° **D** 25°

27 When a pin is placed in front of a convex lens and a plane mirror as shown below, an image of the pin is formed at the same position.

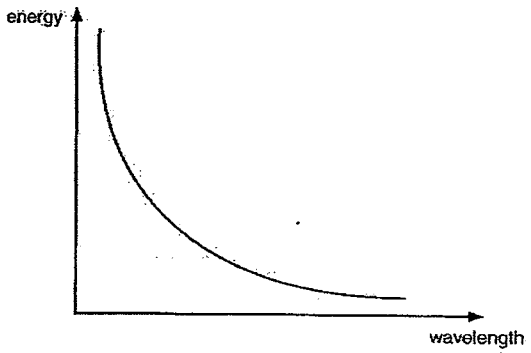


Which of the following statements is/are correct?

1 The image is real.
2 The focal length of the lens is 15 cm.
3 If the distance between the lens and the plane mirror is changed to 4.0 cm, the position of the image remains unchanged.

A 3 only **B** 1 and 2 only
C 2 and 3 only **D** 1, 2 and 3

28 The diagram shows the relationship between the energy of electromagnetic radiation and the wavelength of the waves.

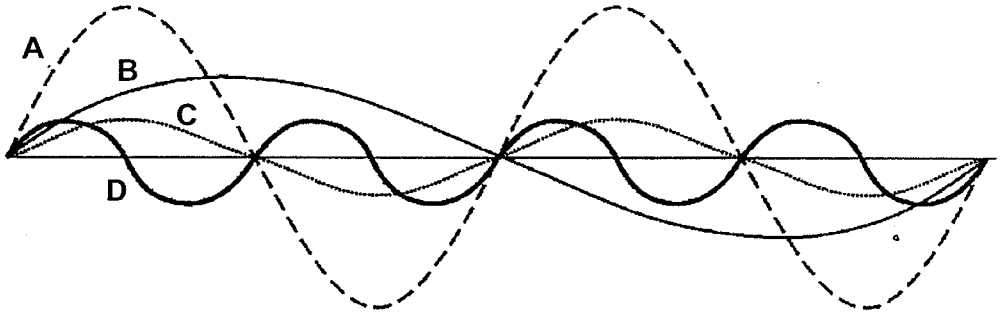


Which of the following has the lowest energy?

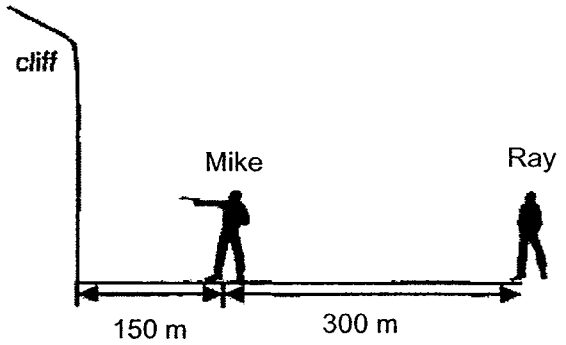
A Microwaves
B Infra-red
C Ultraviolet
D X-rays

29 The diagram shows the different displacement-time graph of the musical notes played on a flute.

Which waveform, **A**, **B**, **C** or **D**, has the highest pitch?



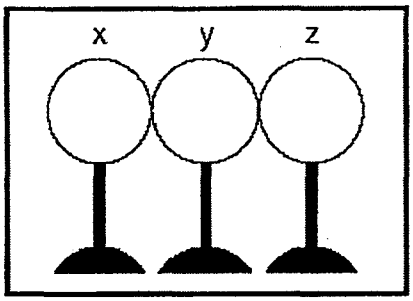
30 Mike fires a gun 150 m from a cliff. Ray who is standing 300 m further away from the cliff hears the gunshot 1.0 s after he sees the flash.



Ray then hears the echo _____

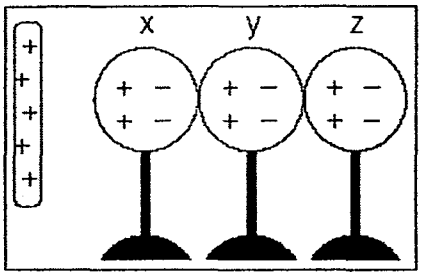
A 1.0 s after seeing the flash.
B 2.0 s after hearing the gunshot.
C 2.0 s after seeing the flash.
D 3.0 s after hearing the gunshot.

31 The diagram below shows three neutral metal spheres, **X**, **Y** and **Z**, in contact and on insulating stands.

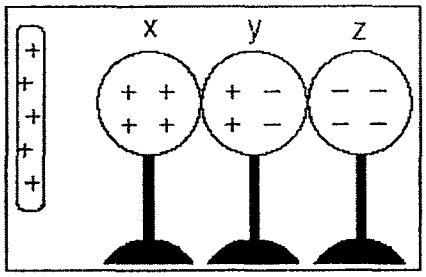


Which diagram best represents the charge distribution on the spheres when a positively charged rod is brought near sphere **X**, but does not touch it?

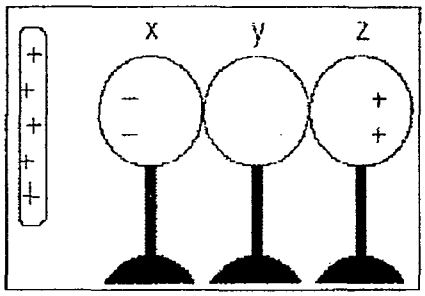
A



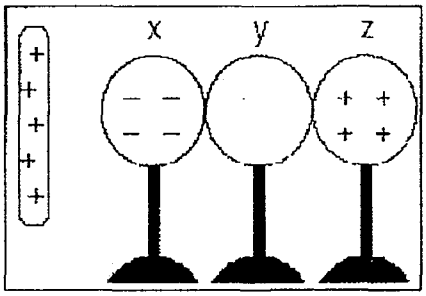
B



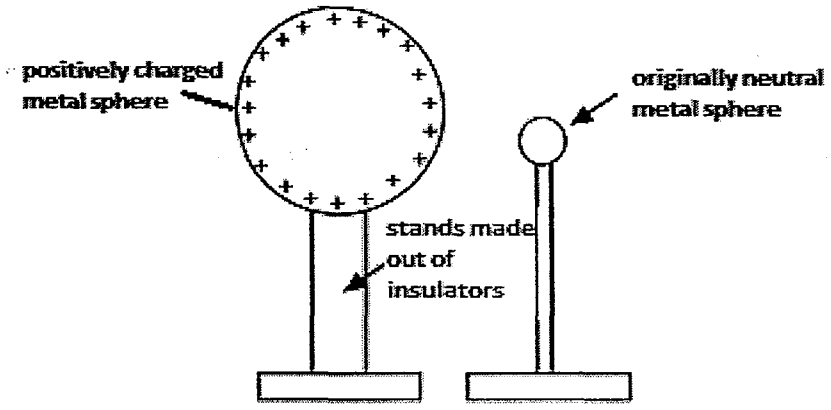
C



D



32 A small metal sphere, which is electrically neutral, is brought close to but not touching a positively charged metal sphere as shown in the diagram below.

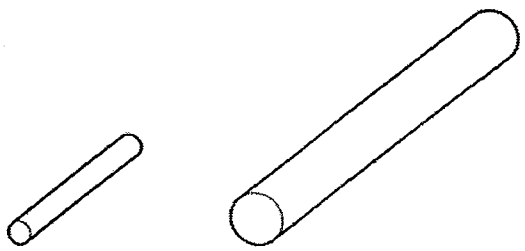


Which of the following is correct?

A Current will flow from the large sphere to the small sphere.
B Some of the positive charges on the larger sphere is neutralised.
C The smaller sphere becomes negatively charged.
D There is a potential difference between the two spheres.

33 The resistance of a cylindrical wire **P** is 80 Ω. A second wire **Q** is made from the same material.

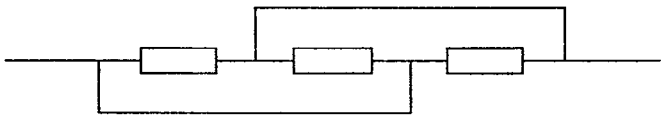
The cross-section area of **Q** is four times that of **P**. The length of **Q** is twice the length of **P**.



What is the resistance of **Q**?

