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Name : () Class :



YISHUN TOWN SECONDARY SCHOOL

PRELIMINARY EXAMINATION II 2016

SEC 4 EXPRESS

PHYSICS (5059/1)

Date : 31st Aug 2016
Duration : 1 hour

Day : Wednesday
Marks : 40 marks

ADDITIONAL MATERIALS

Multiple choice answer sheet (OMS)

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name and class on the question booklet.

There are **forty** questions. 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.

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

This question paper consists of 17 printed pages, including the cover page.

- 1 Which one of the following physical quantities does not match with its approximate measurement?

	physical quantity	measurement / m
A	diameter of a hydrogen atom	1×10^{-10}
B	length of a bee	6×10^{-2}
C	height of Mount Everest	1×10^4
D	radius of Earth	6×10^6

- 2 Figure A shows the readings on a pair of vernier caliper when its jaws are closed and there is nothing clamped between its jaws. Figure B shows the length of a block being measured by the same pair of vernier caliper.

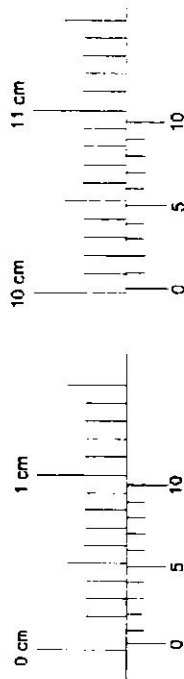


Figure A

Figure B

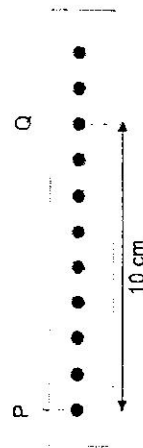
What is the actual length of this block?

- A 9.98 cm B 9.99 cm C 10.02 cm D 10.05 cm

- 3 Which of the following is a scalar quantity?

- A the braking force needed to stop a car
B the effort needed to hammer a nail into a wooden plank
C the heat needed to boil some water
D the thrust needed to lift a rocket off the ground

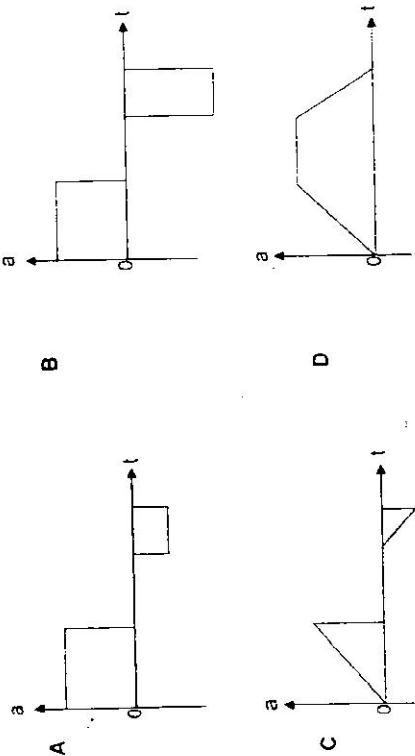
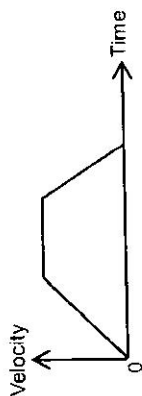
- 4 Aloysius uses a ticker tape timer to investigate the speed of a moving toy truck. The ticker tape timer is set to a frequency of 50 Hz and a portion of the tape obtained is shown below.



What is the average speed of the toy truck between point P and point Q?

- A 0.016 cm / s B 55.6 cm / s C 62.5 cm / s D 500 cm / s

- 5 The velocity-time graph below represents a car moving along a straight road. Which of the following represents the corresponding acceleration-time ($a-t$) graph?



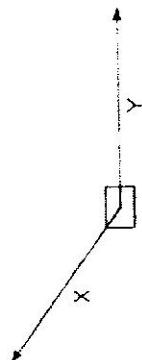
- 6 Beatrice takes a total of one and a half hours to make a journey of 12 km. During the journey, she takes a break of 15 minutes and spends another 30 minutes to stop for lunch.

At what average speed must she travel during the rest of the time for the whole journey to take one and a half hours?

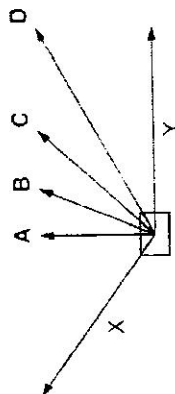
- A 8 km/h B 10 km/h C 12 km/h D 16 km/h

3

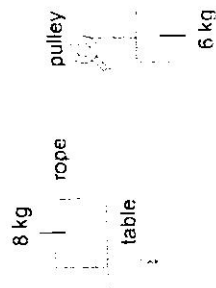
- 7 Forces X and Y act on a block in the directions shown on the scale diagram.



In which direction is the resultant force acting?



- 8 An 8 kg mass is connected to a 6 kg mass by a rope which passes over a smooth pulley.



If the friction between the 8 kg mass and the table is 10 N, find the acceleration of the 8 kg mass.

- A 1.25 N B 3.57 N C 4.29 N D 10.0 N

- 9 Two spherical objects, P and Q , are dropped from the top of a skyscraper at the same time. P has a greater weight than Q , but both objects are identical in shape and volume.

Which of the following statements is correct?

- A Both P and Q take the same amount of time to reach terminal velocity.
B P experiences a greater acceleration than Q upon release.
C P takes a longer time than Q to reach the ground.
D The terminal velocity of P is greater than that of Q .

4

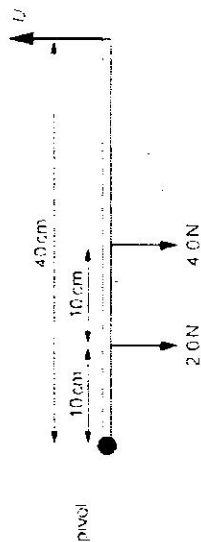
- 10 Gold has a density of 19.3 g/cm^3 .

The volume occupied by a single atom of gold may be considered to be a cube with sides of length $2.6 \times 10^{-8} \text{ cm}$.

What is the mass of a gold atom?

- A $3.4 \times 10^{-26} \text{ g}$
 B $3.4 \times 10^{-22} \text{ g}$
 C $1.3 \times 10^{-17} \text{ g}$
 D $1.3 \times 10^{-14} \text{ g}$

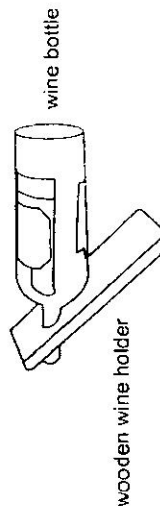
- 11 A beam of length 40 cm is pivoted at one end. The weight of the beam is 4.0 N and acts at a point 20 cm from the pivot. A weight of 2.0 N hangs 10 cm from the pivot.



An upward force U is needed to keep the beam horizontal. What is the magnitude of U ?

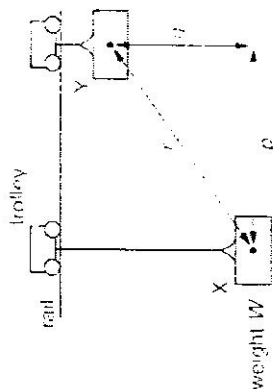
- A 0.5 N B 1.5 N C 2.5 N D 6.0 N

- 12 The diagram below shows a wine bottle in a wooden wine holder in equilibrium. Which of the following statements is true?



- A The C.G. of the bottle and the C.G. of the wooden holder are at the same point.
 B The C.G. of the bottle and wooden holder together is directly above the base of the wooden holder.
 C The C.G. of the bottle is directly above the base of the wooden holder.
 D The C.G. of the wooden holder is directly above the base of the wooden holder.

- 13 A weight W hangs from a trolley that runs along a rail. The trolley moves horizontally through a distance p and simultaneously raises the weight through a height q .



