ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2020

SECONDARY 4E

Candidate's Name	Class	Register Number

PHYSICS 6091 /01

22 September 2020
1 hour

Additional Materials: OTAS

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 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 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.

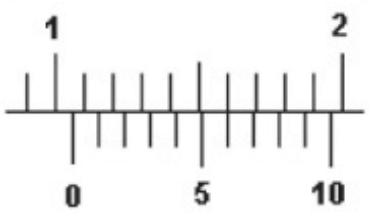
Any rough working should be done in this booklet.

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

Set by: Mr Lawrence Tang and Mrs Ngiam-Fok Kar Yin
Vetted by: Mr Tan Jun Hong

[Turn over

1 The diagram below shows the reading on a Vernier calliper scale in cm. The caliper has a zero error. The corrected reading is 1.05 cm.



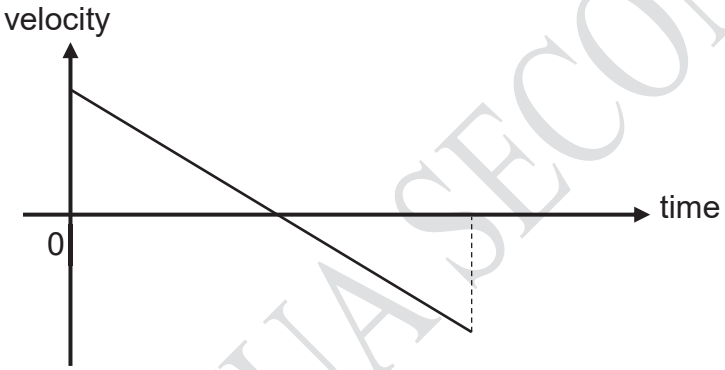
What is the zero error of the caliper?

A -0.02 cm **B** -0.01 cm **C** +0.01 cm **D** +0.02 cm

2 The diameter of a typical atom has an order of magnitude of _____.

A 10^{-10} m **B** 10^{-7} m **C** 10^{-3} m **D** 10^{-1} m

3 The following diagram shows how the velocity of a ball changes over time.



Which of the following statements is correct?

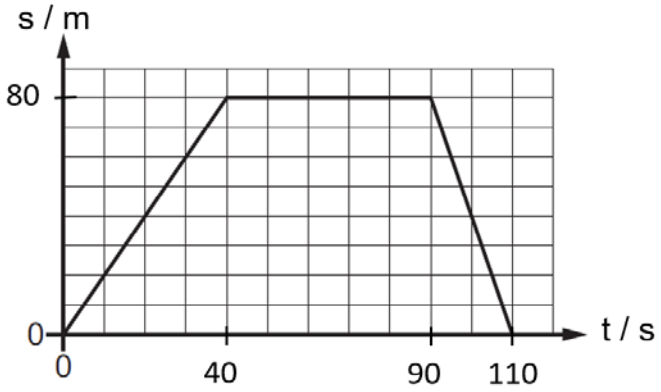
A The ball decelerates uniformly before accelerating uniformly in the same direction.

B The ball decelerates uniformly for the entire duration of time.

C The ball travels upwards then downwards.

D The ball travels at constant velocity.

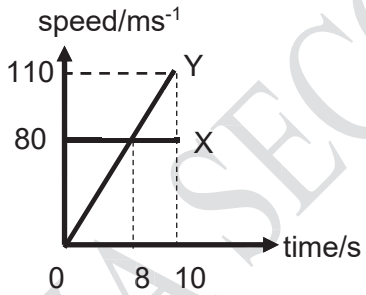
4 The graph below shows how the posistion *s* of an object varies with time *t*.



Which of the following shows the average speed of the object over the 110 s?

A 0.73 m/s **B** 1.45 m/s **C** 58 m/s **D** 6400 m/s

5 Two cars in a race, X and Y, start off from the same point. The following graph shows how their speeds vary with time. One car wins the race at time 10 s.



Which of the following statements is true?