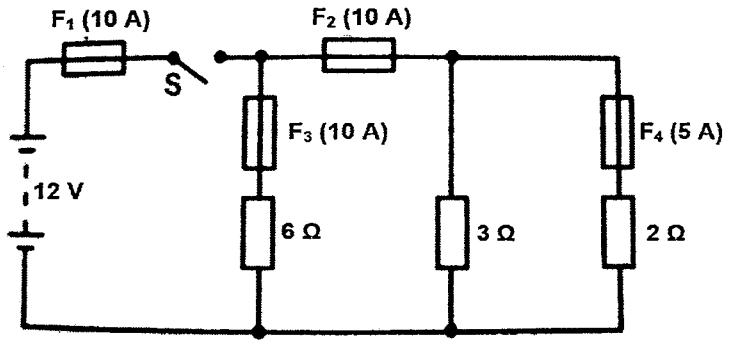
A 10 Ω
B 40 Ω
C 160 Ω
D 640 Ω

34 What is the effective resistance of the diagram below if each resistor has a resistance of 12 Ω?



A 0 Ω **B** 3 Ω
C 4 Ω **D** 12 Ω

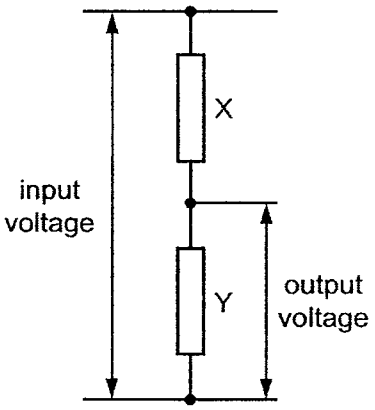
35 Four fuses are set up in a circuit as shown below. Their fuses ratings are labelled accordingly.



When switch S is closed, which two fuses will be blown?

A F_1 and F_2 **B** F_2 and F_3
C F_3 and F_4 **D** F_1 and F_4

36 An engineer uses the potential divider shown in the diagram.

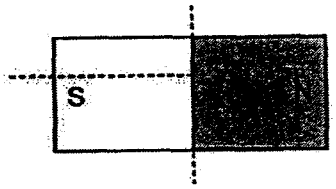


He needs the output voltage to be one tenth (1/10) of the input voltage.

Which pair of values could he use for the two resistors X and Y?

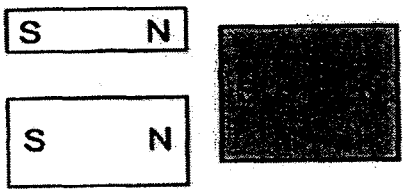
	X / kΩ	Y / kΩ
A	1.0	9.0
B	1.0	10.0
C	9.0	1.0
D	10.0	1.0

37 A bar of permanent magnet is cut into three smaller pieces along the dotted lines as shown.

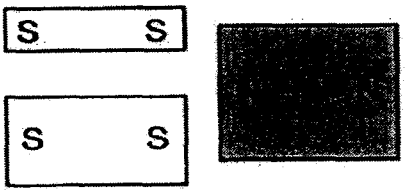


Which diagram correctly shows the polarities of the three small pieces just after the cuts have been made?

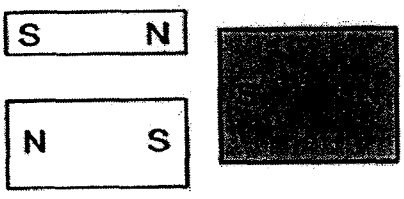
A



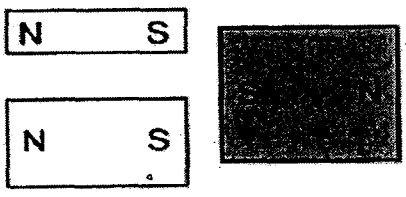
B



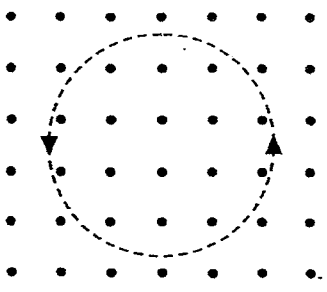
C



D



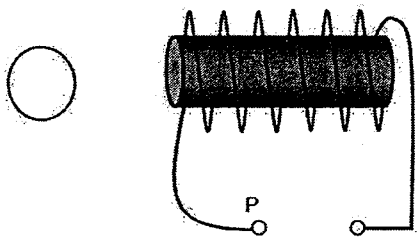
38 The diagram below shows the circular anti-clockwise path of a charge particle in a field. The direction of the field is out of the paper.

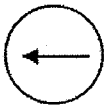
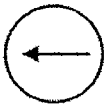


Ignoring the effect of gravity, which of the following correctly describes a possible state of charge of the particle and the nature of the field?

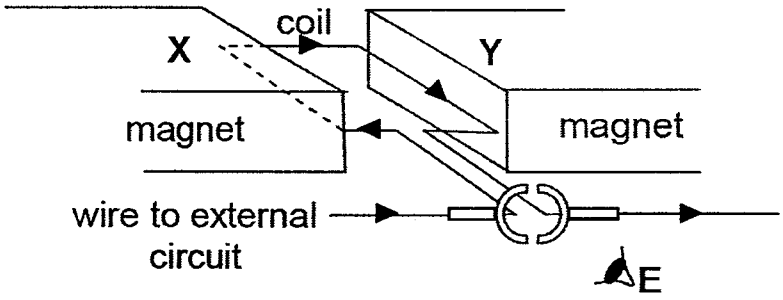
	Charge	Field
A	Negative	Magnetic
B	Positive	Electric
C	Negative	Electric
D	Positive	magnetic

39 In the diagram below, which of the following shows the correct terminal of P that will give the correct compass direction when placed near to the electromagnet as shown below?



	Terminal at P	Compass direction
A	Positive	
B	Positive	
C	Negative	
D	Negative	

40 The diagram below shows a simple d.c. motor.



Which of the following correctly indicates the direction of rotation of the coil for the given current in the coil (direction of current indicated by the arrow) when viewed from E and the given poles of the magnets X and Y, in the motor?

	X	Y	Direction of coil rotation
A	N-pole	S-pole	Clockwise
B	N-pole	S-pole	Anti-clockwise
C	N-pole	N-pole	Clockwise
D	S-pole	N-pole	Anti-clockwise

- END OF PAPER -

2016 PRELIMINARY EXAMINATION 2
Secondary Four Express

NAME			
CLASS		**REG. NO**	

Physics

5059/02

Paper 2 Theory

30 Aug 2016

1 hour 45 minutes

Candidates answer on the Question Paper.

No additional materials are required.

Setter: Mdm. Teo Joo Keng

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, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question **13** 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.

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	
..... Parent's signature/ Date	Total	

Section A (50 marks)

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

1 Joyce and her sisters are snatching a rigid hula hoop (see Fig 1.1). The pulling forces of her two sisters, F_1 and F_2 are 150 N and 210 N respectively. They are 80° apart. To keep the hoop stationary, Joyce exerts a force F_3.

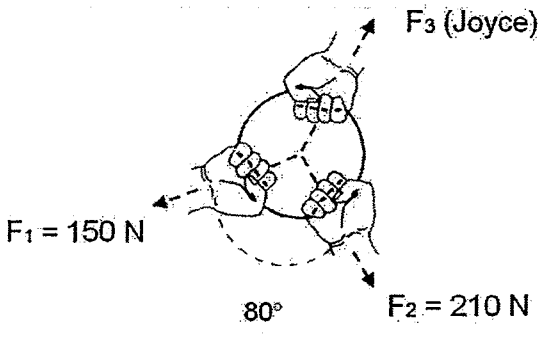


Fig 1.1

By means of a labelled vector diagram, determine the

(a) smallest force F_3 that Joyce must exert, and

(b) angle between F_3 and F_1.

Magnitude of F_3 : ..... [1]

Angle between F_3 and F_1 : ..... [3]

2 Fig 2.1 shows a child's ride, which consists of a steel cable that runs between two posts of different heights.

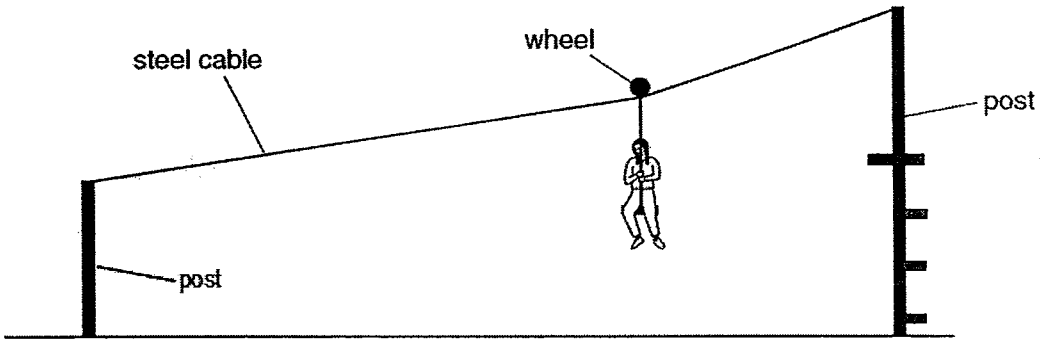


Fig 2.1

A girl starts and finishes the rides as she descends in a straight path along the steel cable. She accelerates uniformly at 0.8 ms^{-2} from rest for 3.0 s. She maintains a constant velocity of 2.4 ms^{-1} for a further 5.0 s. She decelerates uniformly to a stop in 1.0 s.

