Preliminary Examination 2016

CANDIDATE NAME		( )
CLASS		

PHYSICS **5059/01**

Paper 1 Multiple Choice **19 September, 2016**

Secondary 4 Express **1 hr**

Set by: **Mr Lawrence Tang and Ms Chin Gui Jin**

Vetted by: **Mrs Ngiam Kar Yin and Mr Tan Jun Hong**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, index number and class on the OTAS Answer Sheet in the spaces provided.

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 OTAS 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.

Where necessary, take acceleration due to gravity, $g = 10\ m/s^2$

1 Pendulum A makes 20 complete oscillations in 10 s. Pendulum B makes 15 complete oscillations in 15 s. Both pendulums were displaced by a small angle before their oscillations.

Which of the following statements must be true?

A Pendulum B has a shorter period than pendulum A.

B The string of pendulum B is longer than that of pendulum A.

C The mass of the bob of pendulum B is smaller than that of pendulum A.

D The angle of swing of release for pendulum B is smaller than that of pendulum A.

2 A pair of vernier calipers is used to measure the thickness of a coin.

Diagram 1 shows the reading with the jaws closed. Diagram 2 shows the reading when the jaws are closed around the coin.

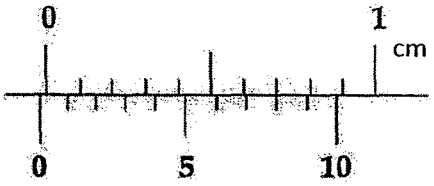


diagram 1

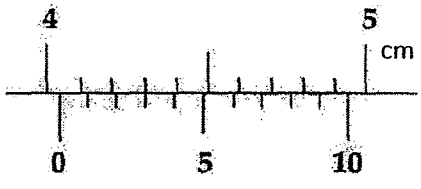


diagram 2

What is the zero error and the actual thickness of the coin?

	zero error / cm	corrected reading / cm
A	-0.02	4.05
B	-0.02	4.01
C	+0.08	3.95
D	+0.08	4.11

3 A student uses a micrometer screw gauge to measure the diameter of a ball bearing. Diagram 1 shows the zero error of the gauge and diagram 2 shows the measurement of the diameter before it is corrected.

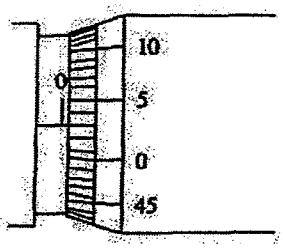


diagram 1

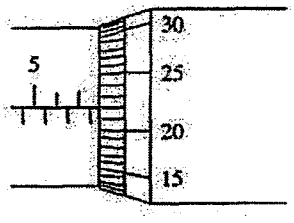
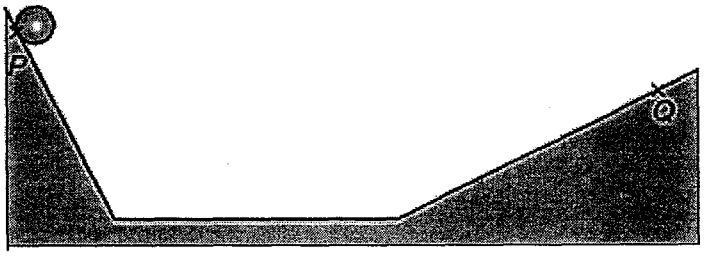


diagram 2

What is the true diameter of the ball bearing?

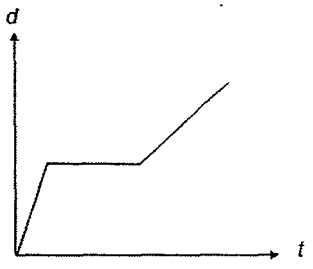
A 7.19 mm **B** 7.69 mm **C** 7.72 mm **D** 7.75 mm

4 A sphere runs along a smooth rail from **P** to **Q** as shown.

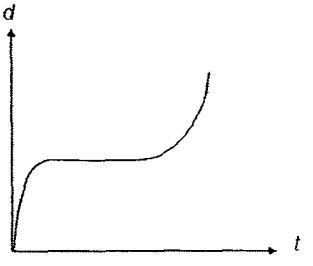


Which of the following graphs best represents the variation of the distance *d* travelled by the sphere with time *t*?

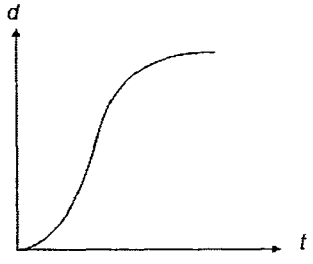
A



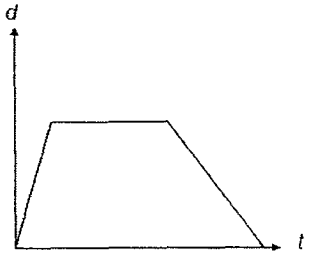
B



C



D



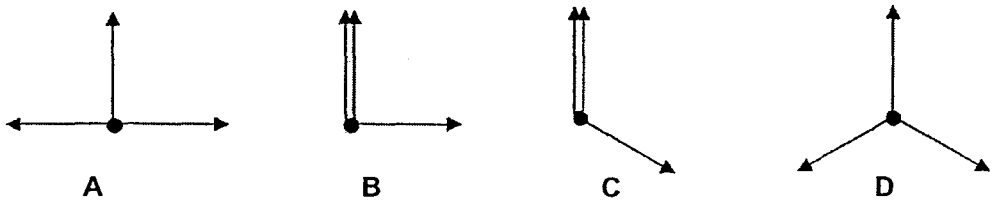
5 A bicycle accelerates from a speed of 2.0 m/s to 10 m/s in 8.0 s.

What is its average speed during the journey?

A 4.0 m/s
B 5.0 m/s
C 6.0 m/s
D 7.0 m/s

6 Three forces of the same magnitude act simultaneously on a small object.

Which one of the following combination of these three forces will give the greatest resultant force?

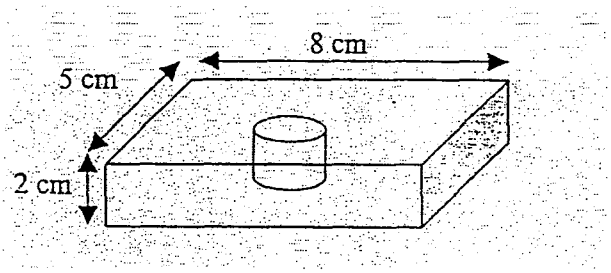


7 A 10.0 kg block of iron is brought from Earth to the surface of Planet Y.

Given that the gravitational field strength of Planet Y is 3.90 N/kg, how will the properties of the iron block change?

	inertia	density	weight
A	decreases	remains unchanged	increases
B	decreases	increases	increases
C	remains unchanged	decreases	decreases
D	remains unchanged	remains unchanged	decreases

8 A rectangular block of steel has a cylindrical hole bored through it as shown. The density of steel is 8.0 g/cm^3 and the mass of the block with the hole is 560 g.



What is the cross-sectional area of the hole?

A 3.5 cm^2 **B** 5.0 cm^2

C 2200 cm^2 **D** 4400 cm^2

9 An object is in static equilibrium. Which of the following statements about the object is true?

A It is moving in a straight line at uniform speed.

B It is rotating at a constant rate at a fixed point.

C It is rotating anti-clockwise and then clockwise in cycles.

D It is at rest and not rotating.

10 A parachutist has opened his parachute and is falling to Earth at constant speed. What is the principal energy conversion taking place as he falls?

A kinetic energy → potential energy

B kinetic energy → thermal energy

C potential energy → kinetic energy

D potential energy → thermal energy

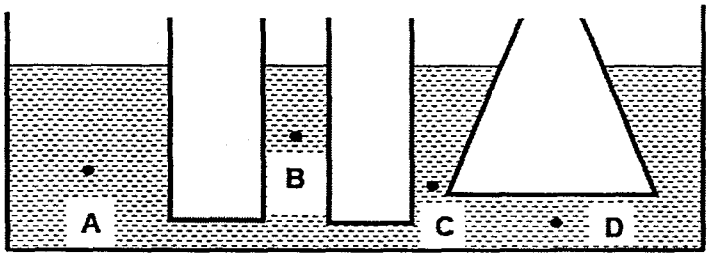
11 A motor drives a pump that raises 0.20 m^3 of water up by 5.0 m in 10 minutes. If the efficiency of the pump is 75 %, what is the power input by the motor? Take density of water to be 1000 kg m^{-3}.

A 12.5 W **B** 22.2 W

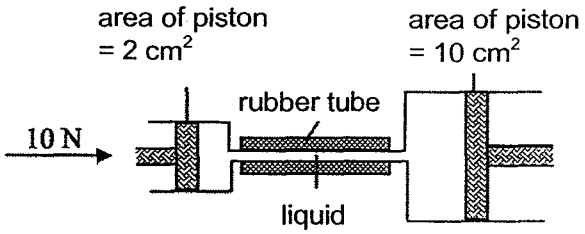
C 556 W **D** 1330 W

12 The diagram shows a container with openings of different shapes filled with a liquid.

Which of the points **A** to **D** has the greatest pressure?



13 The diagram shows two syringes connected by a rubber tube. The space between the two pistons is filled with a liquid. The areas of the small piston and the large piston are 2 cm^2 and 10 cm^2 respectively. A force of 10 N is applied to the small piston.



What is the ratio of the pressure acting on the small piston to the pressure acting on the large piston?

A 1 : 1 **B** 1 : 2

C 1 : 5 **D** 5 : 1

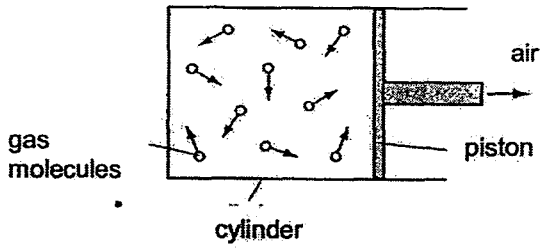
14 A resistance thermometer shows a resistance of 1.0 Ω and 4.0 Ω when placed in melting ice shavings and in a liquid at 60 °C respectively.

What is the thermometer reading when it is placed in a liquid at 80 °C?

A 1.5 Ω **B** 2.3 Ω

C 4.0 Ω **D** 5.0 Ω

15 Gas inside a cylinder is heated slowly to a higher temperature. The pressure inside the cylinder remains constant as the piston moves outwards.



How does the speed of the gas molecules and their rate of collision with the piston compare with their initial values at the lower temperature?

	speed of molecules	rate of collision
A	greater	greater
B	greater	reduced
C	greater	same
D	same	greater

16 A heated smooth metallic body is allowed to cool in air. Which of the following statements about its heat loss is incorrect?