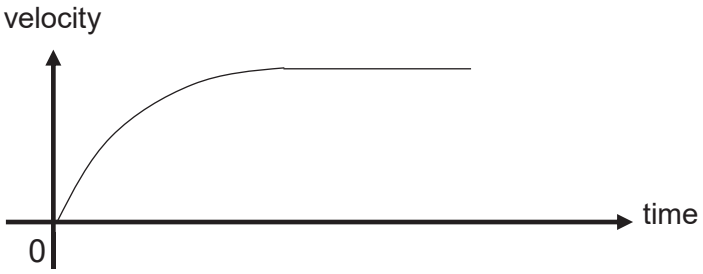
A X and Y meet at time 8.0 s.

B X travels twice the distance as Y at 8.0 s.

C Y eventually wins the race at time 10 s.

D Y travels a greater distance than X over the 10 s.

6 The following diagram shows how the velocity of a rocket vary over time.



Which of the following describes how the resultant force on the rocket change with time?

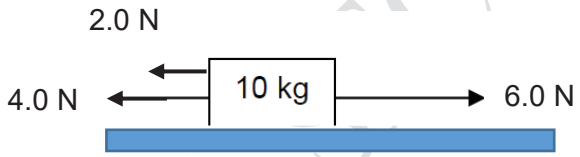
A decreases to a constant non zero-value

B decreases to zero

C increases then remains constant

D remains constant

7 The following shows the forces acting on a 10 kg block that was initially moving to the right.



Which of the following describes the motion of the block at the next instant?

A The block moves towards the right at constant velocity.

B The block moves towards the left at constant velocity.

C The block stops immediately.

D The block moves towards the right but decelerates until it comes to rest.

8 A constant resultant force acts on a block.
Which of the following statements cannot be true?

A The block decelerates.

B The block accelerates.

C The block moves at constant velocity.

D The block's displacement increases at a non-uniform rate.

9 A hot air balloon rises high up the atmosphere. Which of the following describe how the internal gas pressure of the balloon, the gravitational field strength and weight of the balloon change as it rises?

	internal gas pressure of balloon	gravitational field strength	weight
A	decreases	decreases	decreases
B	decreases	constant	constant
C	increases	decreases	decreases
D	increases	constant	constant

10 Which of the following quantities affects the inertia of a lorry?

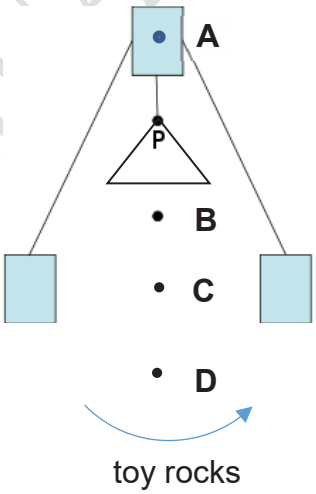
A mass of lorry

B velocity of lorry

C acceleration of lorry

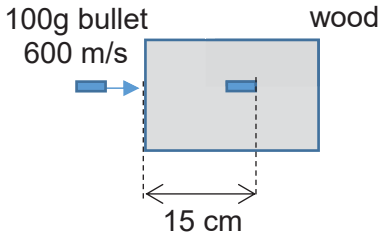
D resultant force on lorry

11 The diagram below shows a stability toy that is made up of three identical rectangular weights connected together. The toy is pivoted at P. The toy can be rocked back and forth as shown.



Which is the most likely centre of gravity of the toy?

12 A 100 g bullet travelling at 600 m/s strikes a piece of wood. It comes to rest 15 cm in the wood.



What is the maximum force acted by the wood to on the bullet decelerate it?