(a) On Fig 2.2, draw a velocity-time graph of her motion. [3]

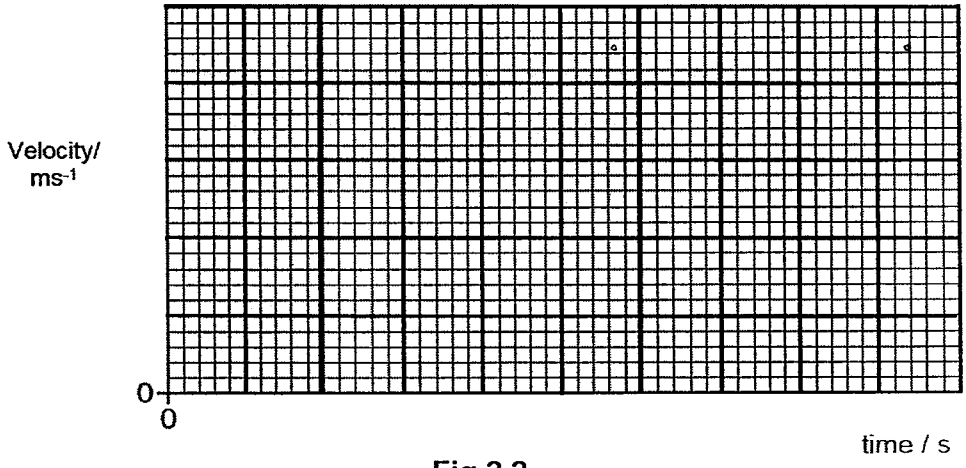


Fig 2.2

(b) Using Fig 2.2, describe how the graph shows the magnitude of the uniform deceleration in the last 1.0 s, is larger in size than the initial acceleration in the first 3.0 s.

.....

[1]

.....

(c) Calculate the distance travelled by the girl in the first 8.0 s.

Distance = ... [2]

(d) Explain why the gain in kinetic energy of the girl is less than the decrease in her gravitational potential energy towards the end of the ride.

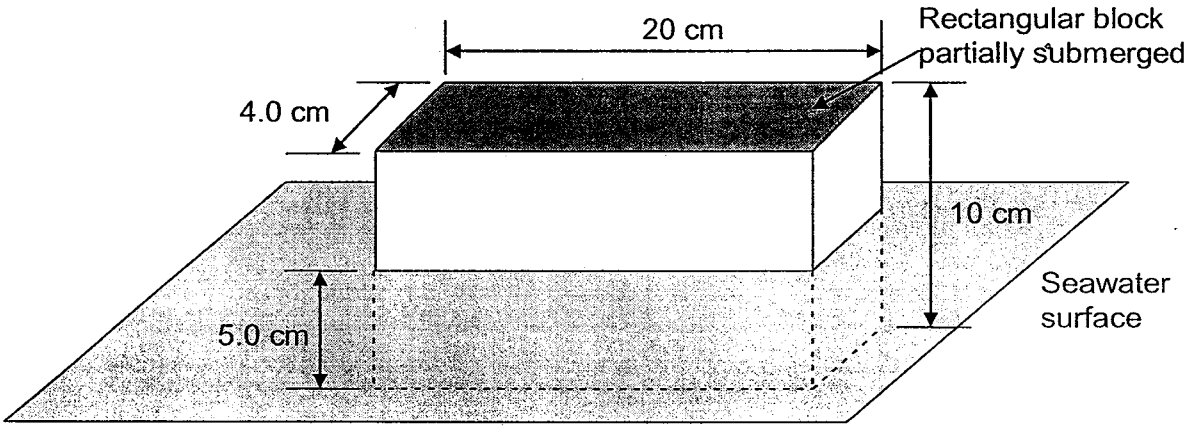
.....

.....

[2]

.....

3 The diagram below shows a rectangular block partially submerged into seawater 5.0 cm below the seawater surface. The dimensions of the rectangular block are 20 cm by 4.0 cm by 10 cm.



(a) Given that the density of seawater to be 1030 kg/m^3, calculate the pressure due to the seawater 5.0 cm below its surface.

Pressure = ... [2]

(b) Calculate the magnitude of the force acting on the bottom surface of the rectangular block due to the pressure from the seawater.

Force = ... [2]

(c) Calculate the mass of the rectangular block, in grams, given that the density of the block is 430 kg/m^3.

Mass = ... [2]

4 Fig 4.1 shows a non-uniform plank **XY** 2.50 m long and weighs 950 N. Spring balances **A** and **B** are attached to the plank at a distance of 0.40 m from each end, as shown in Fig 4.1.

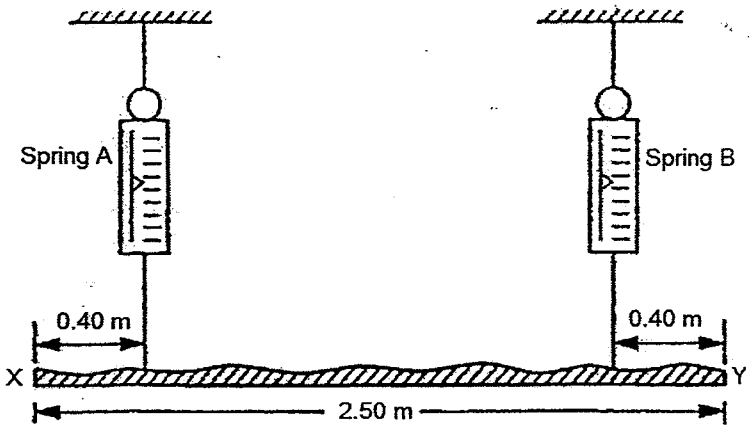


Fig 4.1

When the plank is horizontal, spring balance **A** records 570 N.

(a) Calculate the reading on spring balance **B**.

Reading = ... [1]

(b) On Fig 4.1

(i) indicate clearly with a cross (X) a likely position for the centre of gravity of the plank. Label it 'C.G.'. [1]

(ii) mark and label all the forces, with suitable force arrows, acting on the plank. [2]

(c) Taking moments about spring balance **A**, determine the distance of the centre of gravity from the end **X** of the plank.

Distance = ... [3]

(d) Why is the tension in spring balance **A** not considered for the calculation in part **(c)**?

.....

.....

.....

[1]

.....

5 A converging lens of focal length of 7.0 cm. An object of height 2.0 cm is placed 3.0 cm from the centre of the lens. Fig 5.1 is a full-scale grid that shows the arrangement of the object, the lens and the two principal foci (focal points).

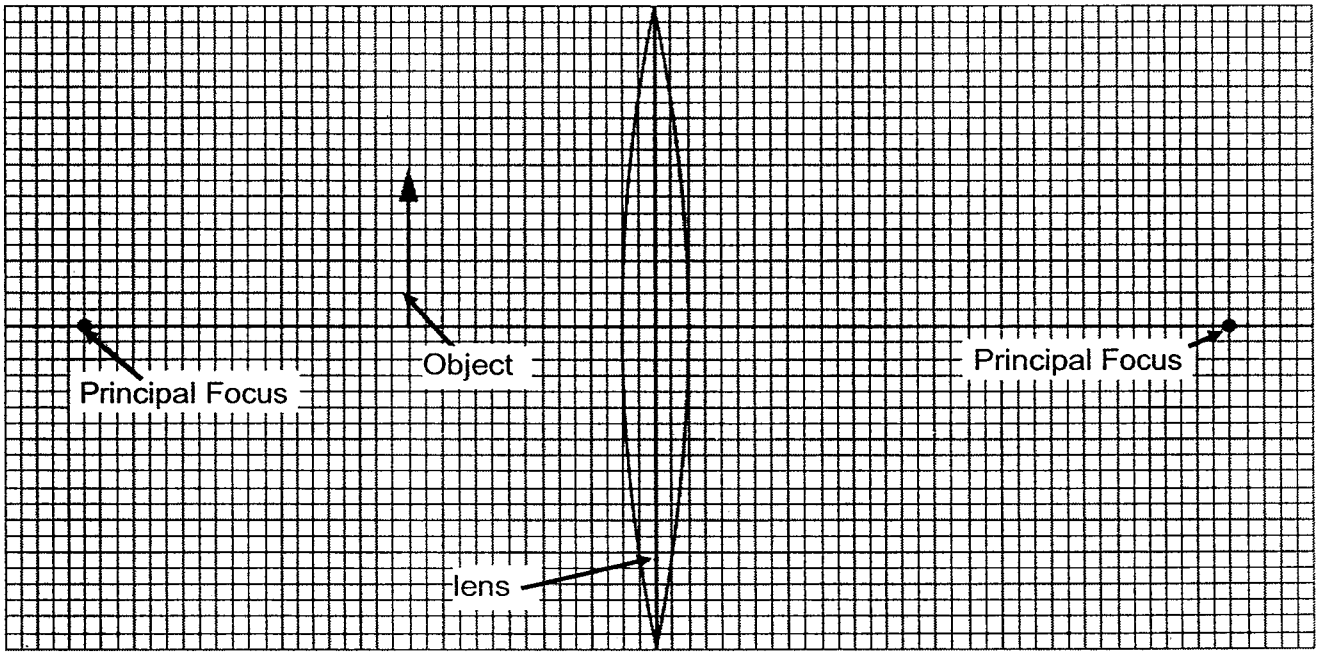


Fig 5.1

(a) By drawing on Fig 5.1, show how the lens forms image of the object. [3]

(b) State TWO features of the image.