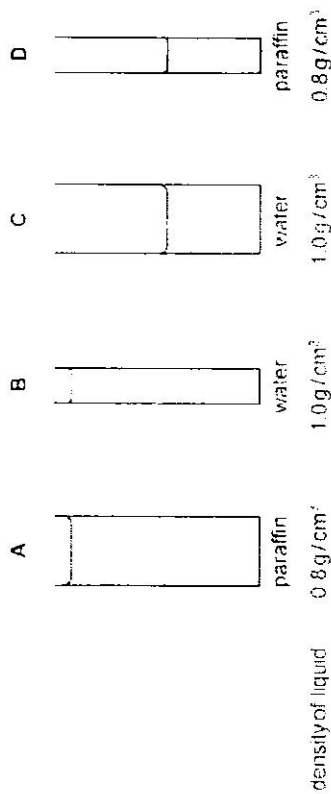
As a result, the weight moves through a distance r from X to Y . It starts and finishes at rest. How much work is done on the weight during this process?

- A Wt B $W(p + q)$ C Wq D Wp

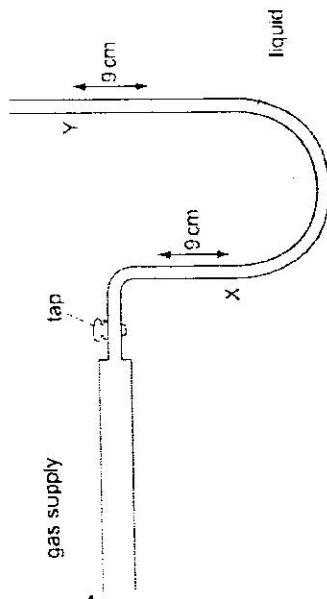
- 14 A builder lifts eight slabs from the ground onto the back of a lorry 1.5 m high. The total time taken is 48 s and each slab weighs 200 N . How much useful power does the builder produce?

- A 50 W B 400 W C 2400 W D 3200 W

- 15 The diagrams show liquids in containers. Which column of liquid exerts the greatest pressure on the base of its container?



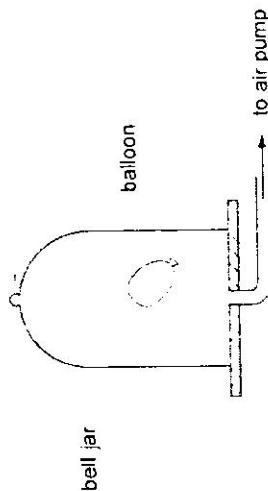
- 16 The diagram shows the levels X and Y in a liquid manometer with the gas tap open.



What is the pressure of the gas supply?

- A 18 cm of liquid below atmospheric pressure
- B 9 cm of liquid below atmospheric pressure
- C 9 cm of liquid above atmospheric pressure
- D 18 cm of liquid above atmospheric pressure

- 17 A partially-inflated balloon is placed inside a bell jar. The bell jar is connected to an air pump.

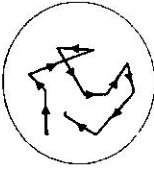


The air pump is switched on and air is removed from the bell jar. What happens to the pressure and volume of the gas inside the balloon?

	pressure	volume
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

7

- 18 Smoke particles in a transparent box are observed using a microscope. A small point of light is seen to move around as shown.



What does this experiment demonstrate about air molecules?

- A They move because of collisions with smoke particles.
- B They can be seen through a microscope.
- C They are in continuous random motion.
- D They move more quickly when they are heated.

- 19 A rod of metal is heated at one end. Which statement best describes the conduction of heat through the metal?

- A Atoms move from the hot end and hit electrons at the cold end.
- B Atoms vibrate and hit atoms at the cold end.
- C Free electrons move from the hot end and hit atoms further along the rod.
- D Free electrons vibrate and pass energy to free electrons further along the rod.

- 20 Fillings in teeth should be made from a material which

- A does not expand when heated.
- B expands by the same amount as the tooth when heated.
- C expands less than the tooth when heated.
- D expands more than the tooth when heated.

- 21 Four metal cans are identical except for the colour and texture of their outer surfaces. The same volume of water at 70 °C is poured into each can. Which can cools most rapidly?

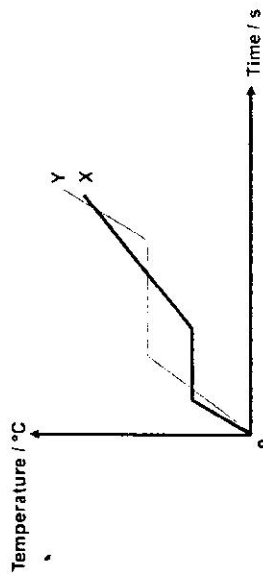
- A black and rough surface
- B black and shiny surface
- C white and rough surface
- D white and shiny surface

- 22 In calibrating a thermocouple thermometer, one of its junctions is kept in melting ice and the other in boiling water. The reading on the milli-voltmeter is 200 mV, and the pointer points to the right. If the "hot junction" is immersed in another substance and the reading is 20 mV with the pointer pointing to the left. What is the temperature of the substance?

- A -20 °C
- B -10 °C
- C 10 °C
- D 20 °C

8

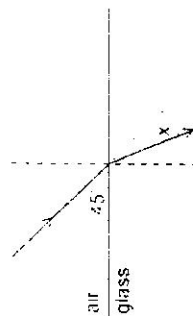
- 23 Equal masses of two solids X and Y are heated successively in a well-lagged calorimeter. Heat is supplied to each of them at the same rate. The diagram shows the temperature-time graph for the heating process.



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

- I Solid X has a lower melting point than solid Y.
 II Solid X has a higher specific heat capacity than solid Y.
 III Solid X has a higher specific latent heat of fusion than solid Y.
 IV Liquid X has a higher specific heat capacity than liquid Y.
- A I and IV only B II and III only
 C I, II and IV only D I, II, III and IV

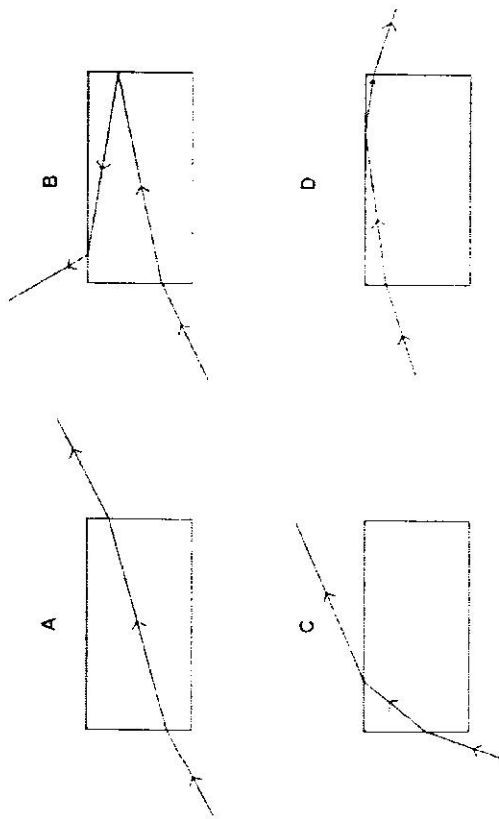
- 24 A ray of light is incident on the surface of a glass block, as shown in the diagram below.



The refractive index of the glass is 1.5. The light ray changes direction when entering the glass. What is the angle x through which the ray moves?

- A 15° B 17° C 28° D 30°

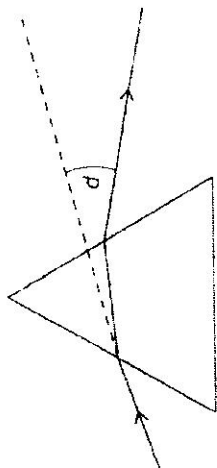
- 25 A ray of light is incident on one side of a rectangular glass block. Its path is plotted through the block and out through another side. Which path is not possible?