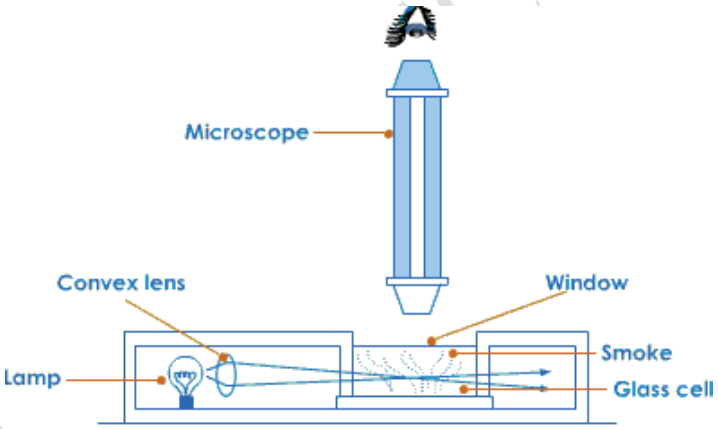
A 2.0×10^2 N

B 2.0×10^3 N

C 1.2×10^5 N

D 1.2×10^8 N

13 The following shows a Brownian motion experiment. Moving bright specks can be seen when viewed under a microscope.



Which of the following describes and explains the observation?

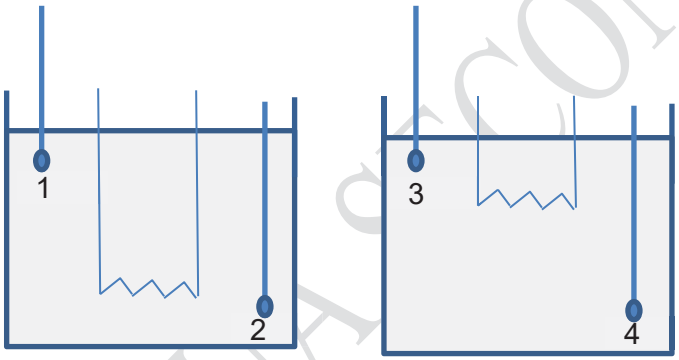
	specks are	motion of specks	cause
A	smoke particles	random	collision with air molecules
B	smoke particles	random	collision with smoke particles
C	air molecules	random	collision with smoke particles
D	air molecules	uniform	collision with smoke particle

14 A balloon filled with air is brought into an air-conditioned room.
Which of the following describes how the speed of air molecules inside the balloon and the distance between them will change?

	speed	distance between air molecules
A	decreases	decreases
B	decreases	increases
C	constant	constant
D	increases	decreases

15 An experiment was conducted to determine if conduction or convection was the more dominant form of heat transfer in water.

Two identical tanks of water, X and Y, are filled with the same volume of water and heated by identical heaters at the same time. Temperature probes are placed at the locations 1 to 4 below.



Which one of the following shows which temperature probe heats up the fastest?

	heats up the fastest	→		heats up the slowest
A	3	1	2	4
B	3	2	1	4
C	2	3	1	4
D	4	2	1	3

16 Which of the following shows the units for specific latent heat of vaporisation?

A J

B J/kg

C J/kg K

D J/kg ºC

17 The resistance of a thermistor R is used as the property used to measure temperature. Its calibrated readings are as shown.

R at ice point / Ω	R at steam point / Ω
100	600

Which of the following shows the R reading at 25 ºC?

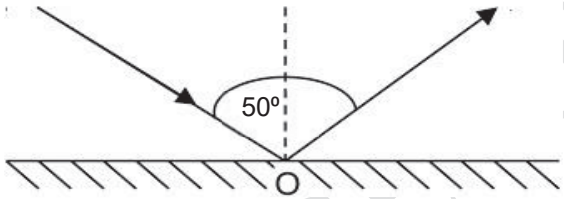
A 125 Ω

B 150 Ω

C 225 Ω

D 750 Ω

18 A ray of light is incident on the mirror at an angle of 50º.



The mirror is subsequently rotated clockwise about point O by 20º with the incident ray remaining the same. The reflected ray is observed to rotate as well.

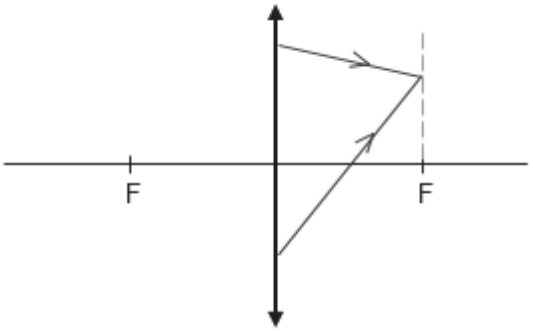
What is the new angle of reflection?