A Convection currents in the air aid the process of heat loss.

B Conduction is the main mode of heat loss as the body is a good conductor of heat.

C The rate of heat loss by thermal radiation is increased due to its smooth metallic surface.

D The rate of heat loss decreases as the temperature of the body nears room temperature.

17 A person places his two feet on two separate surfaces, a woollen carpet and a marble tile. Both surfaces are initially at the same temperature.

Which statement best describes how the person will feel?

A Both surfaces feel the same since both are at the same temperature initially.

B The foot on the carpet feels warmer because the carpet transfers heat to the foot.

C The foot on the tile feels cooler because the tile transfers coldness to the foot.

D The foot on the carpet feels warmer because the rate of heat transfer is slower through the wool.

18 A piece of ordinary kitchen aluminium foil is used to wrap around food to be cooked in a barbecue fire. The foil has a shiny side and a dull side. Which side should be on the outside and why?

A The dull side should be on the outside because it is a better emitter of thermal radiation.

B The dull side should be on the outside because it absorbs thermal radiation better.

C The shiny side should be on the outside because it is a better thermal conductor.

D The shiny side should be on the outside because it is a better absorber of thermal radiation.

19 Object A is 2 kg. It has a temperature of 40 ℃ and has an internal energy of 500 kJ. Object B is 2 kg. It has temperature of 50 ℃ and has an internal energy of 400 kJ. Which of the following statement is correct?

A Heat flows from object A to object B.

B Heat flows from object B to object A.

C No heat flow between object A and object B.

D There is not enough information to determine the direction of heat flow.

20 An ice tray contains 0.30 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 – 4.0°C. 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 – 4.0 °C?

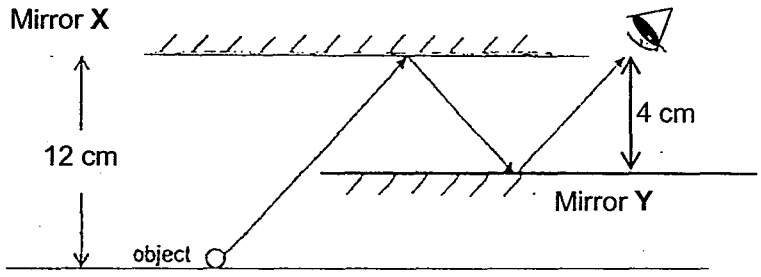
A 18 kJ

B 25 kJ

C 125 kJ

D 128 kJ

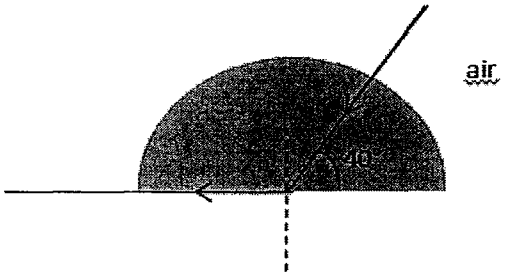
21 The figure below shows how a ray of light from an object enters the eye after being reflected twice.



What is the vertical distance (distance perpendicular to plane mirror) between the final virtual image of the object in mirror Y and the eye?

A	12 cm	**B**	16 cm
C	20 cm	**D**	32 cm

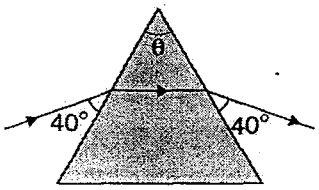
22 The following diagram shows a ray of light entering a transparent block from air.



The speed of light in air is 3.0×10^8 m/s. Calculate the speed of light in the transparent block.

A	1.93×10^8 m/s	**B**	2.30×10^8 m/s
C	1.14×10^8 m/s	**D**	3.92×10^8 m/s

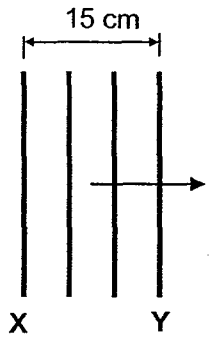
23 A light ray passes through a triangular glass prism of refractive index 1.5.



What is angle θ?

A	51°	**B**	53°	**C**	61°	**D**	65°

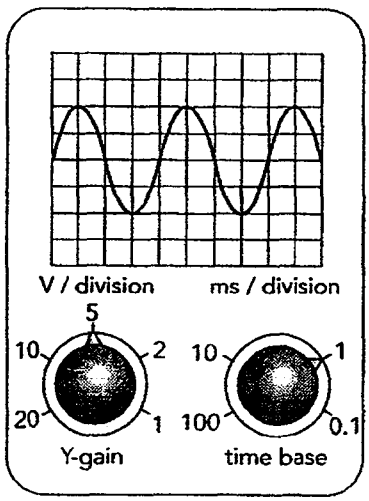
24 The figure below shows a water wave travelling in a ripple tank. The wavefront at **X** travels to **Y** in 5.0 s.



What is the frequency of the water wave?

A 0.60 Hz **B** 3.0 Hz **C** 15 Hz **D** 75 Hz

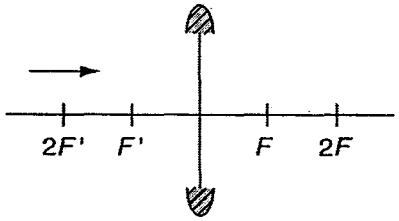
25 A wave is displayed on an oscilloscope with the settings as shown.



Which of the following shows the correct values for the peak voltage and frequency of the wave?

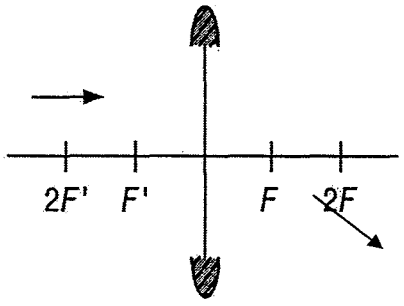
	Peak voltage / V	Frequency / Hz
A	10	100
B	10	250
C	20	250
D	20	1000

26 In the following diagram, F and F' are the focal points of a thin converging lens. An object represented by an arrow is placed in front of the lens.

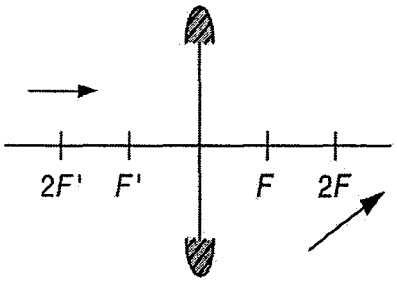


Which one of the following diagrams show the correct location and orientation of the image formed?

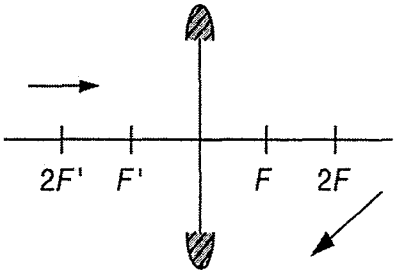
A



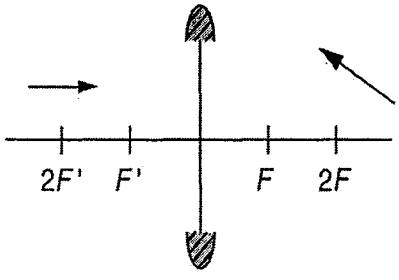
B



C

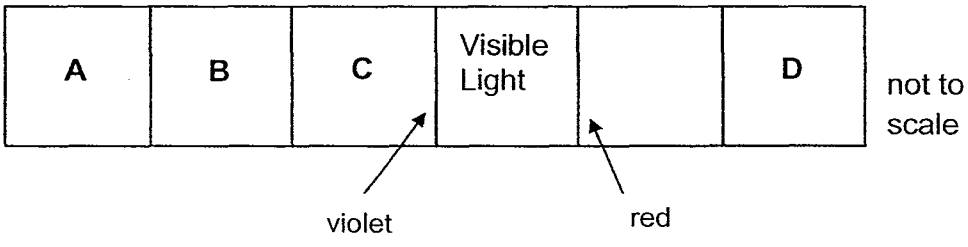


D

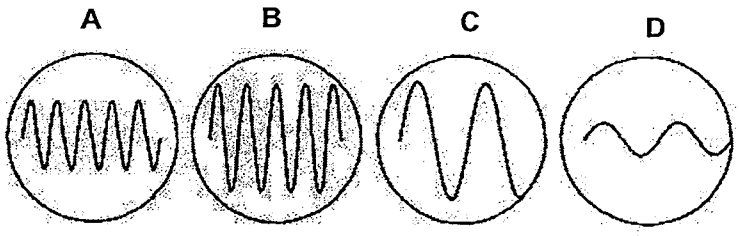


27 The following diagram shows an electromagnetic spectrum. The violet and red ends of the visible spectrum are marked. Which part of the spectrum can be used to detect counterfeit notes?

The Electromagnetic Spectrum

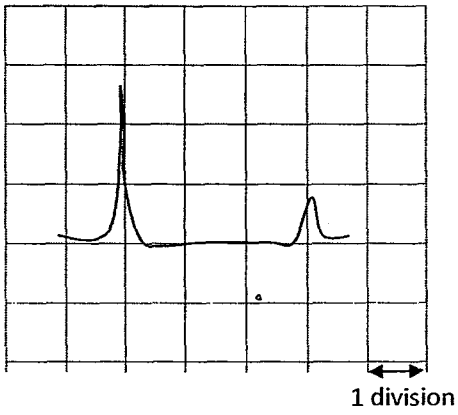


28 The diagram shows the waveforms produced by different sounds. Which diagram corresponds to the loudest sound with the lowest pitch?



29 A man shouts on a mountain and detects the echo from the nearest neighbouring mountain after using a microphone attached to a cathode ray oscilloscope (CRO). The following CRO screen shows the original sound and echo trace. Sound travels at 330 m/s in air.

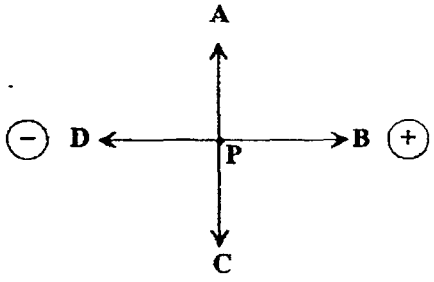
The time-based setting of the CRO is set to 10 s/div.



What is the distance between the man and the mountain?

A 30 m B 4950 m C 9900 m D 19800 m

30 The diagram below shows two electric charges. Which of the following shows the direction of the electric field at point P?