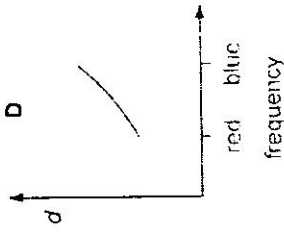
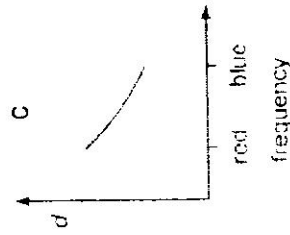
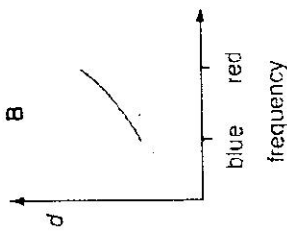
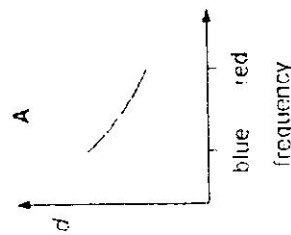
- 26 Which statement about the speed of sound is correct?

- A Sound travels fastest in a vacuum.
 B Sound travels fastest in gases.
 C Sound travels fastest in liquids.
 D Sound travels fastest in solids.

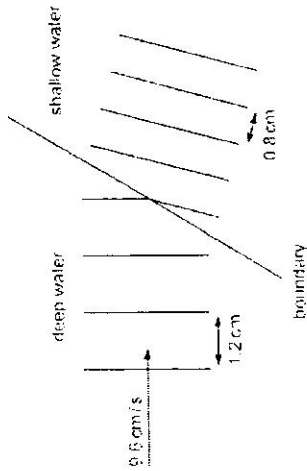
27 Light rays are deviated by a prism.



The deviation angle d is measured for light rays of different frequency, including blue light and red light. Which graph is correct?



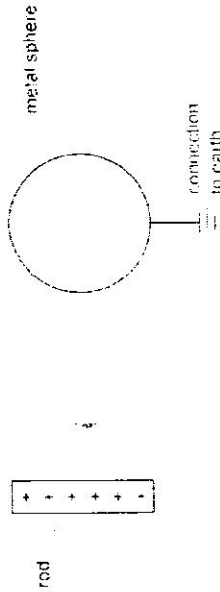
28 A ripple tank is used to demonstrate refraction of plane water waves.



Waves in deep water have a wavelength of 1.2 cm and a speed of 9.6 cm / s. The wavelength of the waves in shallow water is 0.8 cm. What is the speed of the waves in the shallow water?

- A 6.4 cm / s B 8.0 cm / s C 9.6 cm / s D 14.4 cm / s

29 A metal sphere is connected to earth. A positively-charged rod approaches the sphere and stops before touching it.



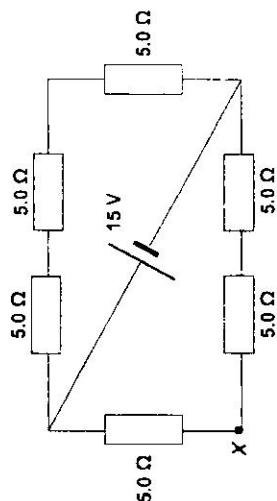
What is the movement of charge on the sphere and what is the final charge on the sphere?

	movement of charge	final charge on sphere
A	negative charge moves from earth to the sphere	negative
B	negative charge moves from earth to the sphere	neutral
C	positive charge moves from the sphere to earth	negative
D	positive charge moves from the sphere to earth	neutral

- 30 During a thunderstorm, lightning sends an electric charge of 90 C from a thundercloud to the earth. The potential difference between the thundercloud and the earth is 3×10^{10} V during the discharge. How much energy is produced during the lightning?

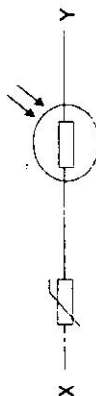
A 2.7×10^{10} J B 2.7×10^{12} J C 3.0×10^{12} J D 1.3×10^{13} J

- 31 The diagram shows six 5.0Ω resistors connected to a 15 V cell. What is the current that flows through the point X?



A 0.50 A B 1.0 A C 2.0 A D 3.0 A

- 32 The diagram shows a thermistor and a light dependent resistor in series.



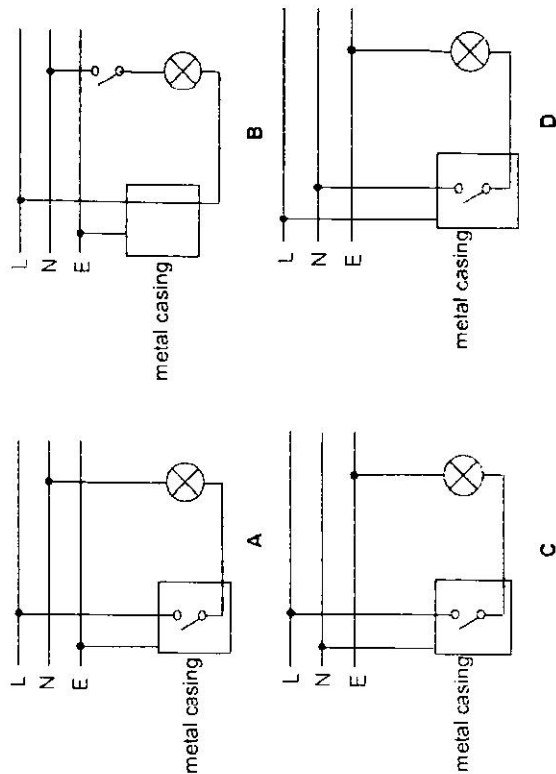
Which of the following conditions make the total resistance between X and Y the lowest?

	temperature	lighting
A	cold	bright
B	cold	dark
C	hot	bright
D	hot	dark

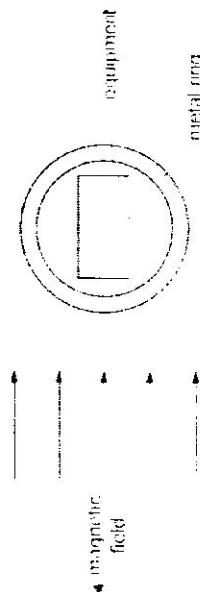
- 33 A kilowatt-hour of electrical energy is used when

A a 50 W lamp is used for 200 hours.
 B a 3000 W heater is used for 20 minutes.
 C a 100 W lamp is used for 1 hour.
 D two 100 W lamps in parallel are used for half an hour.

- 34 Which diagram shows the correct connections for a switch, lamp and its metal casing in a lighting circuit?



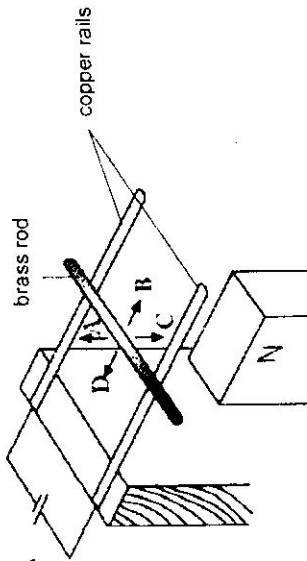
- 35 A metal ring screens a piece of equipment from a magnetic field.



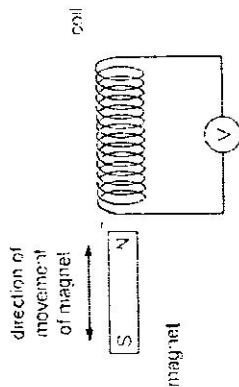
Which metal should be used for the ring, and why?

	metal	reason
A	copper	the metal carries the field lines around the equipment
B	copper	the metal is non-magnetic
C	iron	the metal carries the field lines around the equipment
D	iron	the metal is non-magnetic

- 36 The diagram below shows a brass rod supported on two copper rails, which are connected to a battery. The north pole of a magnet is placed beneath the rails. In which directions **A**, **B**, **C** and **D** does the brass rod experience a force?



- 37 A teacher moves a magnet into and out of a coil of wire, as shown, in order to demonstrate electromagnetic induction.

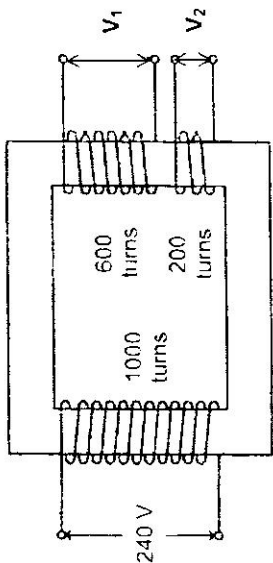


Which statement is correct?