A 20º **B** 40º **C** 70º **D** 140º

19 The speed of light in a diamond is 1.25×10^8 m/s. Light slows down when travelling from air to diamond. Which of the following is the refractive index of diamond?

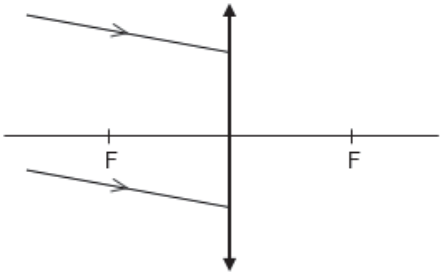
A 0.42 **B** 1.3 **C** 1.5 **D** 2.4

20 The diagram below shows two rays emerging from a converging lens.

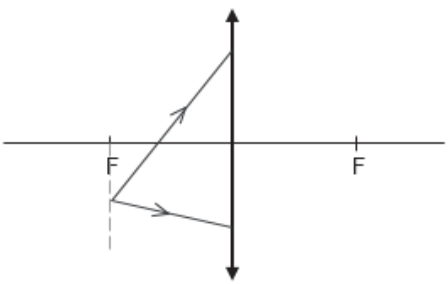


Which of the following incident rays could have produced them?

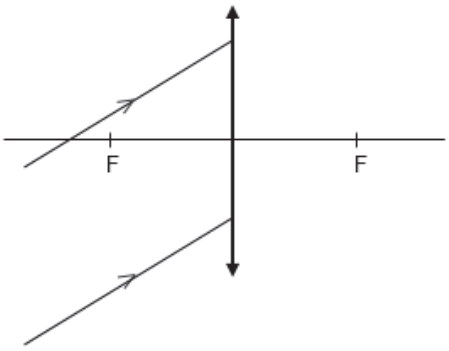
A



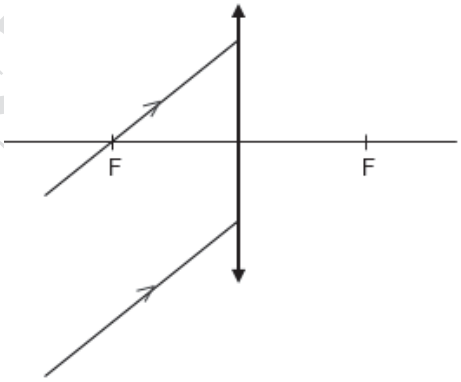
B



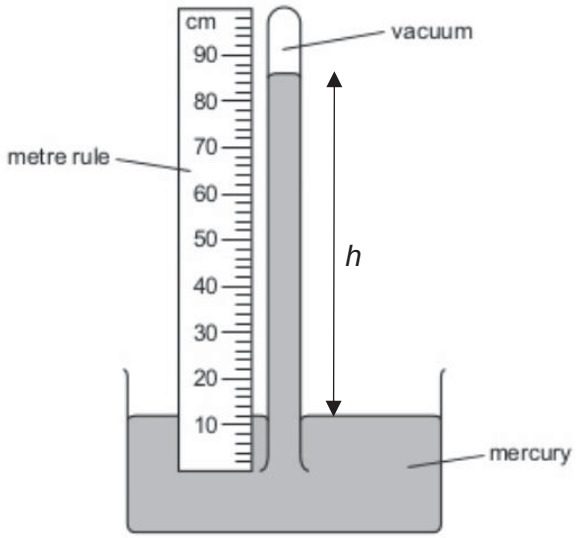
C



D



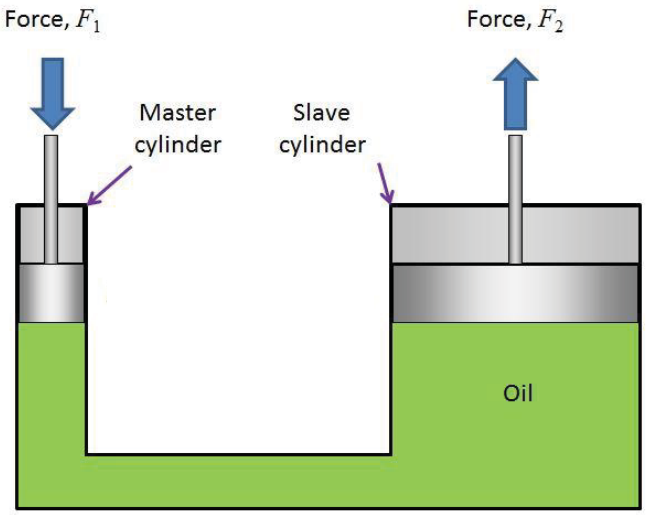
21 The diagram shows a barometer filled with mercury which has a density of 13600 kg/m^3.