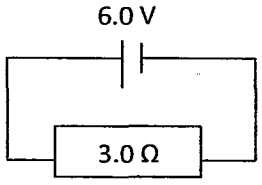


31 Wire X is 1.0 m long and has a diameter of 0.50 mm. It has a resistance of 5.0 Ω. Wire Y is made up of a material that has twice the resistivity of wire X's material. Wire Y is 2.0 m long but it has a diameter of 0.25 mm.

What is the resistance of Wire Y?

A 0.63 Ω **B** 5.0 Ω **C** 40 Ω **D** 80 Ω

32 A 3.0 Ω resistor is connected to a 6.0 V supply. How much charge flows through the resistor in 20 s?

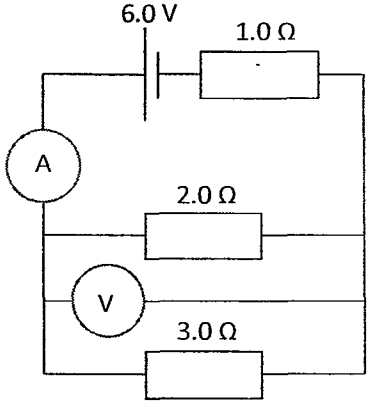


A 10 C **B** 40 C **C** 60 C **D** 120 C

33 Electromotive force is defined as the

A rate of flow of charge at a point
B the magnitude of force required to move a unit charge across the whole circuit
C the amount of energy required to move a unit mass of charge across the whole circuit
D the amount of energy converted per unit charge from non-electrical to electrical energy

34 The following diagram shows three fixed resistors connected to a 6.0 V supply.



Which of the following show the voltmeter reading V and ammeter reading I?

	V/V	I/A
A	6.0	11
B	6.0	5.0
C	3.3	2.7
D	3.3	0.45

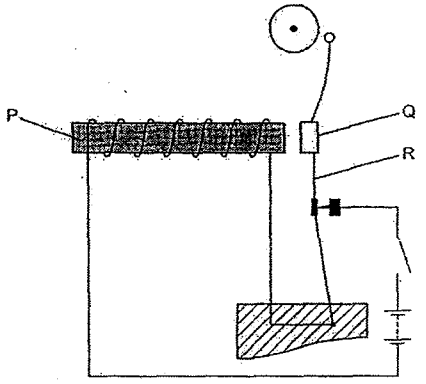
35 An electric iron is connected to the mains supply of 110 V by a cable. Which of the following shows a possible combination of the potential and current of the respective wires under normal operating conditions?

	live wire		neutral wire		earth wire	
	current/A	Potential	current/A	potential	current/A	potential
A	1.0	High	0.0	Low	0.0	Low
B	1.0	High	1.0	Low	0.0	Low
C	1.0	Low	1.0	High	1.0	High
D	0.0	Low	1.0	High	1.0	Low

36 An air-conditioner has a rating of 240 V, 1500 W, The cost of operating the air conditioner came up to $45 for a particular month. What is the duration of time that the air-conditioner was switched on for the month if one unit of electricity costs $0.20?

A 9 min **B** 150 hrs **C** 744 hrs **D** 938 hrs

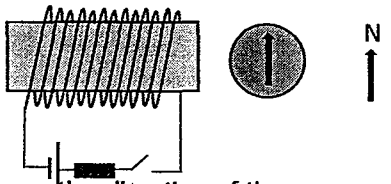
37 The following diagram shows an electric bell.



Which materials would be suited for the parts labelled P, Q and R?

	P	Q	R
A	soft iron	brass	soft iron
B	soft iron	soft iron	spring steel
C	soft iron	brass	brass
D	spring steel	soft iron	spring steel

38 The following diagram shows a solenoid connected to a DC supply and the direction of a compass near it before the switch is closed.



Which of the following shows the direction of the compass after the switch is closed? Assume that a small current flows in the solenoid.

A

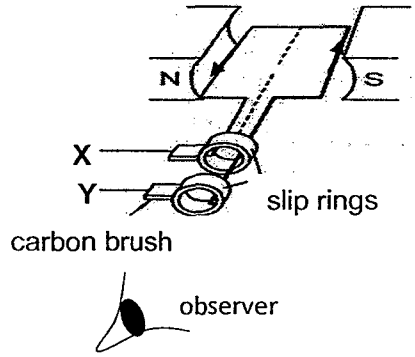
B

C

D

Refer to the following diagram for questions 39 and 40

The following diagram shows a representation of an AC generator connected to leads **X** and **Y**. At the instant shown, the current direction in the coil is as shown.



39 Which of the following shows the direction of rotation of the coil as seen by an observer and the rule used to obtain this direction of rotation?

	direction of rotation	rule used
A	clockwise	Fleming's Left Hand Rule
B	clockwise	Fleming's Right Hand Rule
C	anti-clockwise	Fleming's Left Hand Rule
D	anti- clockwise	Fleming's Right Hand Rule

40 Which of the following states the function of a slip ring in the AC generator?

A To prevent entanglement of the wire
B To ensure electrical contact between the coil and the external circuit
C To ensure the coil rotates continuously by changing the direction of the current in the coil every half a revolution
D To increase the magnetic field strength of the rotating coil

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

Preliminary Examination 2016

CANDIDATE NAME		( )
CLASS		

PHYSICS **5059/2**

Paper 2 Theory **30 August, 2016**

Secondary 4 Express **1 hr 45 minutes**

Set by: **Mr Lawrence Tang and Ms Chin Gui Jin**

Vetted by: **Mrs Ngiam Kar Yin and Mr Tan Jun Hong**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page and on all separate answer paper used.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

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

Section A

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Section B

Answer all **three** questions, the last question is in the form either/or.

Write your answers on the separate answer papers provided.

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

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.

All essential working must be shown clearly.

Where necessary, take acceleration due to gravity, g = 10 m/s^2.

For Examiner's Use	
Section A	
B 9	
B 10	
B 11	
Total	

Section A

Answer **all** the questions.

Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 shows a velocity-time graph for a ball bouncing vertically on a hard surface on an unknown planet. The ball was dropped at $t = 0$ s.

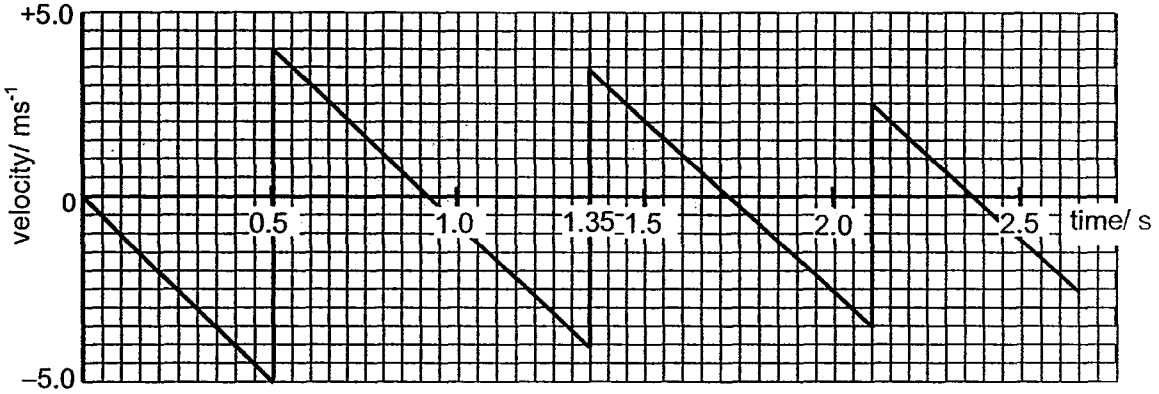


Fig. 1.1

(a) State the time at which the ball was just in contact with the ground for the first time.

_____ [1]

(b) Calculate the height from which the ball was first dropped.

height = ... [2]

(c) State the acceleration of the ball at 0 s.

acceleration = ... [1]

Total marks:	

(d) Sketch a displacement-time graph on Fig. 1.2 for the first 1.35 s of the motion.

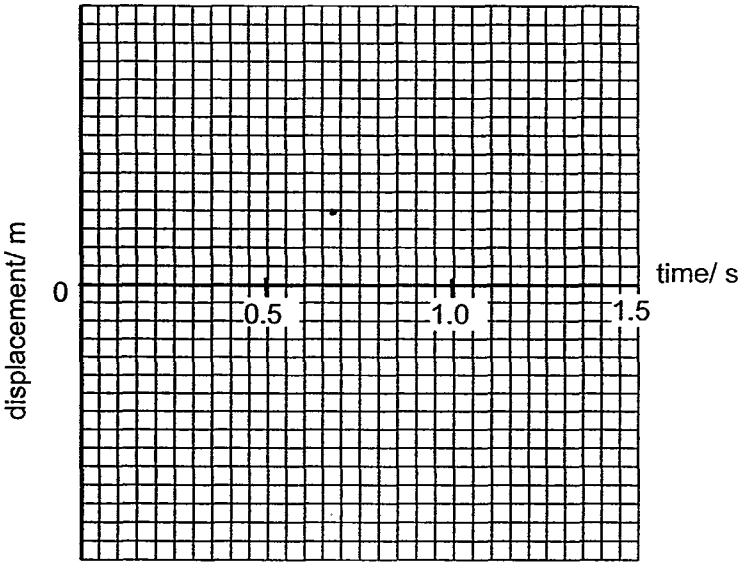


Fig. 1.2

[2]

Total marks:	

2 Fig. 2.1 shows three cubes, **A**, **B** and **C**, of mass 35 kg, 5 kg and 20 kg respectively resting on a smooth horizontal surface initially. The cubes are in contact with each other as shown in Fig. 2.1. A horizontal force of 300 N is then exerted on cube **A**.

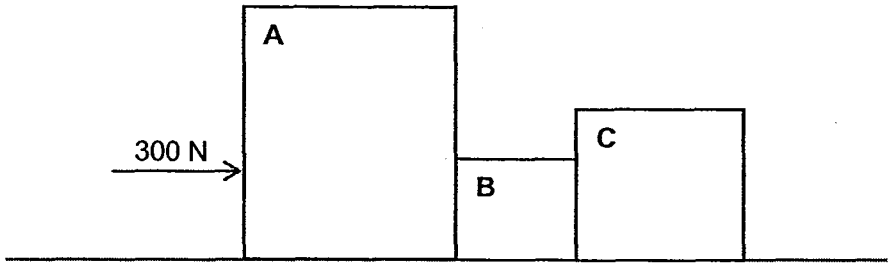


Fig. 2.1

(a) Calculate the acceleration of cube **B** and hence the resultant force acting on it.

acceleration = ...

force = ... [2]

(b) Calculate the force exerted on cube **A** by cube **B**.

force = ... [2]

(c) Draw all the pairs of action-reaction forces acting on cube **C** and label the forces clearly in Fig. 2.1. [2]

Total marks:	

3 Fig. 3.1 shows an uniform gondola suspended in mid-air that is used to clean the window of buildings. A cleaner of mass 85 kg stands 2.0 m away from rope X inside the gondola. The mass of the gondola is 630 kg and the distance between the ropes is 6.0 m.