- A** As the magnet is moved into the coil the left-hand end of the coil becomes a S-pole.
- B** As the magnet is taken out of the coil the left-hand end of the coil becomes a N-pole.
- C** Increasing the speed at which the magnet enters the coil increases the induced voltage.
- D** Increasing the speed at which the magnet leaves the coil decreases the induced voltage.

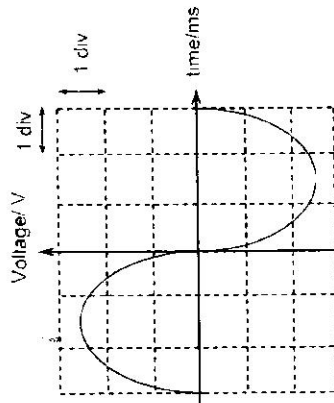
15

- 38 The diagram shows a transformer with two outputs. Which of the following output voltages is correct?



	V_1 / V	V_2 / V
A	120	40
B	144	48
C	180	60
D	600	200

- 39 The following diagram shows a trace on the Cathode Ray Oscilloscope (CRO) when a source is connected to it. The amplitude of the input source is 5.0 V and the time-base of the CRO is 4.0 ms / div. Find the voltage gain of the CRO display and the frequency of the input source.

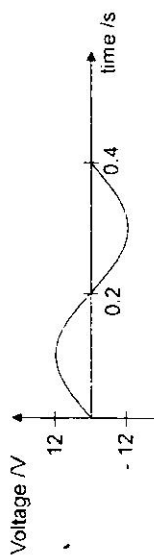


Find the voltage gain and time base of the trace.

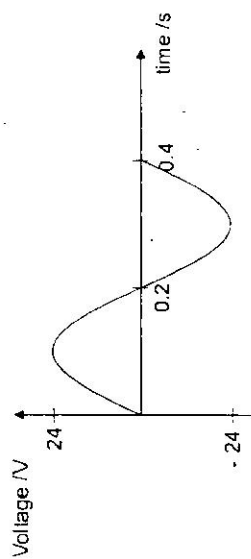
	Voltage gain	Frequency
A	2.0 V/ div	24 Hz
B	2.0 V/ div	42 Hz
C	2.5 V/ div	24 Hz
D	2.5 V/ div	42 Hz

16

- 40 A simple alternating current (a.c.) generator initially produces a voltage which varies with time as shown below.



After a certain change was made to the a.c. generator, the voltage against time waveform is shown below.



What is the likely change that has been done to the generator?

- A The speed of the coil rotation in the generator has doubled.
- B The coil rotation in the generator has reduced to half the original speed.
- C The strength of the magnet used in the generator has reduced to half its original value.
- D The number of turns of the coil in the generator has doubled.

Name: _____ () Class: _____



YISHUN TOWN SECONDARY SCHOOL

PRELIMINARY EXAMINATION II 2016

SEC 4 EXPRESS

PHYSICS

(5059/2)

Date : 31 August 2016
Duration : 1 hour 45 minutes

Day : Wednesday
Marks : 80 marks

ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

Write your name, class and register number in the spaces provided at the top of this page and on any separate writing paper used.

Section A.

Answer all the questions.

Section B

Answer all questions. Question 11 has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include **appropriate units and number of significant figures**.

Candidates are required 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.

Take the value of g , acceleration due to gravity, to be 10 ms^{-2} .

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

For Marker's Use

Section A

Section B

TOTAL

Section A

Answer all the questions in this section.

- Fig 1.1 shows a firework rocket that contains a solid fuel inside a cardboard tube. The burning of the fuel creates a thrust to propel the rocket upwards.

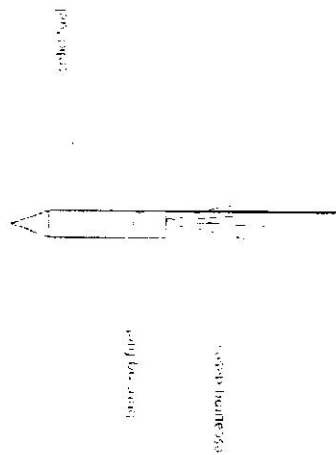


Fig 1.1

Before the fuel is lit, the total mass of the rocket including fuel is 0.07 kg . There is a resultant force on the rocket of 0.50 N upwards when it takes off.

- Draw arrows on Fig 1.1 to show the size and direction of the forces acting on the rocket when it takes off. [2]
- Calculate the acceleration of the rocket when it takes off.

acceleration = ... [2]

This question paper consists of 23 printed pages.

2. Fig 2.1 shows the side view of a section of a vertical locker door with a horizontal hinge along its lower edge.

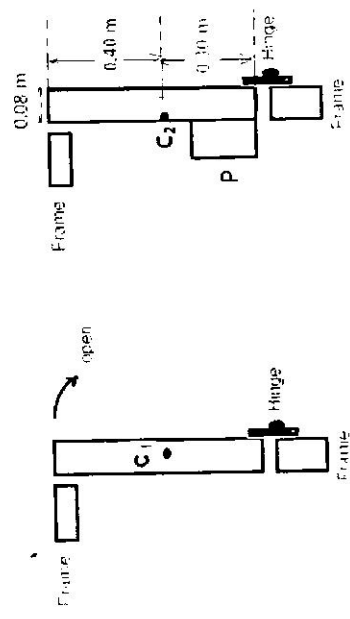


Fig 2.1

C_1 is the position of the centre of gravity of the door, and the door opens in the direction indicated.

Fig 2.2 shows the door with a piece of wood, P, attached to it so that the door is less likely to fall open; the position of the centre of gravity of the door and the wood is C_2 .

- (a) Explain why the door shown in Fig 2.2 is now less likely to fall open.
- (b) The total mass of the door and the wood is 6.0 kg. Using the dimensions given in Fig 2.2, calculate the turning moment holding the door closed when it is in this vertical position.

moment = [2]

3. Fig 3.1 below represents a simple mercury barometer on a particular day. The scale alongside the barometer is marked in mm.

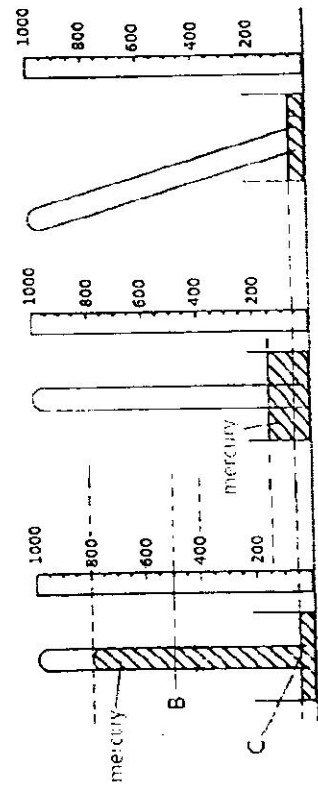


Fig 3.1

Fig 3.2

Fig 3.3

- (a) What is the pressure inside the barometer tube in Fig 3.1
- (i) at point C? [2]
- (ii) at point B? [2]
- (b) More mercury is poured into the reservoir until it reaches the level indicated by the dotted line in Fig 3.2. On Fig 3.2, show the correct level of mercury inside the tube now. [1]
- (c) On Fig 3.3, show the correct level of mercury inside the tube after tilting the tube from the position shown in Fig 3.1 to the position shown in Fig 3.3. [1]

- (d) (i) When air is introduced into the barometer tube in Fig 3.1, the difference between the mercury levels in the barometer tube and in the reservoir becomes 742 mm.

Deduce the pressure of the air above the mercury in the barometer tube. Write your answer in Pascal.
(Given that the density of mercury is 13600 kg/m^3)

pressure = ... [2]

- (ii) After the air has been introduced, the barometer tube is lowered so that its lower end is immersed more deeply in the reservoir. By considering the air above the mercury in the barometer tube, would you expect the difference between the mercury levels in the tube and the reservoir to be **less** or **more** than 742 mm? Explain your answer.