If the liquid in the barometer is changed to water of density, 1000 kg/m^3, what is the new height, *h*, of the liquid column?

A 5.4 m **B** 10.1 m **C** 10.5 m **D** 11.7 m

22 The diagram shows a simple hydraulic system. When a force of 3.0 N (F_1) is applied on the master cylinder, the force exerted on the slave cylinder is 9.0 N (F_2).



Which statement wrongly describes the hydraulic system?

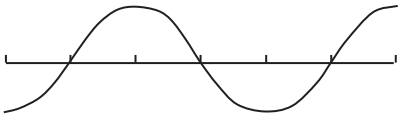
A Pressure exerted at the master and slave cylinder is the same.

B The work done by F_1 is the same as the work done by F_2.

C The upwards distance moved by the piston at the slave cylinder is smaller than the downwards distance moved by the piston at the master cylinder.

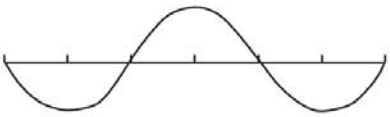
D The diameter of the piston at the slave cylinder is three times larger than the diameter of the piston at the master cylinder.

23 A student generates a transverse wave in a long rope and the wave travels to the right. He makes two oscillations in 1.6 s.

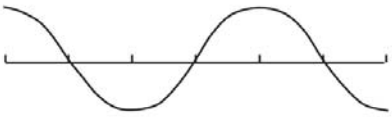


Which of the following correctly represents the shape of the rope 1.0 s later?