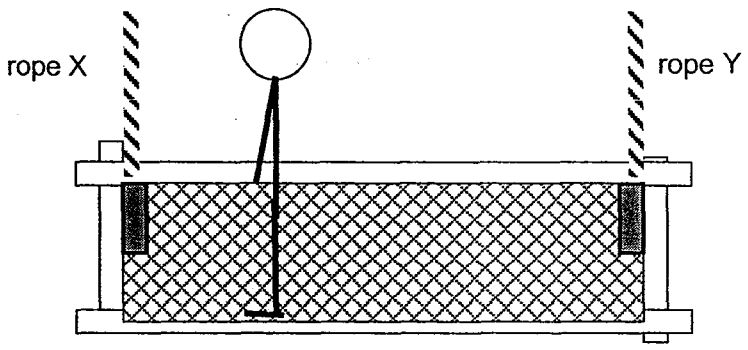


Fig. 3.1

(a) Draw and label all the vertical forces in Fig. 3.1 which are acting on the gondola.

[2]

(b) Calculate the force exerted by rope Y on the gondola.

force = _____ [2]

(c) State and explain qualitatively how the force exerted by rope **Y** on the gondola will change as the cleaner moves towards rope **Y**.

_____

_____

_____

_____ [2]

Total marks:	

4 Fig. 4.1 shows part of an experimental arrangement which is used to obtain a value for l_v, the specific latent heat of vaporisation of water.

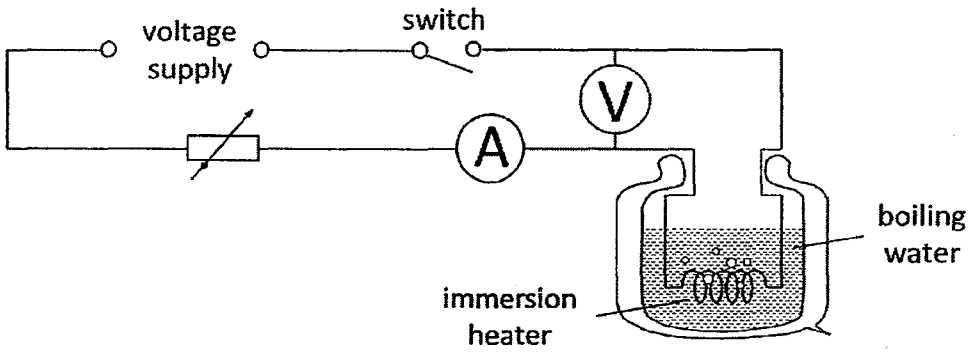


Fig. 4.1

(a) In a particular experiment using the apparatus in Fig. 4.1, a student uses an immersion heater which supplies 300 J of energy per second. He closes the switch for 2 minutes, and 0.015 kg of boiling water is vaporised.

(i) Calculate a value for l_v.

l_v = _____ [1]

(ii) State and explain whether you would expect the answer in **(a)(i)** to be larger or smaller than the true value of l_v.

_____

_____

_____

_____ [2]

Total marks:	

(b) Another student doing the same experiment decides to insert a thermometer into the boiling water at the start of the experiment, as shown in Fig. 4.2, to ensure that the temperature remains at 100 °C throughout the experiment.

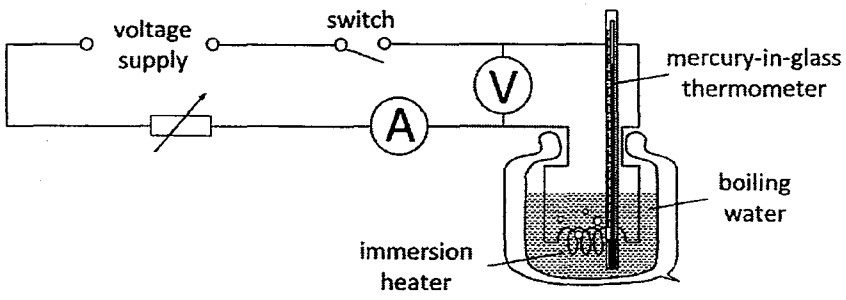


Fig. 4.2

(i) Suggest a reason why this student's concern may be invalid.

_____

_____ [1]

(ii) The student inserts the thermometer at 30 °C into the boiling water, right at the start of the experiment. Given that he uses the same immersion heater and keeps it on for the same 2 minutes, use your answer in **(a)(i)** to calculate the mass of boiling water that will be boiled off.

(You may take the average heat capacity of the mercury-in-glass thermometer to be 28.5 J K^{-1}, and assume that the thermometer reaches 100 °C before the end of the experiment.)

mass = _____ [2]

(ii) Hence explain why thermometers cannot be made of thermometric substances with high heat capacities.

_____

_____ [1]

Total marks:	

5 Fig 5.1 (an actual 1:1 scaled diagram) shows an object and its corresponding virtual image when the object is placed in front of a thin converging lens.

(a) Complete the diagram with two sets of rays to show how the image is formed. Mark the optical centre of the lens clearly with an X.

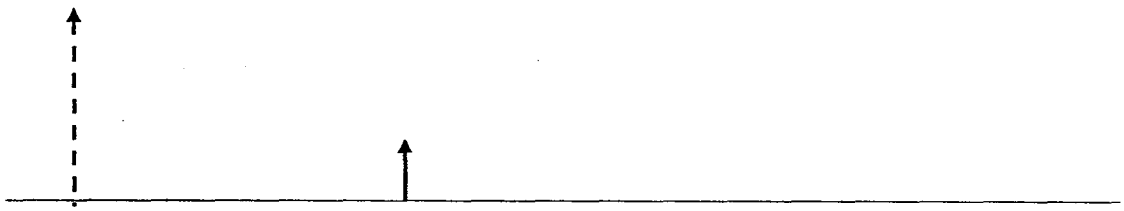


Fig 5.1

[2]

(b) State the magnification of this lens and its focal length.

magnification factor = ... [1]

focal length = ... [1]

6 Fig 6.1 shows a highly negatively-charged metallic ball on an insulated stand.

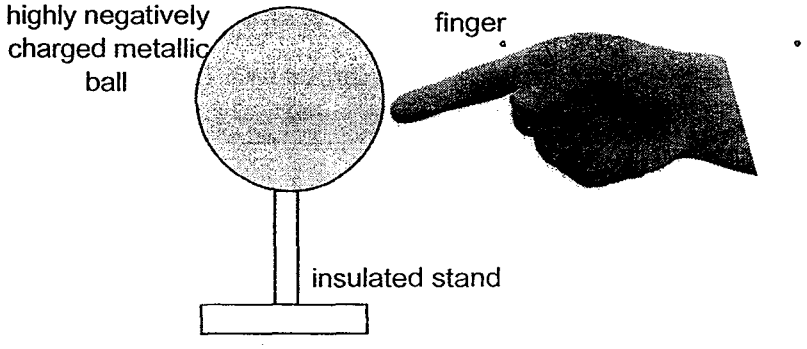


Fig 6.1

Describe and explain what happens to the charges in a person's finger when it approaches the ball without touching it. You may use the diagram to illustrate your answer. Include the idea of an electric field in your answer.

.....

.....

.....

..... [2]

Total marks:	

7 Seismic waves are generated by earthquakes. These waves start from the epicentre. Primary (P) waves travel in a direction parallel to the direction of the vibration of its particles. Secondary (S) waves travel in a direction perpendicular to the direction of vibration of its particles.

(a) State the type of wave that the P wave is.

..... [1]

(b) Fig 7.1 shows the time taken by the waves to travel different distances from the epi centre.

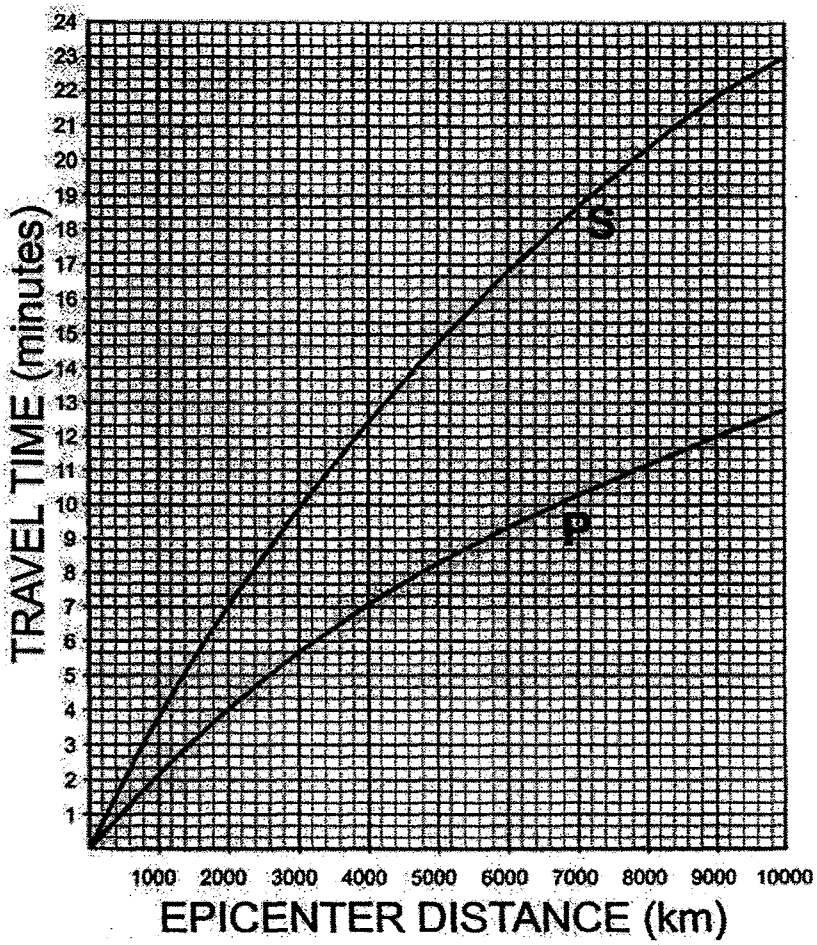


Fig 7.1

Calculate the average speed of the S wave that reached 10 000 km from the epi centre in m/s.

average speed = ... [2]

Total marks:	

[Turn over

(c) A typical S wave has a frequency ranging from 0.50 to 1.0 Hz. Calculate the maximum possible wavelength of the S wave that reached 10 000 km from the epi centre.

wavelength = ... [2]

8 Fig 8.1 shows part of a circuit that is designed to switch on a LED when it is dark.

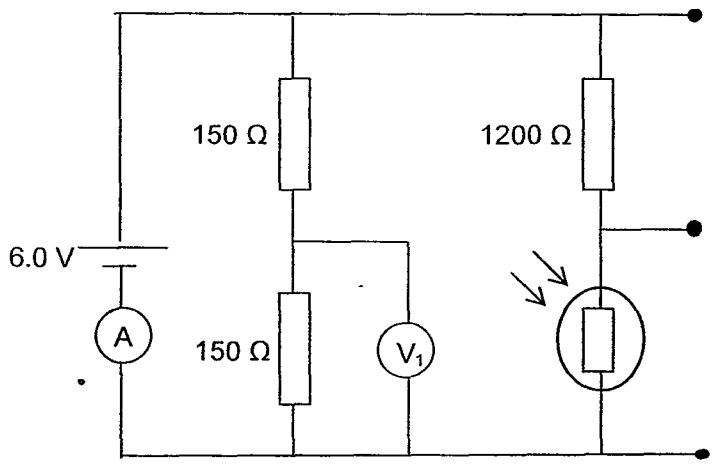


Fig 8.1

(a) Calculate voltmeter reading V_1.