..... [2]

4. John installs a solar water-heating unit on the roof of his house.
Fig 4.1 shows part of the unit.

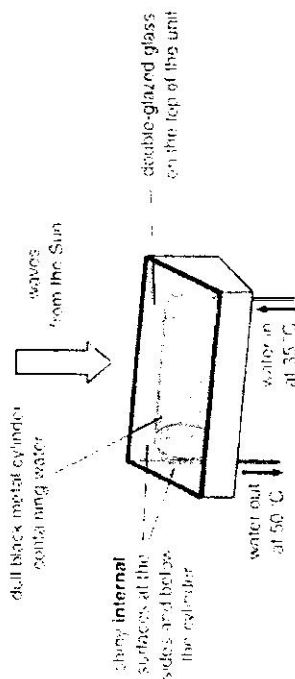


Fig 4.1

- (a) Energy is transferred through parts of the unit by different methods.
What is the main method of energy transfer from a position above the glass to the surface of the cylinder?
..... [1]
- (b) (i) These solar water-heating units have an efficiency of 85%.
Calculate the useful energy output for every 200 kJ of energy input.

energy output = ... [1]

- (ii) Describe how **one** feature of the solar water-heating unit helps to produce this high level of energy efficiency.

..... [2]

(c) (i) Which type of electromagnetic radiation provides energy to the solar water-heating system? [1]

(ii) The Sun emits all the waves in the electromagnetic spectrum. Explain why all these waves take the same time to travel to Earth from the Sun. [1]

(iii) Name one of the electromagnetic radiations that has strong ionisation effect on living matter. [1]

5. Figure 5.1 shows the variation with time t of the displacement x of a particular particle in a water wave.

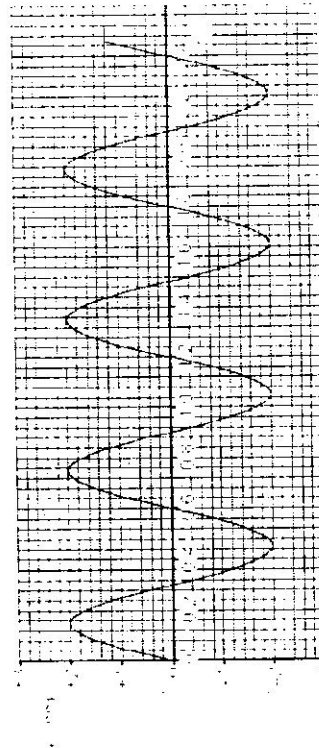


Fig 5.1

The distance d of the oscillating particles from the source of the waves is measured.

At a particular time, the variation of the displacement x with this distance d is shown in Fig 5.2.

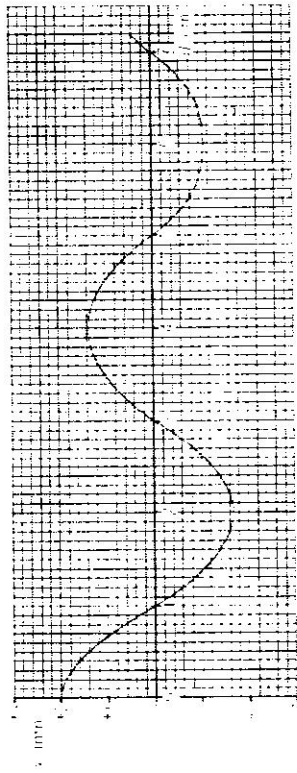


Fig 5.2

(a) For a wave, state what is meant by

(i) amplitude [1]

(ii) wavelength [1]

(b) Use Fig 5.1 and 5.2 to determine, for the water wave,

(i) the frequency f of vibration.

frequency = ... [1]

(

(ii) the wavelength λ .

..... [1]

(iii) the speed v .

speed = ... [1]

(c) State and explain whether the wave is losing energy as it moves away from the source.

..... [1]

6. Fig 6.1 shows a thin converging lens forming an image I of a point object O.

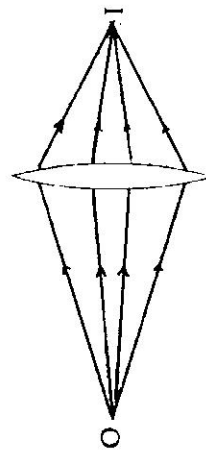


Fig 6.1

(a) (i) State clearly what happens to the path of a ray of light as it passes through each surface of the lens.

..... [2]

(

(ii) Explain why the lens has a bigger effect on the paths of rays passing near the edge than it does on the paths of rays near the centre.

..... [1]

(iii) State what happens to the speed, wavelength and frequency of the light ray as the light ray enters the glass block.

speed

wavelength

frequency

[2]

(b) This converging lens is used as a magnifying glass to view the caterpillar as shown in Fig 6.2.

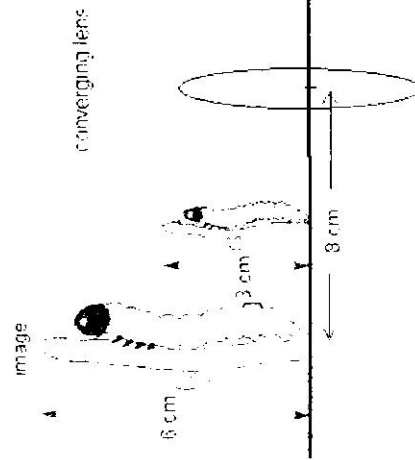


Fig 6.2

- (i) By means of a scale diagram, determine the focal length of the lens.



7. The picture shows an electric bicycle. The bicycle is usually powered through a combination of the rider pedalling and an electric motor.

- (a) A 36 V battery powers the electric motor. The battery is made using a number of individual 1.2 V cells.
- (i) Explain how a 36 V battery can be produced using individual 1.2 V cells.
- (ii) The battery supplies a direct current. What is the difference between a **direct current** and an **alternating current**?

- (ii) When fully charged, the battery can deliver a current of 5 A for 2 hours. The battery is then fully discharged.

Calculate the maximum charge that the battery stores.

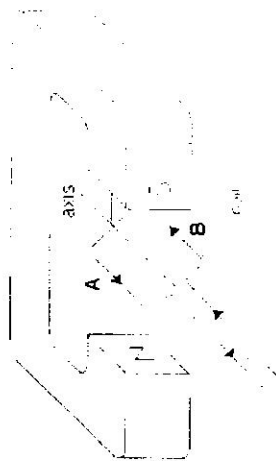
- (ii) Would it be possible to obtain this image on a white screen? Explain your answer.

charge = ... [2]

- (iv) Determine the energy delivered by the battery before the battery needs recharging.

energy = ... [1]

8. The diagram below shows the flow of current in a wire coil placed in a magnetic field.



- (a) What happens to the coil in this situation, and why?

.....

.....

.....

..... [2]

- (b) (i) Draw and label on the diagram the additions necessary to make the device useful as a d.c motor. [2]

- (ii) Explain why the additions are able to make the device work as a d.c motor.

.....

.....

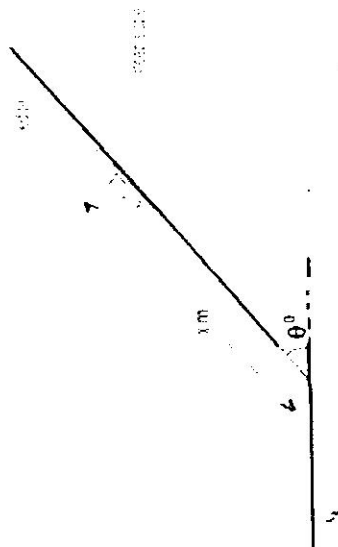
.....

Section B

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

Answer only one of the two alternative questions in Question 11.