.....

[1]

.....

6 A beam of yellow light is incident on a water droplet as shown in Fig 6.1.

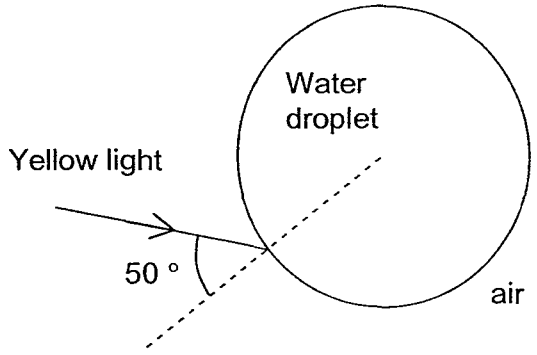


Fig 6.1

The refractive index of water for yellow light is 1.33.

(a) Calculate the angle of refraction in the water droplet.

Angle of refraction = ... [1]

(b) Calculate the critical angle.

Critical angle = ... [1]

(c) Draw accurately on Fig 5.1 the subsequent path of the yellow light until it emerges into the air again. Calculate and label the values of all the angles needed to draw the path on the diagram. [2]

7 Fig 7.1 represents the original positions of the air molecules in the tube. Fig 7.2 represents the position of the same molecules as a sound wave passes through the tube at t = 0 s.

Fig 7.1

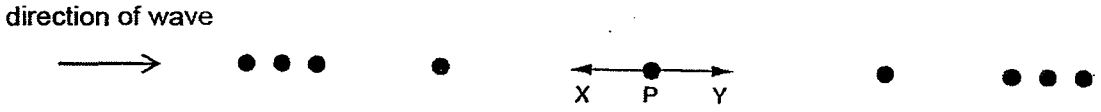


Fig 7.2

(a) Explain how sound energy is transferred through the air without transferring matter.

.....

.....

..... [2]

.....

(b) Describe how Fig 7.1 and Fig 7.2 shows that sound is a longitudinal wave.

.....

..... [1]

.....

(c) On Fig 7.2, mark a distance equal to the wavelength of the sound wave. [1]

(d) Particle P vibrates from the original position to X, then to Y and then back to the position as shown in Fig 7.2. All the particles will be back in positions shown in Fig 7.2 for the first time at t = 2.0 s. The distance between X and Y is 8.0 mm.

(i) Determine the amplitude of the wave.

Amplitude = ... [1]

(ii) Calculate the frequency of the wave.

Frequency = ... [1]

8 A microphone is connected to a cathode-ray oscilloscope (CRO). A note produced by a musical instrument caused a trace on the screen. The trace is stored electronically in the CRO Fig 8.1 shows the stored trace displayed on the screen.

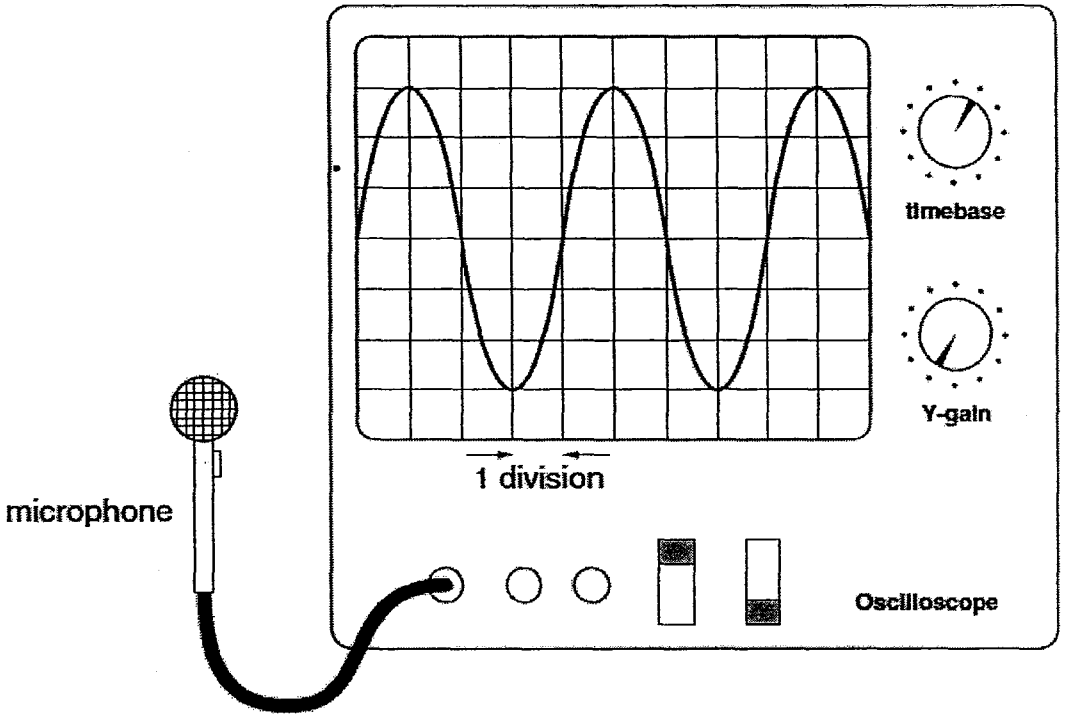


Fig 8.1

The time-base setting on the oscilloscope is 0.20 ms/div.

Determine the frequency of this note.

Frequency = ... [2]

9 Fig 9.1 shows a method of producing sandpaper using static electricity.

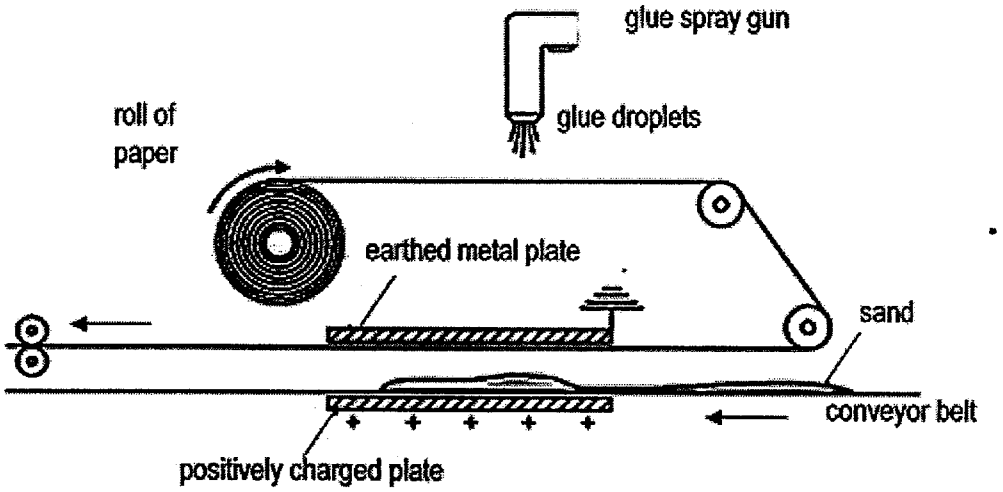


Fig 9.1

Glue is sprayed onto a moving strip of paper. As the glue leaves the spray gun, the glue breaks up into tiny negatively charged droplets which coat the paper. The sticky paper passes between two metal plates.

Sand moving on a conveyor belt also passes between the metal plates.

(a) Explain why the sand moves towards the sticky paper.

.....

.....

.....

[2]

.....

(b) State the purpose of the earthed metal plate.

.....

[1]

.....

10 Fig 10.1 shows a transformer. The number of turns in the primary coil is 2000 turns, and the number of turns in the secondary coil is 100 turns. A 20 V a.c. supply is connected to the primary coil.

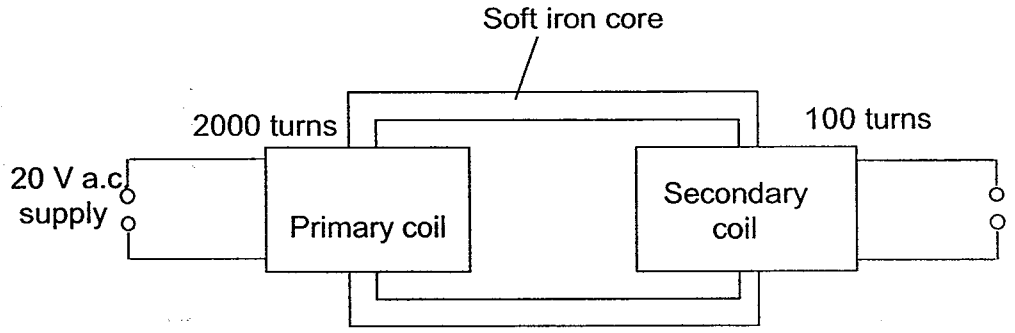


Fig 10.1

(a) State the purpose of the core.