V_1 = ... [1]

(b) State and explain if the LED should be placed across the 1200 Ω or LDR so that it can light up when the light intensity of the surroundings decreases.

.....

.....

.....

..... [2]

Total marks:	

(c) Fig 8.2 shows how the current through a filament lamp changes as the potential difference (p.d) across it varies.

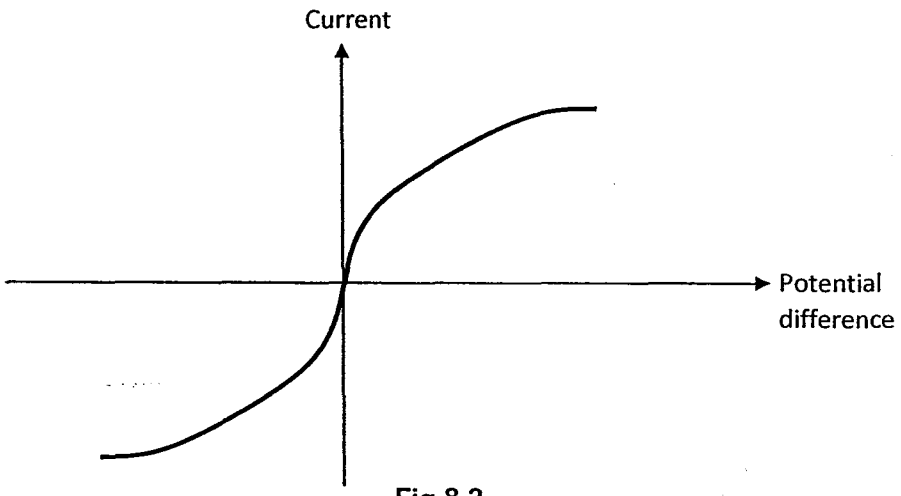


Fig 8.2

(i) Sketch on the same axis above how the current of an LED will change as the p.d across it changes. [2]

(ii) Hence or otherwise, explain the advantage of the LED over a filament lamp.

.....

..... [1]

9 Fig 9.1 shows part of a ring circuit in a phone shop. The ring circuit draws power from a 230 V supply.

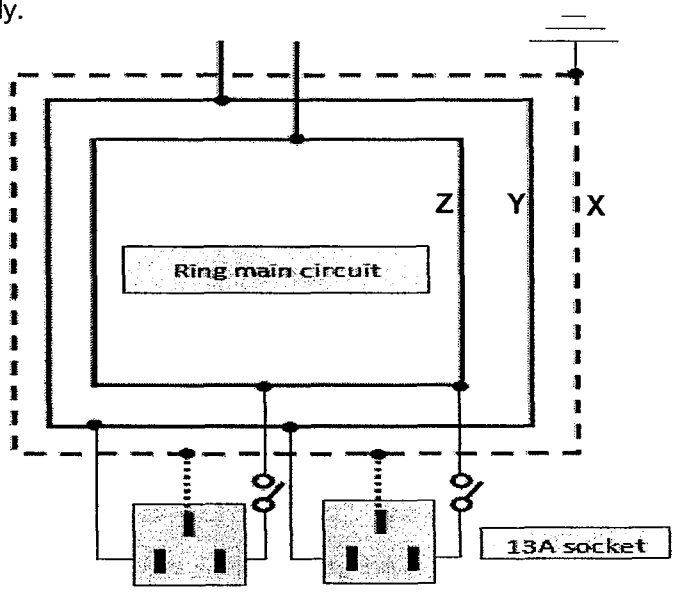


Fig 9.1

Total marks:	

(a) Wire X is the earth wire. Label wires Y and Z.

Y: ..... Z : ..... [1]

(b) Fig 9.2 shows a 6 point multi plug adaptor that is connected to one of the 3 pin sockets in Fig 9.1.

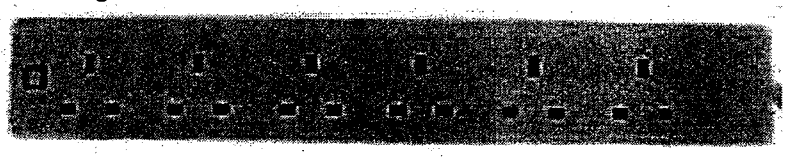


Fig 9.2

The shop owner plugs 6 phone chargers into the multi plug adaptor. Each of the phone charger has an input rating of 230 V, 50 W.

The wires in the 3 pin plug are thin and can only withstand a maximum of 1.0 A. State and explain, with clear working shown, if the 13 A fuse of the 3 pin plug of the adaptor inserted into the socket is able to protect the circuit.

.....

..... [2]

(c) Fig 9.3 shows part of a 3 pin plug with a fuse missing.

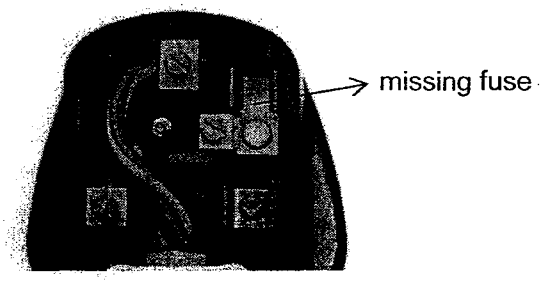


Fig 9.3

The shop owner claims that the missing fuse will not make any difference to the operation of the appliance. Explain if you agree with his statement.

.....

.....

..... [1]

Total marks:	

10 Fig 10.1 shows a simple hand-wound AC generator. The generator consists of a rotating single coil of wire. The emf generated lights up a lamp.

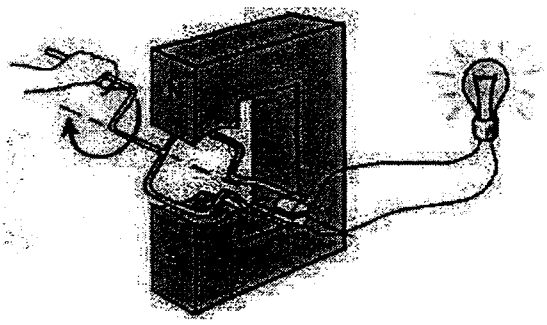


Fig 10.1

(a) Explain using Lenz's law, why the hand that is winding the generator coil experiences a resistive force when the lamp is lit.

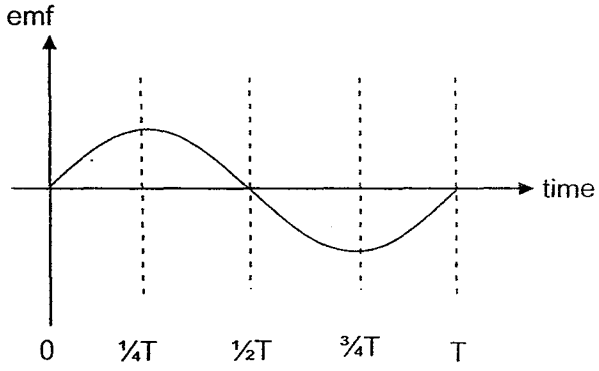
.....

.....

.....

..... [1]

(b) Fig 10.2 shows how the emf across the coil varies with time. Sketch on the same axis how the emf will change if the speed of rotation of the coil is doubled. A complete cycle of rotation of the coil takes a period T.



[2]

Fig 10.2

(c) Explain using Faraday's law, why increasing the number of turns of coil of wire increases the magnitude of the emf generated across the coil.

.....

..... [1]

Total marks:	

Name: _____ ( )

Class: _____

Section B

Answer all **the** questions from this section.
Answer only one of the two alternative questions in **Question 13.**

11 Fig 11.1 shows a small water turbine that generates electricity from a reservoir of water located a height h above the turbine.

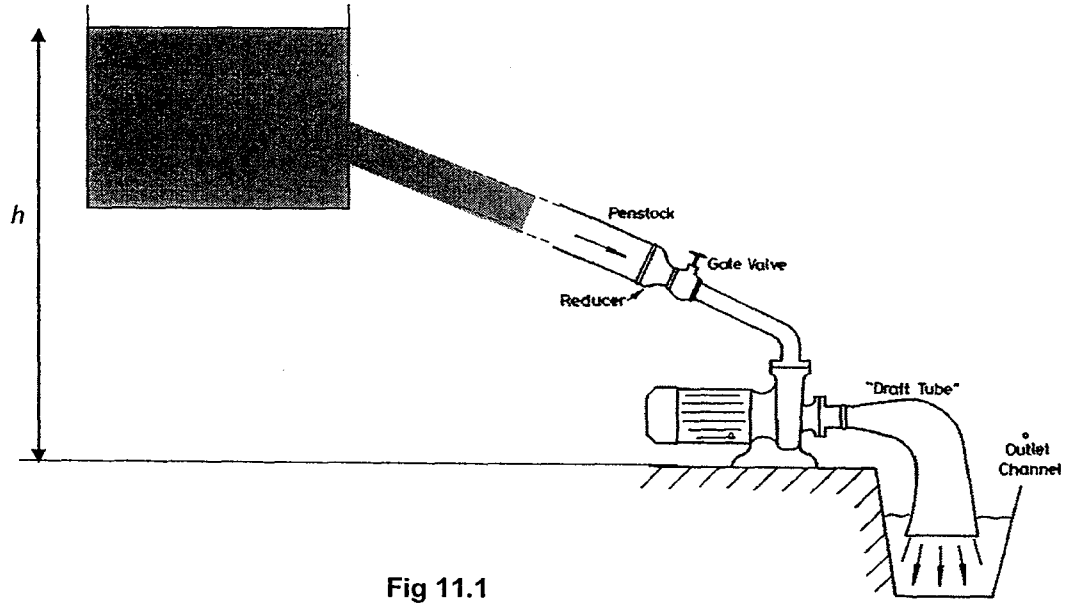


Fig 11.1

(a) Fig 11.2 shows the specifications of the water turbine.

power output (kW)	height h /m	flow rate (m^3/s)
5.0	20	0.035

Fig 11.2

Calculate the efficiency of the water turbine. Assume no frictional losses when the water flows from the reservoir to the water turbine. Take the density of water to be 1000 kg/m^3.

efficiency = ... [2]

Total marks:	

(b) Fig 11.3 shows the cross-section of the water turbine. The water flows into the turbine and turns the rotor blades.