9. The figure below shows a boy sledging down a snowy hill.



The boy starts from different points on the slopes of different angles and his speed upon arrival at the bottom of the hill is recorded. The results are given in Table 9.1.

x/m	Speed / ms^{-1}	
	$\theta = 30^\circ$	$\theta = 40^\circ$
5	3.2	3.2
10	4.5	4.6
15	5.5	5.8
20	6.4	6.8
25	7.1	7.6
30	7.6	8.2

Table 9.1

- (a) For the slope of different angles in table 9.1, state

- (i) a similarity in the speeds for slope at 30° and slope at 40° . [1]
- (ii) a difference between the speeds for slope at 30° and slope at 40° . [1]

- (iii) State how the speed will be affected if the sledge is made longer. [1]

- (b) Describe the energy changes as the boy slides down the hill. [2]

- (c) (i) The total mass of the boy and the sledge is 80 kg. Calculate the approximate total kinetic energy when he arrives at the bottom of the hill from a starting point of $x = 30 \text{ m}$ for $\theta = 30^\circ$. [2]

kinetic energy = [2]

- (ii) Explain why the value calculated in c(i) is only approximate. [1]

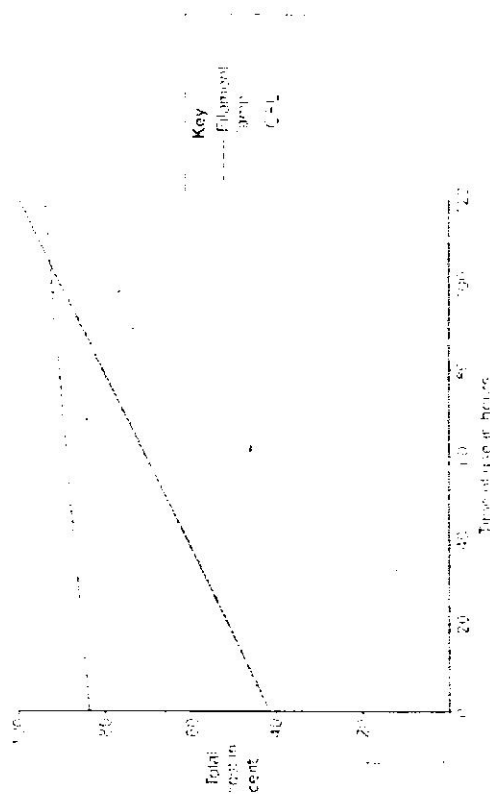
- (d) When the boy reaches the bottom of the hill, the sledge continues to move through 15 m before it stops. Determine the average retarding force exerted by the ground on the sledge. [2]

force = [2]

10. (a) Some information for two types of lamps is shown below.

Filament lamps	Compact Fluorescent lamp (CFL)
- Reach full brightness almost immediately - Efficiency of 0.1 - Expected life : 1000 h	- An 11 W lamp gives as much light as a 60 W filament lamp. - Takes a long time to warm up. - Efficiency of 0.8 - Expected life : 7000 h

The graph shows the total cost of buying and using each type of lamp.



(i) What is meant by 'the efficiency of filament lamp is 0.1'?

(ii) From the graph, compare the cost of buying a CFL with buying a filament lamp.

(iii) When does a CFL become more economical than a filament lamp?

(iv) What is the cost of using a 60 W filament lamp during its expected life if the cost of electricity is 20 cents per unit?

cost = [1]

(v) Which type of lamp would you choose? State your reason.

[1]

(vi) The heat capacity of the filament of the lamp is very small. State one reason why this is an advantage.

[1]

11. EITHER

(b) Avan is learning about power transmission and the National Grid.

He first sets up a model system as shown in Fig 10.1 and the lamp glows dimly.

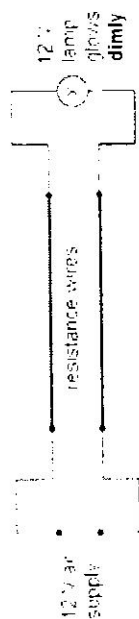


Fig 10.1

He then adds two transformers (TA and TB) before and after the resistance wires as shown in Fig 10.2. The lamp now glows brightly.

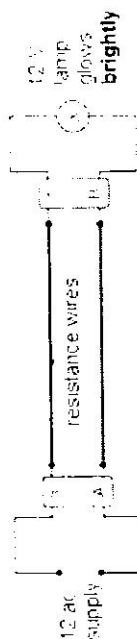


Fig 10.2

Explain these observations.

[4]

19

[4]

11. EITHER

Students investigate the heating effect of an electric heater immersed in water. They measure the temperature of the water and use their measurements to determine the temperature of the water at 5.0 minute intervals after switching on the current.

In the first experiment, the current is kept at a constant value of 1.50 A.

In the second experiment, a fresh amount of water of the same mass is used and the current is kept at a constant value of 1.20 A.

(a) Fig 11.1 shows part of the experimental arrangement.

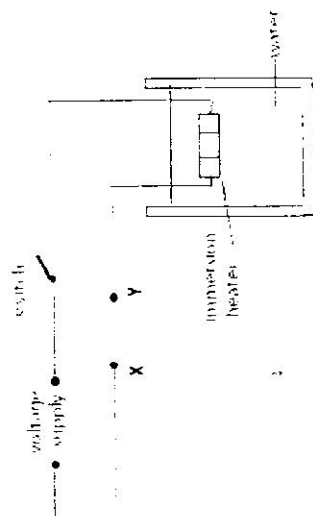


Fig 11.1

- (j) Assuming that the voltage provided by the supply is fixed, add a suitable component between terminals X and Y which enables the power supplied to the heater to be varied. [1]
- (ii) Show on Fig 11.1 how you would connect a voltmeter and an ammeter so that the power supplied to the heater can be determined. [1]
- (b) If the resistance of the immersion heater is $12.0\ \Omega$, calculate the power input to the water when the current is $1.50\ \text{A}$.

power = ... [2]

20

(c) Curve **P** in Fig 11.2 gives the variation of temperature θ with time t when the current is 1.50 A.

Curve **Q** gives the variation of temperature θ with time t when the current is 1.20 A.

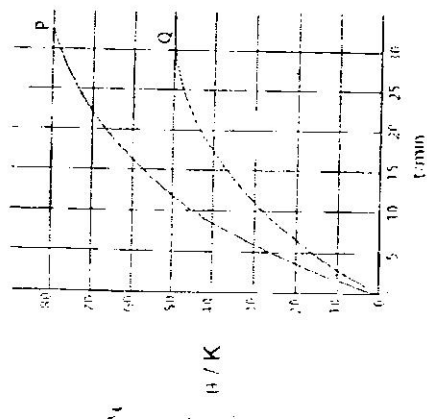


Fig 11.2

(i) Explain briefly why the temperature rises at a smaller rate in the second experiment (curve **Q**).

..... [1]

(ii) Explain why the rate of temperature rise of water **decreases** with time in each case.

..... [2]

(d) In the first experiment (curve **P**), the initial rate of temperature rise is 0.100 K/s. Using this value and your answer to (b), obtain a value for the mass of water used in the experiment.

mass = ... [2]

(e) Suggest one modification to the experimental arrangement to improve the accuracy of the measurement.

..... [1]

11. OR

- (a) (i) Sketch the magnetic field pattern around a straight current-carrying wire.

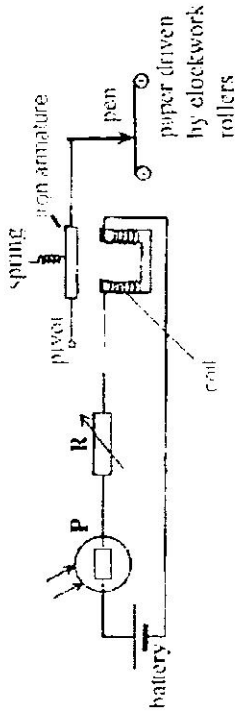


[2]

- (ii) Describe briefly, with the aid of a diagram, how you would use a plotting compass to show that your answer to (i) is correct.

- (b) The arrangement shown below is used to measure the length of the day, i.e. the length of time during which the daylight is above a certain brightness.

The circuit incorporates a device, **P**, which has a high resistance in the dark but it has almost no resistance when light falls on it.



- (i) Explain why the pen begins to draw a trace on the paper when light starts to fall on **P** and stops when it becomes dark.