.....

[1]

.....

(b) State and explain is the transformer above a step-up or a step-down transformer.

.....

.....

[2]

.....

(c) Calculate the output voltage in the secondary coil, assuming that the transformer is 100% efficient.

Output voltage = ... [2]

Section B (30 marks)

Answer **all** the questions from this section.
Answer only one of the two alternative questions in Question 14.

11 Fig 11.1 shows a vacuum cooker. It comprises of an outer pot and an inner pot. More details of the two pots are as listed by the manufacturer below:

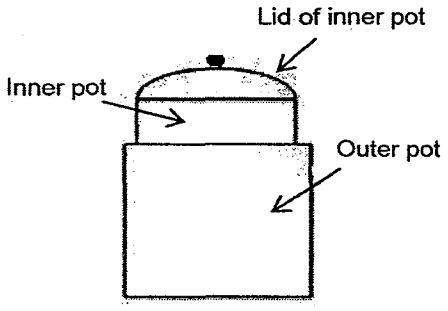


Fig 11.1

Outer pot:

- A two-layered stainless steel container which comes with a lid and a layer of vacuum in between
- The cooker is good for keep food warm for long periods of time

Inner pot:

- A stainless steel container which comes with a lid
- The exterior is highly polished and coated with shiny metallic paint
- It is suitable for a gas stove or electric hot plate

Mary used the vacuum cooker to cook some red bean soup for dessert. She placed the inner pot (with red beans and water in it) over a hotplate and cooked the contents at HI (High power) setting. Next, she transferred the inner pot and its contents immediately into the outer pot and left it there for a period of time. Before serving the dessert, she placed the inner pot (and its contents) back to the hotplate again, and cooked the contents at HI setting for a while. More details are shown in Fig 11.2.

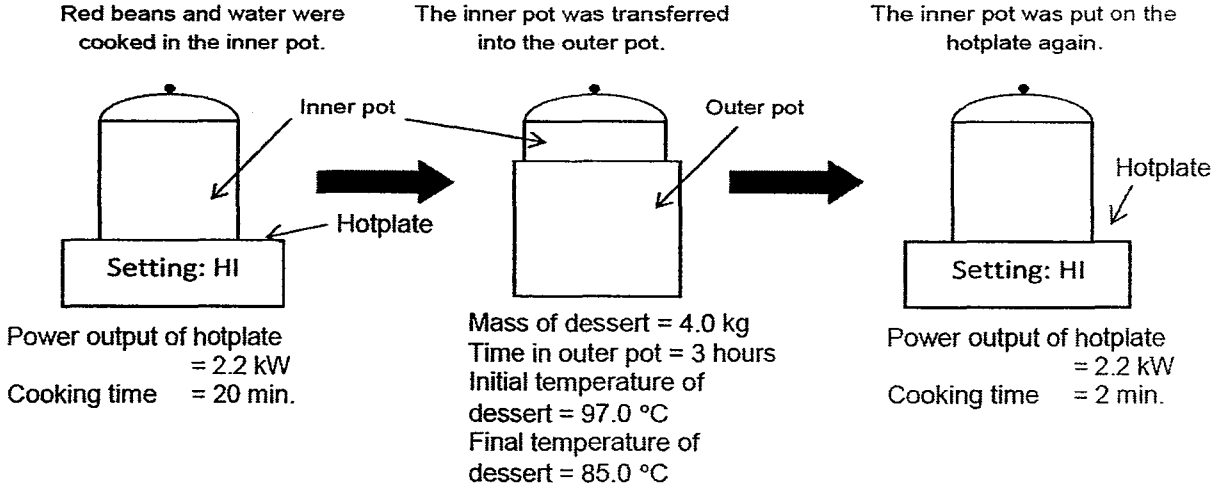


Fig 11.2

(a) (i) Explain three ways in which the cooker is able to keep the

soup warm for several hours.

[3]

(ii) Given that the specific heat capacity of the dessert is 4400 J/(kg K). Calculate the rate of energy loss of dessert. Express your answer in SI units.

Rate of energy loss of the dessert = ... [2]

(iii) Mary scooped all the dessert out of the pot and into a bowl. To make the dessert taste better, Mary mixed 500 g of milk, initially at 3.0 °C, with the hot dessert. If the temperature of the hot dessert is initially at 100°C, calculate the final temperature of the mixture. You may ignore any heat gained by the bowl and the surroundings. (Specific heat capacity of milk = 4200 J/(kg K))

Final temperature of the mixture = ... [2]

(b) John decided to cook the exact same desert for himself too. However, he did so differently. John placed the inner pot (with red beans and water in it) over a

hotplate and cooked the contents at HI (High power) setting. Next, he switched the hotplate to LO (low power) setting and cooked the dessert for another period of time. More details as shown in Fig 11.3

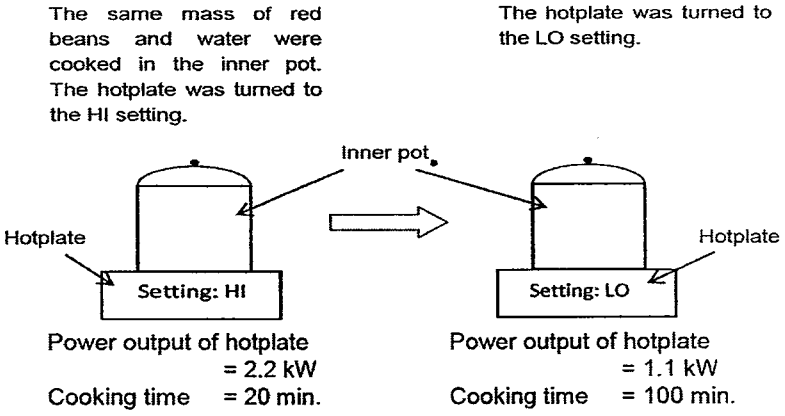


Fig 11.3

Compare the amount of energy supplied by the hot plate for Mary's and John's methods. State which method is more efficient?

[3]

12 Wind is a cheap and renewable energy source. Wind turbines provide electrical energy by making use of wind to turn its turbine blades which in turn spins a coil placed between two permanent magnets.

Wind turbines come in various sizes and have various power ratings. Fig 12.1 shows one of the smallest wind turbines of domestic use while Fig 12.2 shows the generator connected to the turbine blades.

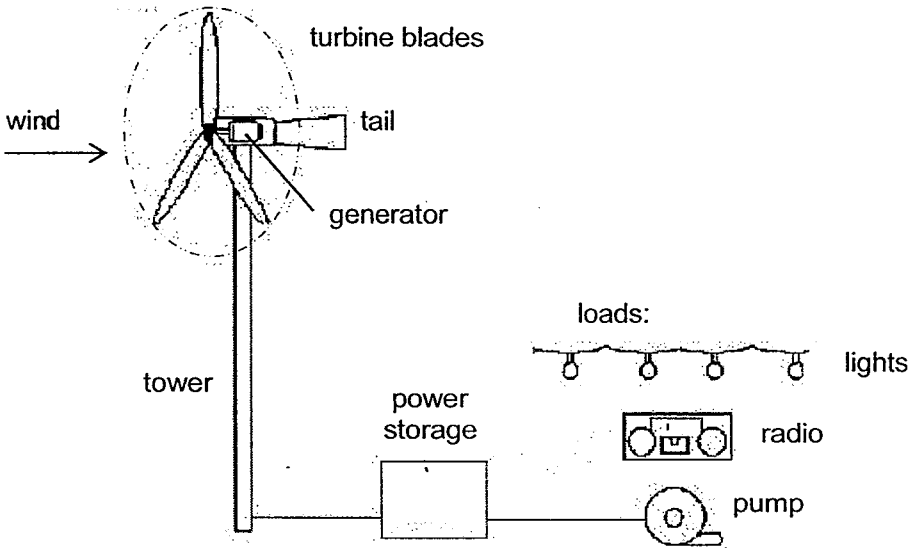


Fig 12.1

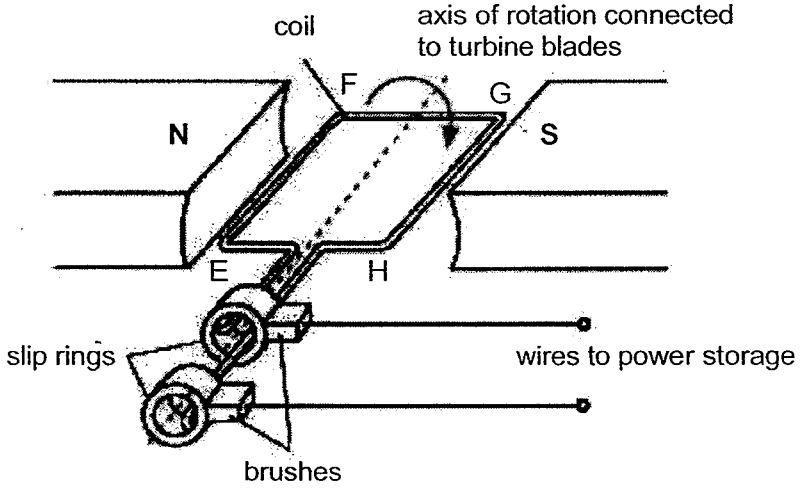


Fig 12.2

Fig 12.3 shows the specification of the wind turbine.

blade diameter	2.7 m
cut-in wind speed	2.5 m/s
rated wind speed	9.0 m/s
cut-out wind speed	15 m/s
maximum output power	650 W
output voltage	48 V (a.c.)
average annual energy output	1997 kWh

Fig 12.3

Fig 12.4 shows the electrical power generated by the wind turbine at different wind speeds.