Fig 11.4 shows the interior of the turbine. The rotor blade is wrapped by a coil of wire connected at a DC input. . An e.m.f. is generated across the coils of wire wrapped around a stator (stator coils) when the water flows.

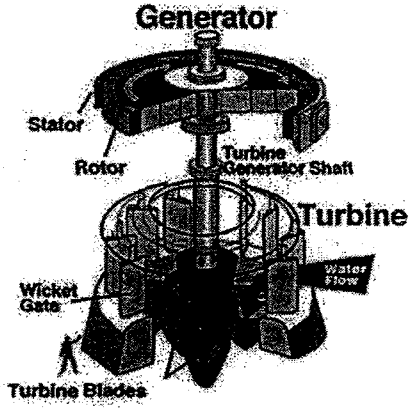


Fig 11.3

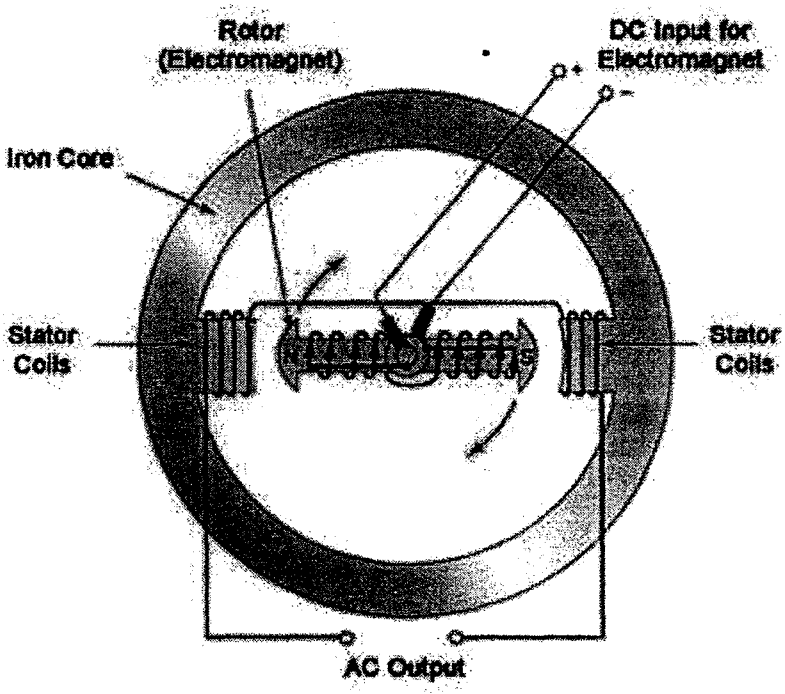


Fig 11.4

Explain how the flow of the water generates an e.m.f. across the stator coils.

.....

.....

.....

.....

.....

..... [3]

Total marks:	

(c) Fig 11.5 shows the representation of how power is generated and transmitted from a hydroelectric plant to homes. Assume both the transformers are 100% efficient.

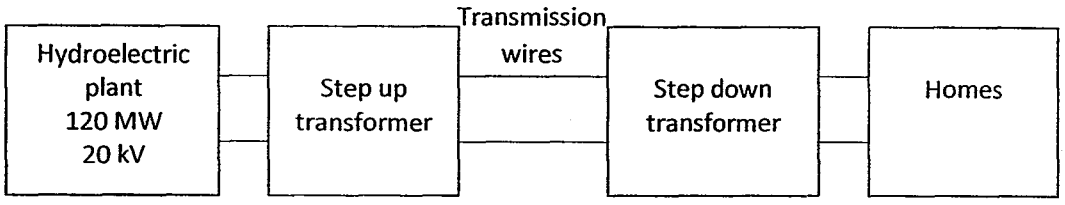


Fig 11.5

(i) Calculate the current generated by the hydroelectric plant.

current = ... [1]

(ii) The step-up transformer has a turns ratio of 40. Calculate the current output of the step-up transformer.

current = ... [1]

(iii) Assuming that each transmission wire has a resistance of 30 Ω, calculate the input voltage to the step-down transformer.

input voltage = ... [2]

(d) State an advantage and a disadvantage generating power using hydroelectric means instead of burning of fossil fuels.

advantage: .....

.....

disadvantage: .....

..... [1]

Total marks:	

12 Fig 12.1 shows the DC motor of a fan. It consists of a single coil rotating in a clockwise manner about a pivot.

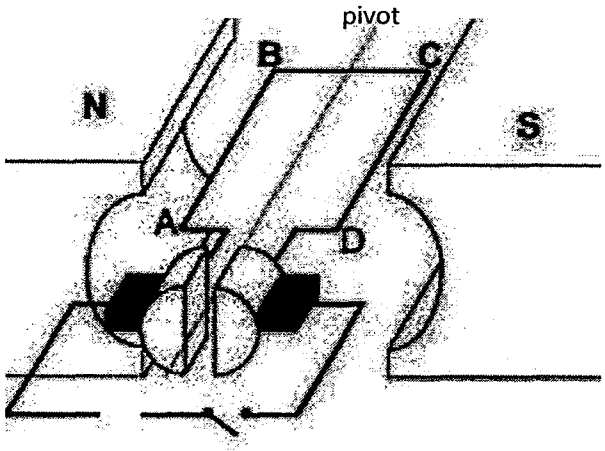


Fig 12.1

(a) **(i)** Draw the current direction in wire **AB** and **CD** so that the coil rotates in a clockwise manner. [1]

(ii) Complete Fig 12.1 to include a 12 V DC supply as well as a potentiometer that will allow the maximum potential difference across the motor to be 12 V [2]

(b) Fig 12.2 shows the front view of the wire **AB** between the two permanent magnets.

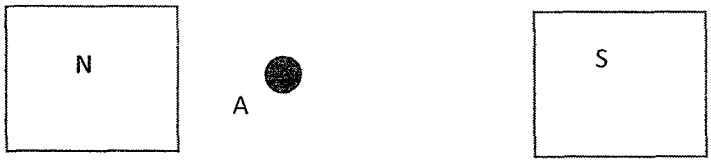


Fig 12.2

Explain, by completing the diagram above, how the magnetic fields interact to produce a force on wire AB.

.....

.....

.....

..... [3]

Total marks:	

(c) The magnetic field strength of the magnets is doubled.

(i) Explain why this would result in an increase in the rotation speed of the fan.

.....

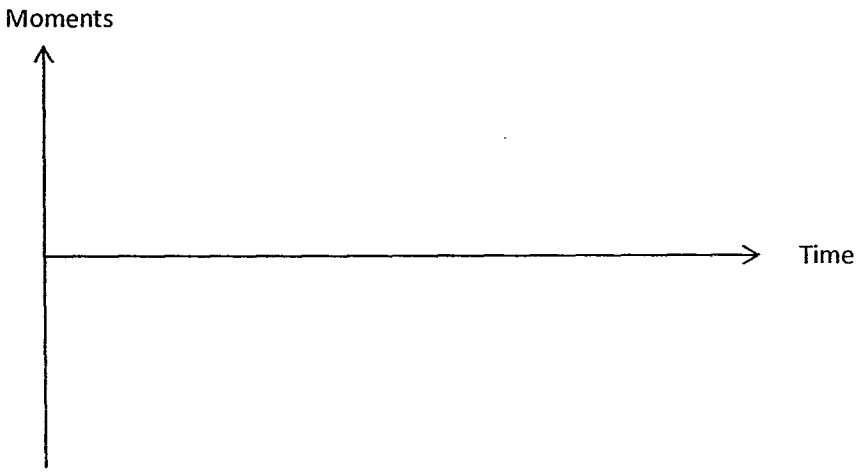
.....

.....

..... [2]

(ii) Sketch in the axis below how the moments about the pivot would vary with time for both the original weaker magnets as well as the stronger magnets. Label the curve due to the weaker magnets as 'W' and the curve due to the stronger magnets as 'S'. The time taken for a complete revolution for the coil with the weaker magnets is T.

Draw the two curves from time 0 to T. Assume both coils are horizontal initially.



[2]

Total marks:	

13 **EITHER**

Fig. 13.1 shows the Griffon. It opened in August 2006 and is the world's tallest, floorless dive roller coaster. The ride features two nearly-vertical dives, one of which occurs at the start of the ride, subjecting the riders to large changes in speed and thrill of the ride.

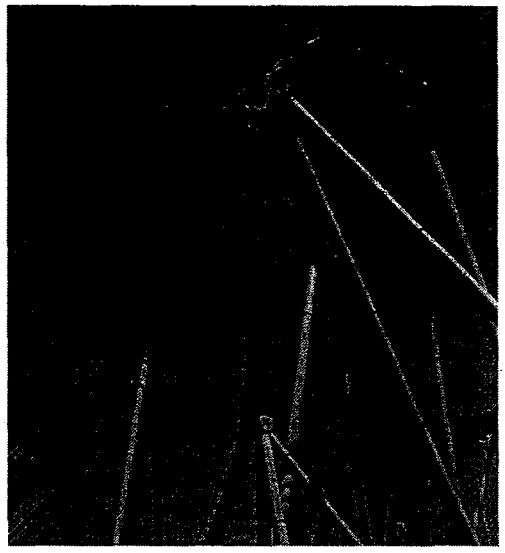


Fig. 13.1

Fig. 13.2 shows the simplified diagram of the first hill of the ride.