[3]

- (ii) Why does the use of a high resistance at **R** make the arrangement less sensitive to light?

[2]

END OF PAPER 2

YISHUN TOWN SECONDARY SCHOOL
4E PHYSICS PRELIM 2 2016 ANSWERS

Answers

Q1 B	Q2 B	Q3 C	Q4 C	Q5 B	Q6 D	Q7 B	Q8 B	Q9 D	Q10 B
Q11 C	Q12 B	Q13 C	Q14 A	Q15 B	Q16 D	Q17 B	Q18 C	Q19 C	Q20 B
Q21 A	Q22 B	Q23 A	Q24 B	Q25 B	Q26 D	Q27 D	Q28 A	Q29 A	Q30 B
Q30 B	Q31 C	Q33 B	Q34 A	Q35 C	Q36 B	Q37 C	Q38 B	Q39 B	Q40 D

Section A

1 (a)

1.2 N [1]

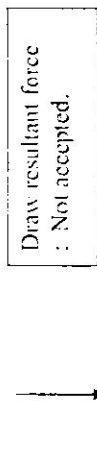


Fig 1.1

(b) $a = F / m = 0.5 / 0.07 = 7.1 \text{ m/s}^2$ [1]

(a) Wider and heavy base; low CG [1]

If tilted, line of action of the weight falls within the base; produces anticlockwise moment by addition of P to hold the door closed [1]

OR

Anticlockwise moment produced in Fig 2.2 is larger than in Fig 2.1.

(b) Anticlockwise moment about the hinge

[1] $= 60 \text{ N} \times 0.08 \text{ m} = 4.8 \text{ Nm}$ [1]
(' wrong unit - 1/2)

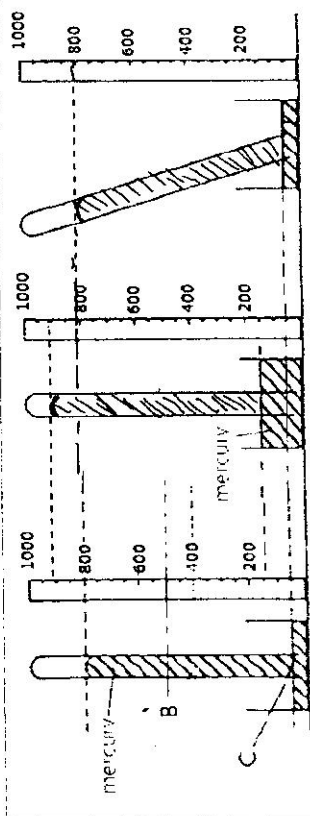


Fig 3.1 (1) Fig 3.2 (1) Fig 3.3

- (a) (i) at point C 750 mm Hg [1]
 (ii) at point B? 300 mm Hg [1]

(d) $P = (750 - 742) \text{ mmHg} = 8 \text{ mmHg}$ [1/2] e.c.f
 $P = h \rho g$ [1/2]
 $= 8 \times 10^{-3} \text{ m} \times 13600 \times 10$
 $= 1088 \text{ Pa}$ [1]

- (e) Less than. [1]

As the volume of air in the tube is compressed, pressure of the air increases provided the temperature remains constant. [1]

$$P_{\text{Hg}} = P_{\text{atm}} - P_{\text{air}}$$

4. (a) Radiation [1]
 (b) (i) $200 \text{ kJ} \times 85\% = 170 \text{ kJ}$ [1] (* wrong unit -1/2)
 (ii) Double glazed top traps air is a Good insulator of heat [1]
 Reduces heat loss by conduction and convection. [1]
 OR
 Shiny surface is a good reflector of thermal energy: [1]
 Reduces heat loss by radiation [1]
 OR
 Dull black metal is a good absorber of thermal energy [1]
 More heat energy can be conducted to water. [1]

- (c) (i) Infra red [1]
 (ii) travel at same speed in free space, $3.0 \times 10^8 \text{ m/s}$ [1]
 (iii) UV or X-ray or Gamma ray [1]

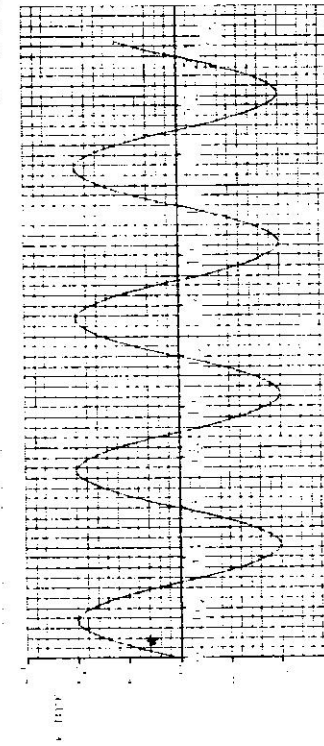


Fig 5.1

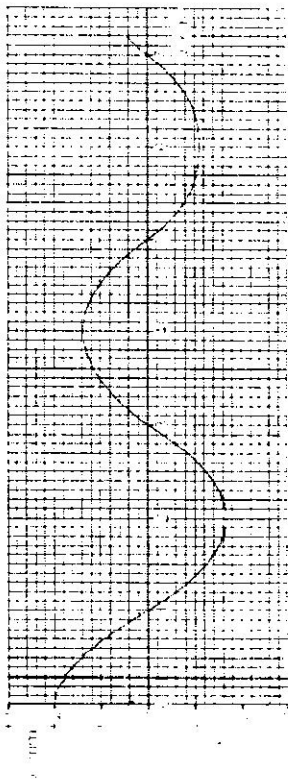


Fig 5.2

(a) (i) amplitude [1]

Maximum displacement of point on wave from rest position

(ii) wavelength [1]

The distance between two successive points with same phase.

OR minimum distance between two adjacent crests or troughs

(b) (i) the frequency f of vibration. [1]

$$f = 1/0.6 = 1.67 \text{ Hz}$$

(ii) the wavelength λ . [1]

$$\lambda = 4.0 \text{ cm} \quad (4 \text{ cm} \times 1/2)$$

(iii) the speed v . [1]

$$v = f\lambda = 1.67 \times 4.0 = 6.68 \text{ cm/s}$$

(c) Refer to Fig 5.2. [1/2]

Losing energy. [1/2]

Amplitude is decreasing [1/2]

OR Energy will be lost due to resistive force during transmission

6. (a) (i) There are refraction of light at both surfaces. [1/2]

At the first surface, the light bends towards normal when travelling from optically less dense medium to denser medium [1/2]

At the second surface, the light bends away from the normal when travelling from optically denser medium to less dense medium. [1]

(ii) With different angles of incidence.

Larger angle of incidence at the edge compared to near the centre. [1/2]
Ray refracted more toward normal. [1/2]

(iii) speed decreases [1/2]

wavelength decreases [1/2]

frequency same [1]

(b)

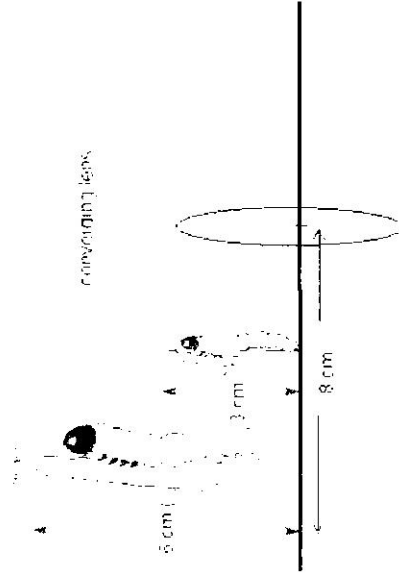


Fig 6.2

(i) By means of a scale diagram, determine the focal length of the lens. [3]

Scale 1 cm : 1 cm OR 1 cm : 2 cm [1/2]
 (* too small diagram -1/2)

Lens



Two correct rays [1]

Direction [1/2] focal length = 8.0 cm [1]
 (7.5 – 8.5 cm)

(ii) No. virtual image can't be formed on screen [1]
 accepted only with correct explanation

OR

If object is placed between f and 2f, real image is obtained and can be formed on screen.