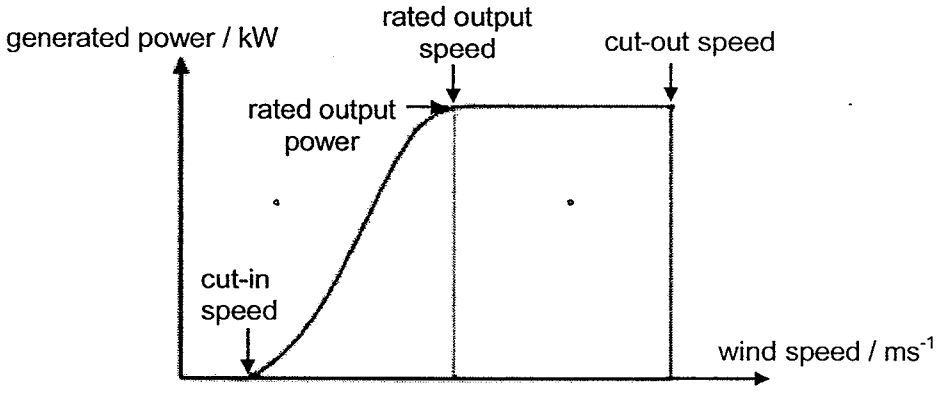


Fig 12.4

(a) State the direction of the induced current on side EF of the coil.

[1]

.....

(b) Explain the purpose of the slip rings and brushes arrangement shown in **Fig 12.2.**

.....

[1]

.....

(c) State the wind speed at which the turbine blades first start to turn. Explain why the turbine blades could only start turning at this speed.

.....

.....

.....

[2]

.....

(d) At the cut-out wind speed of 15 ms^{-1}, brakes are immediately employed to bring the turbine to a standstill. Explain why this is necessary.

.....

[1]

.....

(e) When the wind speed is 15 ms^{-1}, the coil of the generator rotates 2.5 times in each second.

On Fig 12.5, sketch a well-labelled graph of e.m.f. produced by the generator against time for a time interval of 1.0 s from the instant shown in Fig 12.2.

[2]

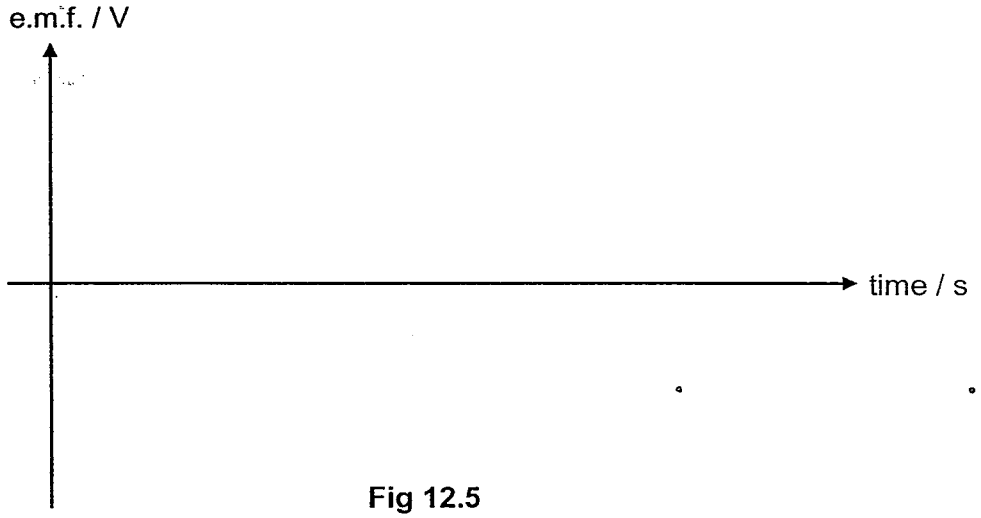


Fig 12.5

(f) A suggestion was made for a small home to be run solely on this wind turbine. On an average day, assume that the following are the electrical needs of the home.

- Lights, 600 W for 6.0 hours
- Radio, 20 W for 12 hours, and
- Water pump, 750 W for 3.0 hours

(i) Calculate the energy needed for a day, leaving your answer in kWh.

Energy needed = ... [2]

(ii) Hence explain if this arrangement is suitable.

.....

.....

.....

[1]

13 Either

(a) Fig 13.1 shows the variation of the resistance of thermistor with temperature.

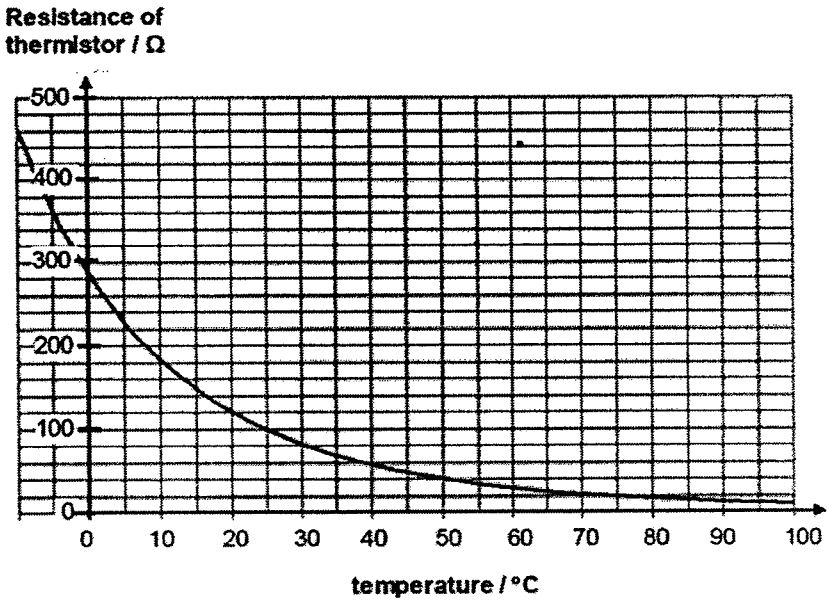


Fig 13.1

A pupil uses the thermistor and sets up a circuit as shown in Fig 13.2. The bulb used in the circuit has the rating of 3.5 V, 0.1 A. The temperature of the surroundings is 25°C.

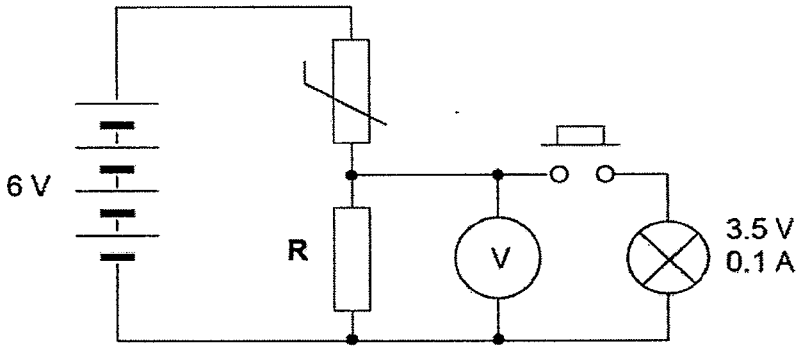


Fig 13.2

(i) When the switch is opened, the voltmeter shows a reading of 3.5 V. Calculate the value of resistance **R**.

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

(ii) The pupil now closes the switch as shown in Fig 13.3.

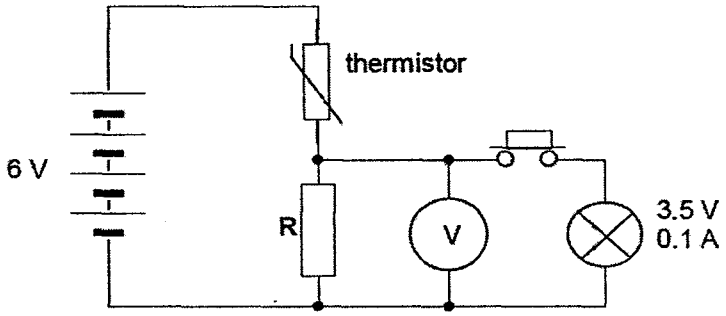


Fig 13.3

Calculate the reading shown on the voltmeter when the switch is closed.