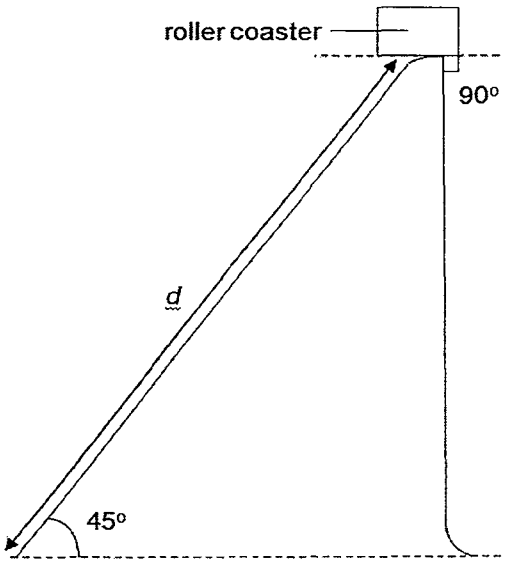


Fig. 13.2

At the start of the ride, the train of mass 3000 kg climbed a 45° lift hill at a constant

Total marks:	

speed of 3.04 m/s. The train then pauses on a holding brake for five seconds before dropping 62.5m at 90° hitting a maximum speed of 31.7 m/s at the bottom of the hill.

(a) State the Principle of Conservation of Energy.

_____

_____

_____

_____ [2]

(b) In dropping from the top to the bottom of the first hill, determine the average friction between the tracks and the train.

mass = _____ [3]

(c) Calculate the distance d and hence the time taken for the train to move up the first hill.

time taken = _____ [2]

(d) The work done in pulling the train is converted to different forms of energy. Name these forms of energy.

_____

_____ [1]

Total marks:	

(e) Calculate the minimum power of the electric motor pulling the train up the first hill. Assume that friction is constant for the entire ride.

power = _____ [2]

Total marks:	

OR The Hare's apparatus is a device used for comparing the densities of two different liquids. As shown in Fig. 13.3, the equipment consists of a three-limbed E-shaped glass tube. The two longer limbs at the side are dipped into the beakers containing the liquids, **X** and **Y**.

One of the liquids is chloroform and the other is methyl isobutyl ketone. The central limb has a tap which allows air to be pumped out. When the tap is closed after air is pumped out, the densities of the liquids can be compared by measuring and comparing the column heights in the two long limbs.

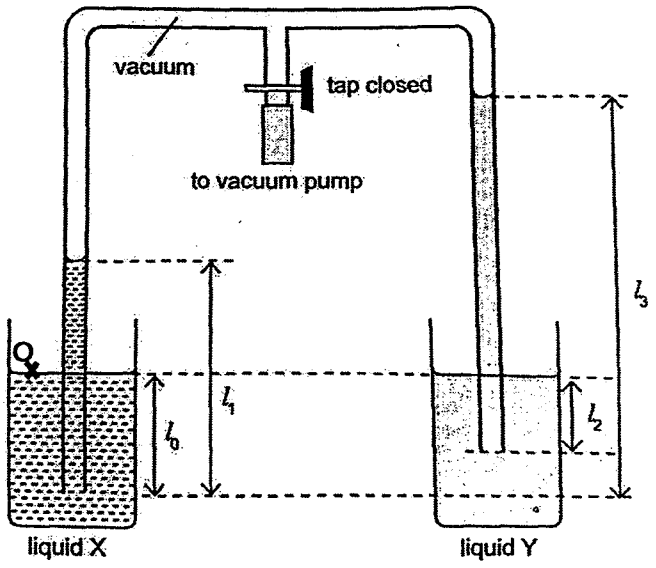


Fig. 13.3

The table below shows the densities of the two liquids.

liquid	density / kg m^{-3}
chloroform	1490
methyl isobutyl ketone	801

(a) Explain, in terms of the air molecules inside and outside the Hare's apparatus, why the liquid levels in the two limbs increase after the air is pumped out.

.....

.....

.....

.....

..... [3]

(b) On Fig. 13.4, sketch a graph to show the relationship between the pressure and

Total marks:	

volume of gas in the Hare's apparatus.

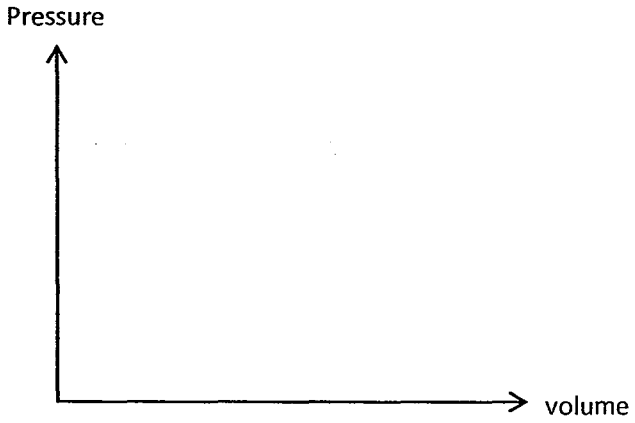


Fig. 13.4

[1]

(c) State which liquid (**X** or **Y**) is chloroform. Explain your answer.

_____

_____

_____

_____ [2]

(d) On Fig. 13.3, mark out a point **P** in liquid Y which has the same pressure as point **O**.

[1]

(e) Given that l_0 = 5.0 cm, l_1 = 26.5 cm and l_2 = 3.0 cm, calculate l_3.

l_3 = _____ [2]

Total marks:	

(f) This experiment is repeated at a mountain top where the atmospheric pressure is lower.

State and explain how your answer in **(e)** will be affected.

_____

_____

_____

_____ [1]

- End of Paper 2-

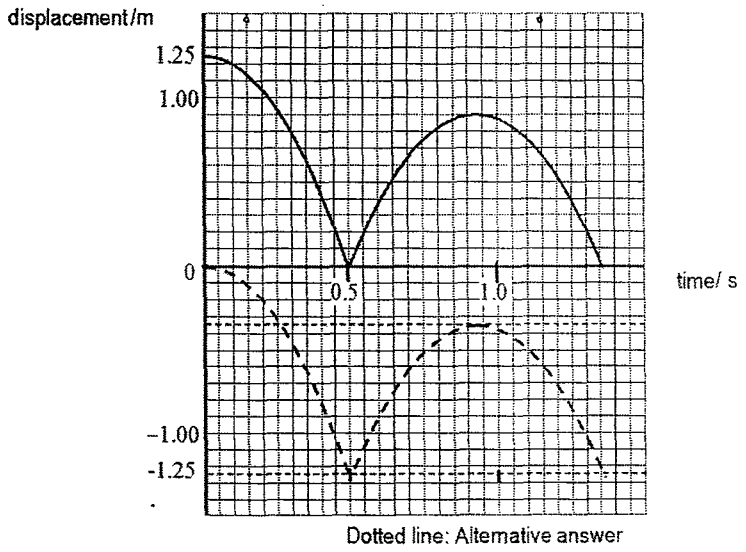
Total marks:	

Preliminary Examinations 2016

5059 Physics Answer Scheme

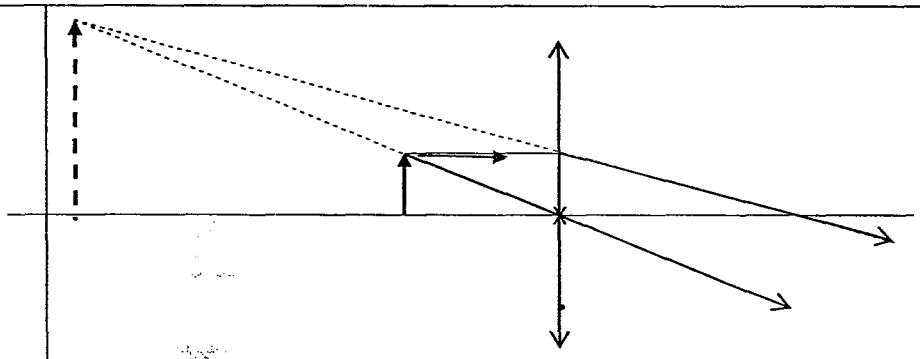
1	**B**	11	**B**	21	**C**	31	**D**
2	**A**	12	**D**	22	**B**	32	**B**
3	**B**	13	**A**	23	**C**	33	**C**
4	**C**	14	**D**	24	**A**	34	**C**
5	**C**	15	**B**	25	**B**	35	**B**
6	**B**	16	**C**	26	**A**	36	**B**
7	**D**	17	**D**	27	**C**	37	**B**
8	**B**	18	**B**	28	**C**	38	**C**
9	**D**	19	**B**	29	**B**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

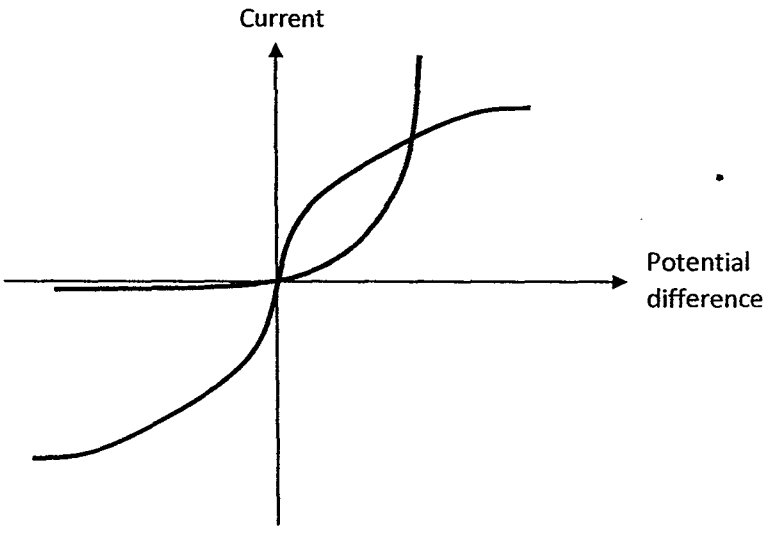
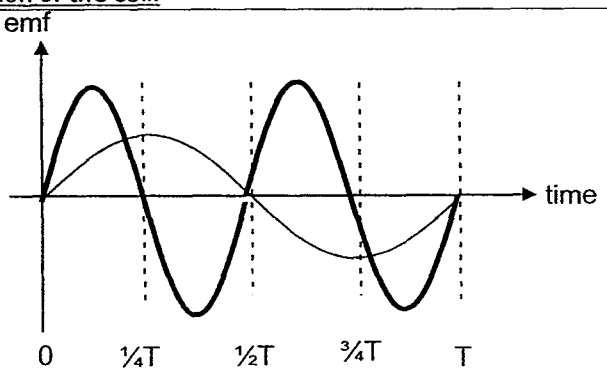
Paper 2