7. (a) (i) 30 cells of 1.5 V are connected in series [1]

(ii) Direct Current flows in one direction only [1]
 (from positive terminal to negative terminal of the battery.)

A.c alternates / reverses its direction of flow continuously. [1]

(iii) $Q = It$ [1/2]

$$= 5 \times 2 \times 3600$$

$$= 36000 \text{ C}$$

[1]

[1/2]

* Wrong unit - 1/2

(iv) $E = VIt$ [1/2] OR $W = QV$

$$= 36 \times 5 \times 2 \times 3600$$

[1]

[1/2]

[1/2]

$$\text{OR } 1.29 \times 10^6 \text{ J}$$

$$\text{OR } 1296 \text{ kJ}$$

8. (a) The coil rotates in a clockwise directions initially for 180° maximum. Because there is upward force acting on side A and downward force on side B.

the coil will then rotates in an anticlockwise direction. and oscillates until it comes to rest in a vertical position.

(b) (i) Commutator [1]

Carbon brushes [1]



- b) (ii) When the split ring commutator is used, the direction of the flow of current relative to the coil is reversed every half turn.
The force acting on the sides of the coil will reverse directions as well.
The coil can then turn in same direction.
Carbon brushes act as contact to allow current to flow from supply to the coil; also to prevent tangling of wires when the coil rotates.

Section B

x/m	Speed / ms ⁻¹	
	Slope at 30°	Slope at 40°
5	3.2	3.2
10	4.5	4.6
15	5.5	5.8
20	6.4	6.8
25	7.1	7.6
30	7.6	8.2

Fig 9.1

- (a) (i) At distance of 5 m, speeds are the same [1]
OR Both speeds increase after 5 m
- (ii) Speed increases at a greater rate in slope at 40° compared to slope at 30°
- (iii) Speed increases more. [1]
Longer sledge (larger area in contact with the slope; smaller pressure acting on the snow. Sledge won't sink deeper in snow, ie less frictional force.)
- (b) Gravitational Potential Energy changes [1] partly to Kinetic Energy [1/2] and
partly wasted as heat and sound energy [1/2] due to work done against friction

(c) (i) $KE = \frac{1}{2} m v^2$ [1/2]
 $= \frac{1}{2} (80)(7.6)^2$ [1]
 $= 2310 \text{ J}$ [1/2]

(ii) GPE ≠ KE at the bottom (shown by calculation of GPE)

OR any sensible answer related to sources of error in taking measurement.

(d) Change in KE = WD against resistive force
 $2310 = F s$ [1]
 $F = 2310 / 15$ [1/2]
 $= 154 \text{ N}$ [1/2]

10. (a) (i) 90% of input energy is wasted. [1]

OR

Only 10% of input energy becomes light energy (useful energy)

(ii) Twice as much [1] (more costly $\frac{1}{2} \text{ m}$)

(iii) after 105 h [1]

(iv) Cost = Pt x \$0.20 = 0.06 kW x 1000 h x \$0.20 = \$12.00 [1]

(v) CFL. On long run, it saves more than filament lamp.

OR

Less energy is wasted as heat.

★ Any sensible answer

(vi) It takes small amount of heat to increase the temperature of the filament by 1 K. Hence, light is emitted in a short time once it is turned on. [1]

(b) In Fig 10.1, energy lost during transmission due to high current flows through resistance wire. Power loss is proportional to $(\text{current})^2$. [1]

In Fig 10.2, TA is step-up and TB is step-down transformer. [1]
TA increases transmitted voltage to reduce current flowing through the resistance wire. Less energy is wasted as heat in resistance wires. [1]

TB lowers the high transmitted voltage to 12 V and thus increases current flows to lamp ie brighter than in Fig 10.1. [1]

11. EITHER

(a) Fig 11.1 shows part of the experimental arrangement.

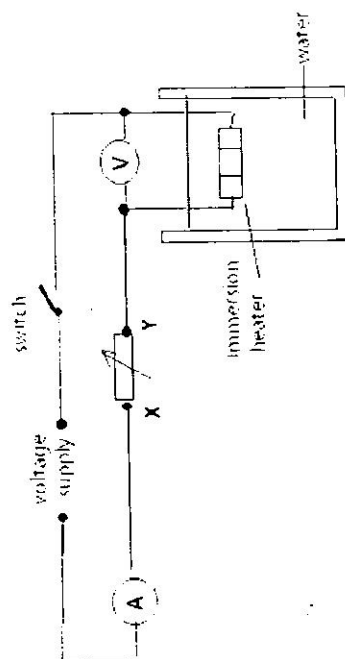


Fig 11.1

(i) variable resistor [1]

(ii) Ammeter in series [1/2]
Voltmeter in parallel to the heater [1/2]

(b) $P = I^2 R$ [1/2]
 $= (1.50)^2 \times 12$ [1]

$= 27.0 \text{ W}$ [1/2] * wrong unit - 1/2 m

(c) (i) $Q = m c \Delta \theta$
 $P = m c \Delta \theta / t$

Power is the rate of heat energy supplied.

Since current is lower, power supplied in second experiment is lower than in first experiment ($P \propto I^2$) [1/2]

rate of temperature rise is thus lower ($\Delta \theta \propto P$). [1/2]

(ii) The amount of heat loss by water to the surroundings is proportional to the temperature difference between hot water and surroundings. [1]

As water is heated, its temperature rises and the temperature difference increases. [1/2]

More heat energy provided by heater is lost to surroundings and less heat energy is used to increase temperature of water. [1/2]

(d) Energy provided by heater = thermal energy gained by water

$Q / t = m c \Delta \theta / t$ [1/2]

$27.0 = m \times 4200 \times 0.100$ [1]

$m = 0.064 \text{ kg}$ [1/2]

(e) Any one:

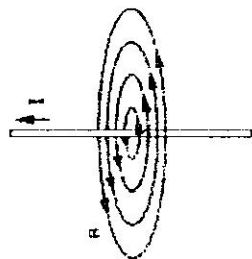
Lower the heater for better convection in water

Cover the container with lid to reduce heat lost by convection and evaporation.

Insulated the container to reduce heat lost by conduction.

11. OR

- (a) (i) Sketch the magnetic field pattern around a straight current-carrying wire.



Concentric circles [1]

Direction of magnetic field [1]

Did not show the circles are closer near the wire but after that further apart -1/2

(ii) (Text book page 407)

1. Thread the wire through a small hole in a sheet of cardboard. The wire should be perpendicular to the cardboard sheet.
2. Place a compass on the sheet.
3. Mark the positions of N and S ends of the compass needle with pencil dots X and Y respectively
4. Move the compass so that the S end of the needle is now at Y.
5. Mark the new position of the N end of a needle with a third dot Z.
6. Repeat steps 2 to 5, placing the compass at different distances from the wire until several field lines are drawn.

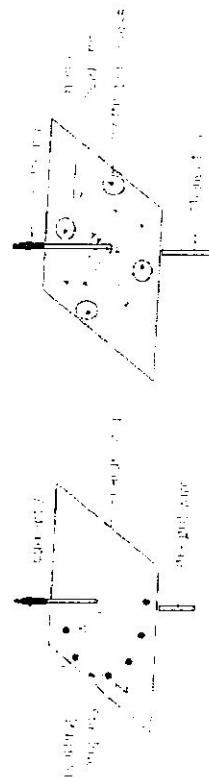


Diagram [1]
Description [2]

- (b) (i) When light falls on P, its resistance becomes so small and large current flows through the coils. [1]
- The magnetic field produced by the coil magnetises the iron armature by magnetic induction: the pen is pulled downwards and drawing a trace on the moving paper. [1]
- When no light falls on P, its resistance is very high and hence low/negligible current flows in the circuit. [1/2]
The small magnetic force produced is unable to pull the iron armature down. No trace is drawn. [1/2]
- (ii) Effective resistance in the circuit
= Resistance of R + resistance of P [1/2]
- The effect of change of effective resistance due to resistance changes in P is reduced if resistance of R is very high. [1]
- Since P does not affect the total resistance in a significant way, the entire arrangement is thus less sensitive to light. [1/2]