Voltmeter reading = ... [3]

(iii) Describe and explain how the brightness of the bulb in Fig 12.3 will change as the temperature increases from 25°C to 100°C.

.....

.....

.....

[2]

.....

(b) Figure 13.4 below shows a soft-iron core wound with two coils.

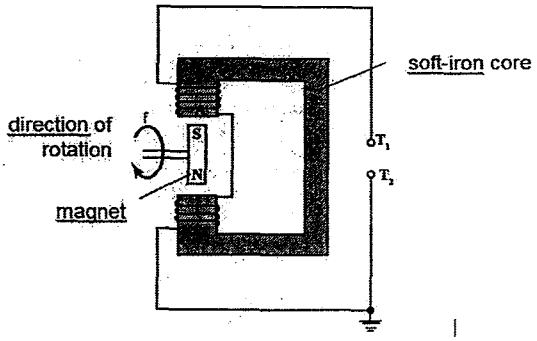


Fig 13.4

The magnet is made to rotate as shown, the S-pole moving from this position up out of the plane of the paper and the N-pole moving down into the plane on the paper.

(i) State Faraday's Law of electromagnetic induction.

.....

.....

[1]

.....

(ii) Describe how the magnetic pole induced at A of the core changes as the south pole of the magnet approaches and moves away from it.

.....

[1]

.....

(iii) When the magnet is rotated, explain why an e.m.f. is induced between terminals T_1 and T_2.

.....

.....

[1]

.....

13 OR

There are three diving boards of different heights in a swimming pool for divers to dive as shown in Fig 13.5. Each level of diving board is connected to the level below by ladders. The height of each step of the ladder to level 1 is 15 cm while those to the levels 2 and 3 are 20 cm.

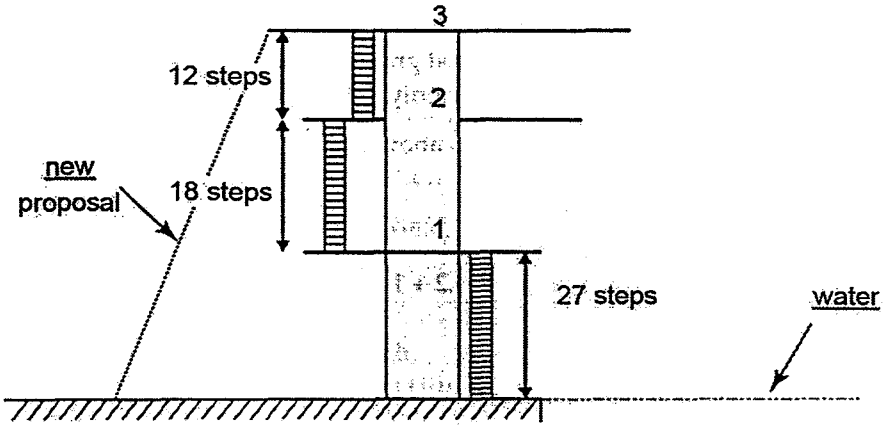


Fig 13.5

(a) A diver of mass 47 kg climbs up the stairs from the ground. Find the potential energy gained by him when he reaches level 3.

Potential Energy = ... [2]

(b) Find the average power if he takes 35 s to climb up from the ground to level 3.

Power = ... [2]

(c) A man walks along level 1. Explain if there is any work done by the weight of the man.

[2]

(d) A new construction plan is to build a flight of stairs that runs directly from the ground to level 3 is proposed. It allows divers to go directly from the ground to level 3 instead of climbing up through level 1 and 2.

Explain why the new proposal will not reduce the amount of potential energy needed to climb up to level 3.

[1]

(e) A diver at level 3 jumps up with an initial velocity of 4.4 ms^{-1}. Find the maximum height he can reach above the water.

Height = ... [3]

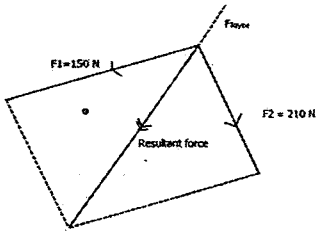
- END OF PAPER –

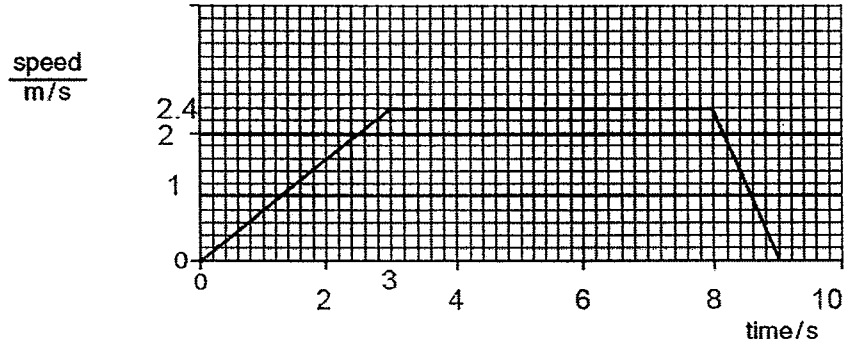
Sec 4 E Physics Prelim 2 2016
Mark Scheme

Paper 1
Multiple Choice

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

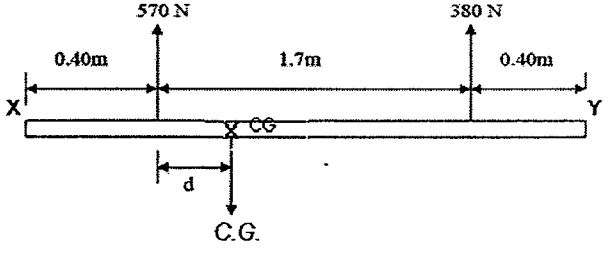
Paper 2
Section A (50 marks)

1	(a)		 Appropriate vector diagram Correct arrows and labels Magnitude of Joyce's force = 274 N to 284 N	 1 1 1
	(b)		Angle of Joyce's force from F_1 = 130° to 134°	1
			Total	**4**

2	(a)			

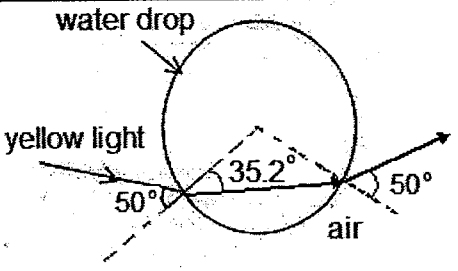
			Shape Timing at 3s, 8s and 9 s Speed at 2.4 m/s	1 1 1
	(b)		The gradient of v-t graph during deceleration is steeper than during acceleration. OR higher rate of change in speed for deceleration (shorter time) as compared to acceleration (lower rate of change in speed – longer time)	1
	(c)		Displacement = area under v-t graph S = 0.5(8+5)(2.4) S = 15.6 m	1 1
	(d)		Difference is due to **work done against friction** between wheel and cable and **air resistance** between the girl and air.	1 1
			Total	**8**

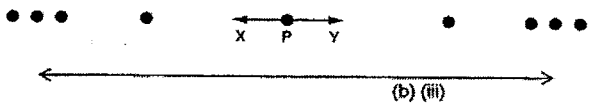
3	**(a)**		Pressure = hpg = (0.05)(1030)(10) = 515 Pa	1 1
	(b)		F = P x A F = 515 Pa x (0.2 m)(0.04 m) F = 4.12 N (ECF)	1 1
	(c)		Volume of block = 0.1 m x 0.2 m x 0.04 m = $0.0008 m^3$ Mass = Density x Volume = 0.0008 m^3 x 430 = 0.344 kg or 344 g (ECF) * student to be awarded marks if they equate the upthrust of the water to the weight of the object. Hence finding the mass of the object.	1 1
			Total	**6**

4	**(a)**		950 – 570 = **380 N**	1
	(b)	**(i)**		1
		(ii)	As seen in diagram above. All three forces must be vertical and acting in the correct directions. (2 m if all 3 forces are correct, 1 m if less than 3, 0 m if none is correct.)	2
	(c)		Taking moment about spring A, Clockwise moment = anti-clockwise moment 950N x d = 380N x 1.7m d = 0.68m Distance of the centre of gravity from X = 0.68 m + 0.40m = **1.08 m**	 1 1 1

	(d)		**Perpendicular distance** between line of action of force in spring A and pivot is zero.	1
			Total	8

5	(a)		• paraxial to lens and on through focal point • un-deviated to centre of lens as if from focal point to lens and then paraxial • - traced back to locate image	1 1 1
	(b)		any two of: virtual/upright/magnified/further from lens/dimmer	1
			Total	4