Qn		Mark
1a	0.50 s	1
1b	½ × 0.5 × 5 = 1.25 m	1 1
1c	10 or -10 m/s^2	1
1d	 Dotted line: Alternative answer	1 – shape from 0-0.5 s 2 m – 1.25 m and lower rebound height
2a	F_{net} on A, B and C = ma 300 = (35 + 5 + 20) a a = 5.0 m/s^2 F_{net} = ma F_{net} on B = 5 × 5 F_{net} on B = 25 N	 1 1
2b	F_{net} on A = 35 × 5 = 175 N	1

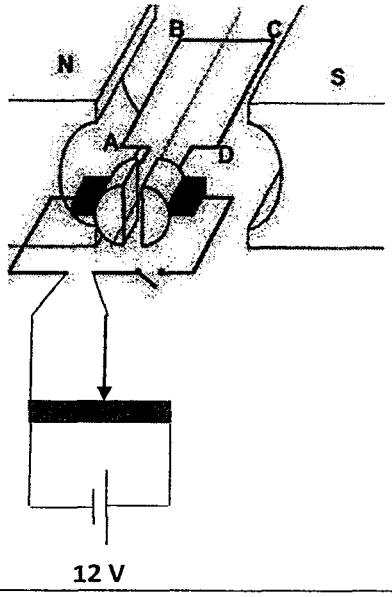
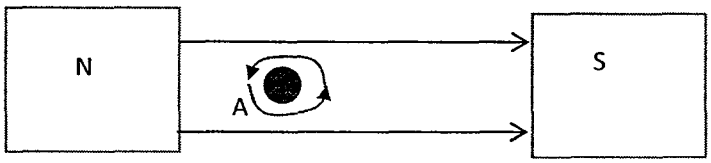
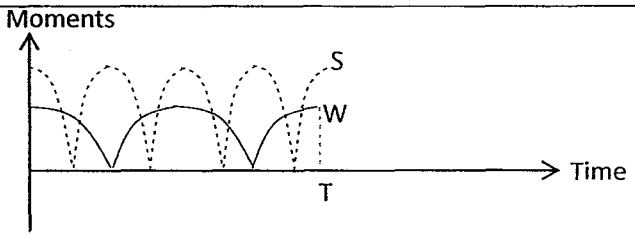
	$300 - F_{(\text{on A by B})} = 175$ $F_{(\text{on A by B})} = 125$ N	1

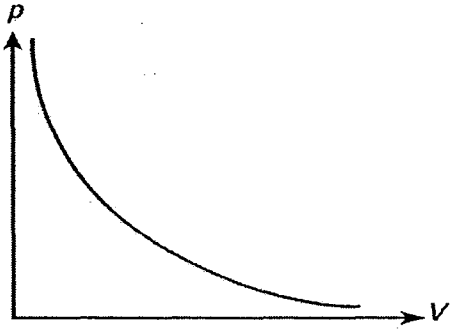
Question	Answer	Marks
2c	F on C by B and F on B by C F on C by surface and F on surface by C F on C by earth and F on earth by C	2
3a	Tension in X Tension in Y Force by cleaner on gondola (850 N) (W not accepted) Weight of gondola (6300 N)	2
3b	Taking X as the pivot: $Y \times 6 = (850 \times 2) + (6300 \times 3)$ $Y = 3430$ N (to 3sf)	 1 1
3c	Force exerted by rope Y will increase. As the cleaner moves from left to right, the perpendicular distance from the line of action of his weight and the pivot (X) increases. This increases the clockwise moment and hence the force exerted by Y has to increase to ensure the anticlockwise moment is equal to the clockwise moment.	1 1
4ai	$Pt = ml_v$ $(300\text{ W})(2 \times 60\text{ s}) = (0.015\text{ kg})l_v$ $l_v = \frac{(300\text{ W})(2 \times 60\text{ s})}{0.015\text{ kg}}$ $= 2.4 \times 10^6\text{ J kg}^{-1}$	 1
4aii	The answer in (b)(i) is larger than the true value, because in reality energy is lost to the surrounding, and the mass of water *m* vaporised is less. Since $l_v = Pt / m$, a lower mass *m* leads to a higher l_v.	1 1
4bi	The boiling point of water is exactly 100 °C and so when the water is boiling the temperature will be constant at 100 °C.	1
4bii	$Q_{supplied} = Q_{thermometer} + Q_{water}$ $Pt = C_{thermometer}\Delta\theta + ml_v$ $(300\text{ W})(2 \times 60\text{ s}) = (28.5\text{ J K}^{-1})(70\text{ °C}) + (m)(2.4 \times 10^6\text{ J kg}^{-1})$ $m = 0.0142\text{ kg}$	 1 1
4biii	If the thermometer has a large heat capacity C, it will take up a significant amount of energy per unit rise in temperature from the heat source and affect the accuracy of the measurements OR a thermometer with a high C is less responsive.	1

5a		1 m – correct X 1 m – all rays
5b	m = 2.8/0.9 = 2.9 to 3.3 f = 3.2 to 3.6 cm	 1 1
6	The negative charges in a ball sets up an electric field (an equivalent diagram) which causes electrons t be repelled from the negative charges in the ball as like charges repel (The electric field set up between the finger and the ball eventually causes the electrons to move from the ball to the fingertip. A spark may be seen)	1 1
7a	Longitudinal waves	1
b	Average speed = 10 000 x10^3 / (23X 60) = 7246 m/s = 7200 m/s	1 1
c	Maximum wavelength = Speed / minimum frequency = 7246 / 0.50 m = 14500 m (or 15000 m) (or 14.5 or 15 km)	 1 1
8a	V_1 = ½ 6.0 = 3.0 V	1
b	When light intensity decreases, R_{LDR} increases. Since $V_{LDR} = \frac{R_{LDR}}{R_{total}} \times emf$, LED should be placed across LDR	1 1

Question	Answer	Marks
8ci		1 m for curve, 1m for line
cii	If high p.d is high enough, the current of LED is higher than filament lamp for the same p.d, the LED will be brighter than lamp.	1
9a	Y: neutral wire Z: live wire	1
b	I = P/V = 50/230 = 0.217 A Total current flowing in fuse = 6(0.217) = 1.30 A There is no protection as 1.30 A > 1.0 A (or high current melt wire) and the 13 A will not blow to protect the fuse.	1 1
c	No, the appliance will not work as a missing fuse means the circuit is open and there will be no current.	1
10a	Lenz's Law states that the emf generated will produce a current which will flow in such a way to produce a magnetic field that opposes the motion of the coil.	1
b		1 – double amplitude 1 – double f
c	The rate of change of magnetic flux linking the coil and magnet increases. Since Faraday's Law depends on this rate of change, emf increases.	1

Question	Answer	Marks
11a)	Efficiency = (Po/Pi) X 100% = (5000/mgh) X 100% = (5000 / 0.035X1000X10X20) X 100% = (5/7) X 100% = 71%	 1 1
b)	The current carrying coils around rotor generate a magnetic field. when the coil rotates, the flux linking the rotating coil and stator coil changes (or flux cuts stator coil) and induces an emf across the stator coil.	Idea of magnetisation of rotor coil -1 Cause of flux change - 1 Flux change - 1
ci)	$I = P/V = 120 X10^6 / 20 X 10^3 = 6000$ A	1
ii)	Assuming no transformer power loss, $P_1 = P_2$ $V_1I_1 = V_2I_2$ $I_2 = (V_1/V_2)I_1$ But $(V_1/V_2) = 1/40$ Hence, $I_2 = (1/40)(6000) = 150$ A	 1
iii)	Input V to step down transformer = Output V of step up transformer – V across 2 transmission wires = (Turns ratio)(Input V of step up transformer) – (Current)(R of 2 wires) Input V to step down transformer = $= (40)(20 X 10^3) – 2(150)(30)$ =791,000 V	Either 2(150)(30) or $(40)(20X10^3)$ – 1 m Ans-1 m
d)	Advantage : Energy is renewable Disadvantage : Have to clear forests to build dam	1

12a)i)	Using Fleming's Left Hand Rule: Current flows in direction BA Current flows in direction DC	**1**
ii)		1 m for terminal correct direction to achieve clockwise moment
b)	 Magnetic field of current and permanent magnet interact such that field is weakened above A and strengthened below A Force acts from region of high to low flux density (upwards)	Diagram-1 1 1
c)i)	The force on the coil is increased when the field strength increases This leads to a higher moment OR this is because there is a greater difference between the two interacting magnetic field densities	1 1
ii)		1 m only if cosine curve 1m for double f and amplitude No marks if sine curve

13Ea	Energy cannot be created nor destroyed. It can be converted from one form to another, or transferred from one body to another, but the total amount remains constant.	2
13Eb	Change in gravitational potential energy = (3000)(10)(62.5) = 1.875×10^6 J Increase in kinetic energy = ½ (3000)$(31.7)^2$ = 1.507×10^6 J Work done against friction = $1.875 \times 10^6 - 1.507 \times 10^6$ = 0.368×10^6 J Average friction = $0.368 \times 10^6 \div 62.5$ = 5880 N	3
13Ec	d = 62.5/sin 45 = 88.4 m t = 88.4 / 3.04 = 29.1 s	1 1
13Ed	Gravitational potential energy and thermal energy due to friction. (sound energy)	1
13Ee	Work done by motor against friction = $88.4 \times 5880 = 5.23 \times 10^5$ J Total work done by motor = $5.23 \times 10^5 + 1.88 \times 10^6$ Power = $(5.23 \times 10^5 + 1.88 \times 10^6)/29.1$ = 8.26×10^4 W	 1 1
13Oa	As the air is pumped out, the number of air molecules per unit volume decreases and becomes lesser than outside. The frequency of collision of the air molecules with the liquid decreases. The pressure inside becomes lower than outside and hence the liquid level increases.	1 1 1
13Ob		1

13Oc	X is chloroform. Chloroform has a higher density from table. h= P/ρg. Since pressure on liquids X and Y is the same, the higher density (ρ) of chloroform will lead to a lower liquid level (h) (liquid X)	1 1
13Od	Any point along the same level as point P in liquid Y	1
13Oe	Px = Py $\rho_x g h_x = \rho_y g h_y$ $(1490 \times 10 \times (l_1 - l_0)) = (801 \times 10 \times (l_3 - l_0))$ l_3 = 45.0 cm (to 3sf)	 1 1
13Of	Answer will not be affected. The ratio of the densities of X and Y is related only to the ratio of their column heights. Since there is no change in the ratio of the densities of X and Y, the column height of X will still be lower than Y.	 1