6	(a)		$r = \sin^{-1}(\sin 50\ °/1.33) = 35.2\ °$ (1 d.p)	1
	(b)		Critical angle = $\sin^{-1}(1 / 1.33) = 48.8\ °$ (1 d.p)	1
	(c)		 Ray with arrow and angle in bubble. Ray with arrow and angle in air.	 1 1
			Total	4

7	(a)		As the molecules vibrate about their original positions, regions of compression and rarefraction are produced. Energy is passed on from one molecule to another molecule when they collide, hence energy is transferred without the bulk transfer of the molecules.	1 1
	(b)		The direction of vibration of the particles is parallel to the direction of travel of the wave.	1
	(c)			1
	(d)	(i)	Amplitude = 4.0 mm	1
		(ii)	T = 2.0 s ; f = 1/T = 0.50 Hz	1
			Total	6

8			f = 1/T = 1/0.0008s = 1250/1300 Hz	1 1
			Total	2

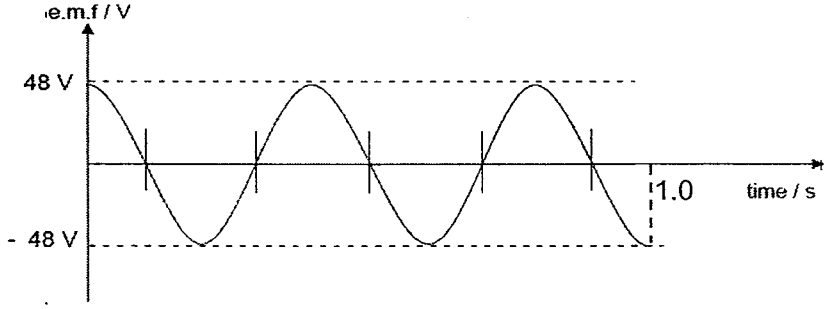
9	(a)		**Sand is charged positively** by the positively charged plate and attracted to the negatively charged glue on the paper since **unlike charges attracts**	1 1
	(b)		earthing helps to **distribute excess negative charges** into metal plate.	1
			Total	3

10	(a)		The soft iron core can **greatly increase the magnetic flux linkage** or The soft iron core strengthens the **magnetic field lines linking the primary to the secondary coil**	1
	(b)		It is a step down transformer. The number of turns in the **secondary coil is less than** the **number of turns in the primary coil**.	1 1
	(c)		$\frac{V_S}{V_P} = \frac{N_S}{N_P}$ $\frac{V_S}{20} = \frac{100}{2000}$ $V_S = 1V$	1 1
			Total	5

Section B (30 marks)

11	(a)	(i)	• Vacuum layer prevents heat from the food / inner pot from being **conducted** to the surroundings. (convection is irrelevant here because the vacuum is not at the top of the pot, or unless you invert the pot during cooking so that the vacuum is on top) vacuum layer: prevent heat lost to the surroundings by conduction and convection. • Metal lid (of inner pot) **prevents the formation of convection currents** above the inner pot – reduces heat loss by convection, or: • □ Metal lid (of inner pot) prevents water (in the soup) from evaporating – reduces heat loss by evaporation. • □ Exterior of inner pot is highly polished / shiny – reduces heat loss to the surroundings by thermal **radiation because shiny surface is a poor emitter of radiation** (Note that it is the exterior, not interior, of the inner pot that is polished/shiny. Thus you cannot mention radiant heat is reflected back into the soup). [Any 3 points, 1 m each] Other points worth taking note of: Stainless steel need not be shiny (not stated in the passage/question). So it is wrong to mention that stainless steel reflects radiant heat back to the soup/food. Be concise and accurate in your phrasing of answer. Phrases like "vacuum traps heat", "vacuum prevents heat loss (without any mention of "by conduction")" will certainly not earn you any credit. Phrases like "vacuum prevents radiant heat from being conducted away" shows poor conceptual understanding	Any 3 points. 1 m each
		(ii)	Q = mcΔθ = (4kg)(4400J/kgK)(97 – 85) [1] = 211200J [1] (not 210000J) Thus, rate of heat loss = 211200J / 3h = 211200J / 10800s = 19.6W(or: 19.6W, 20J/s, 20W)	1 1
		(iii)	Let final temperature of mixture (red bean soup + milk) be x. Ignore heat loss to the surroundings, then: Heat gained by milk = heat lost by red bean soup (0.50 kg)(4200 J/kgK)(x – 3.0) = (4 kg)(4400J /kgK)(100 – x) 2100x – 6300 = 1760000 – 17600x x = (1760000 + 6300) / 19700 = 89.7 deg C (to 3 s.f.) or 90 deg C (to 2 s.f.) [1]	1 1
	(b)		Total energy used (Mary's method) = power × time = (2.2 kW)(20 mins) + (2.2 kW)(2 mins) = (2200 W)(1200 s) + (2200)(120 s) = 2.9 MJ (to 2 s.f.) Total energy used (John's method) = power × time = (2.2 kW)(20 mins) + (1.1 kW)(100 mins)	1

			= (2200 W)(1200 s) + (1100 W)(600 0s) = 9.2 MJ (to 2 s.f.) Since 2.9 MJ < 9.2 MJ, then Mary's method is more energy efficient (as it uses less energy). (NOTE: If energy is expressed in joules, then time must be expressed in seconds and power expressed in watt) OR: Total energy used (Mary's method) = power × time = (2.2kW)(20mins) + (2.2kW)(2mins) = (2.2kW)(1/3)h + (2.2kW)(1/30)h = 0.81kWh (to 2 s.f.) [1] Total energy used (John's method) = power × time = (2.2kW)(20mins) + (1.1kW)(100mins) = (2.2kW)(1/3)h + (1.1kW)(5/3)h = 2.6kWh (to 2 s.f.) [1] Since 0.81kWh < 2.6kWh, then Mary's method is more energy efficient (as it uses less energy). [1]	1 1
			Total	**10**

12	**(a)**		Induced current flows from E to F / flows into the paper.	1
	(b)		The slip rings, together with the brushes, allow the alternating induced current to flow to an external circuit.	1
	(c)		Turbine blades start to turn at 2.5 m/s There must be enough force to overcome the friction between the moving components within the turbine.	1 1
	(d)		This is to prevent too much current / overheating of the cables.	1
	(e)		 • correct shape of graph with 2.5 cycles in 1.0 s • with 48 V and 1.0 marked out and for correct value of 48 V at t = 0 s	 1 1

	(f)	(i)	Total energy consumption in in 1 day = $\frac{600}{1000}$ x 6 + $\frac{20}{1000}$ x 12 + $\frac{750}{1000}$ x 3 = 6.09 kWh	1 1
		(ii)	This arrangement is not suitable as the <u>energy supplied by wind turbine of</u> 1997 / 365 = 5.47 kWh <u>is less than the energy consumed</u> in 1 day.	1
			Total	**10**

13 Either				
	(a)	**(i)**	At 25°C, resistance of thermistor = 100 Ω <u>Method 1: potential divider method</u> $\frac{R}{R+100} = \frac{3.5}{6}$ R = 140 Ω <u>Method 2</u> Since $R_{thermistor}$ = 100 Ω I = 2.5V / 100 Ω = 0.025 A $R_{resistor}$ = V/I = 3.5 / 0.025 = 140 Ω	 1 1
		(ii)	$\frac{1}{R_t} = \frac{1}{\frac{1}{140} + \frac{1}{35}}$ R_t = 28 Ω 28/(28 + 100) = V/6 V = 1.3 V	1 1 1

		(iii)	As temperature rises, the resistance of thermistor will decrease. Hence, the p.d. across the parallel network of fixed resistor and bulb will increase and the bulb wil become brighter.	1 1
	(b)	(i)	The magntiude of the induced e.m.f in a circuit is directly proportional to the rate of change of magnetic flux in the circuit.	1
		(ii)	As the S pole of magnet approaches A, A becomes a South pole. As the S pole leaves A, A becomes a North pole.	1
		(iii)	The two coils cut the magnetic field lines as the magnet rotates between them. This change of magnetic field lines induces an e.m.f.	1
			Total	**10**

13 Or				
	(a)		PE = mgh = 47 x 10 x (27 x 0.15 + 18 x 0.2 + 12 x 0.2) = 4.73 kJ	1 1
	(b)		Power = PE / time = 4.73×10^3 / 35 = 135 W	1 1
	(c)		**No work is done** by the weight of the man when he is walking along level 1. Because his weight and his direction of displacement are perpendicular to each other.	1 1
	(d)		The work done against gravity is independent of the path of the displacement. The potential energy needed depends only on the height of level 3 from the ground.	1
	(e)		Gain in GPE = loss in KE 47 x 10 x h = ½ x 47 x 4.4^2 h = 0.968 m Max. height = 10.05 + 0.968 = 11.0 m	1 1 1
			Total	**10**

~~~~~~End of Paper~~~~~~
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