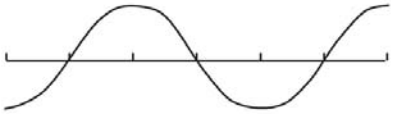
A



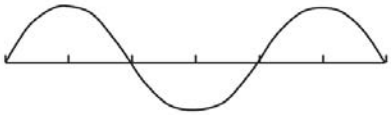
B



C



D



24 Fig. 24 A shows the displacement-time graph and Fig. 24 B shows the displacement-distance graph of a wave.

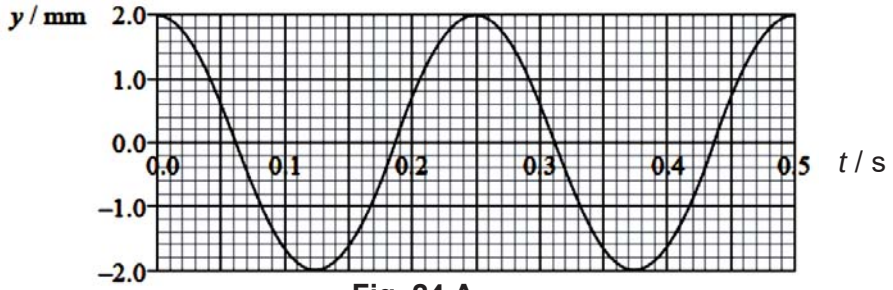


Fig. 24 A

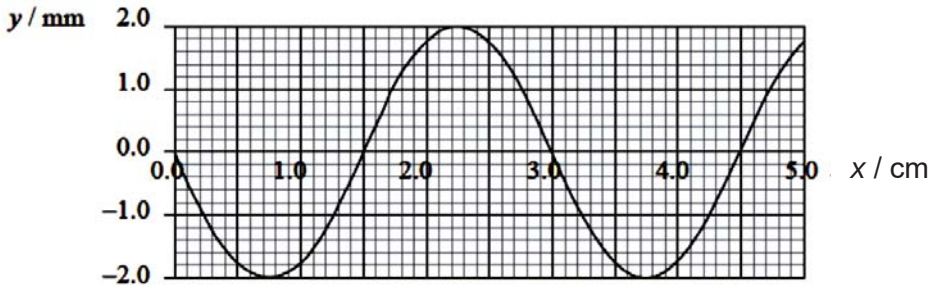


Fig. 24 B

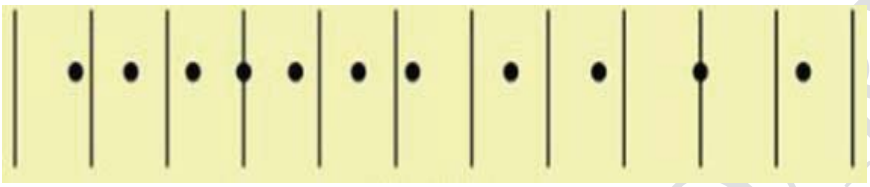
What is the speed of the wave?

A 0.083 cm/s **B** 0.75 cm/s **C** 0.90 cm/s **D** 12 cm/s

25 A student uses echo sounding to measure the depth of a certain sea. Ultrasound travels at 340 m/s in air. The ultrasound is then sent vertically down into the sea and the reflected signal is picked up 30 s later. It is given that sound waves travel 4.2 times as fast in water than in air. The depth of the sea is

A 10.2 km **B** 20.8 km **C** 21.4 km **D** 42.8 km

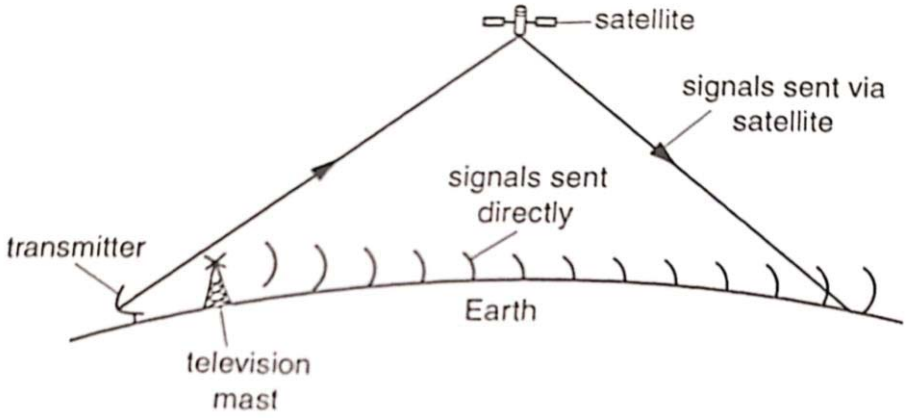
26 The diagram shows the actual position of the particles of a medium at a particular instance when a longitudinal wave passes though the medium. Before the wave arrived, the particles were located on the vertical lines.



What is the amplitude and wavelength of the wave?

	amplitude / cm	wavelength / cm
A	0.5	6.0
B	0.8	6.0
C	0.8	12.0
D	1.6	12.0

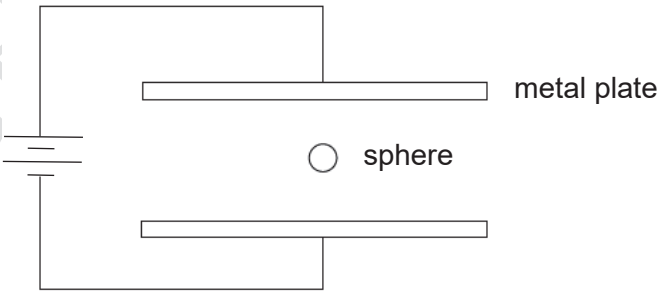
27 The diagram shows two types of waves used for telecommunication. Wave X is used for space-based communication between a satellite and a dish. Wave Y passes signals between transmitters and receivers on earth.



What are waves X and Y?

	wave X	wave Y
A	microwave	radio wave
B	ultrasound	infra-red
C	radio wave	microwave
D	infra-red	ultrasound

28 A charged sphere is suspended between two metal plates that are vertically facing each other.



What is the charge of the sphere?

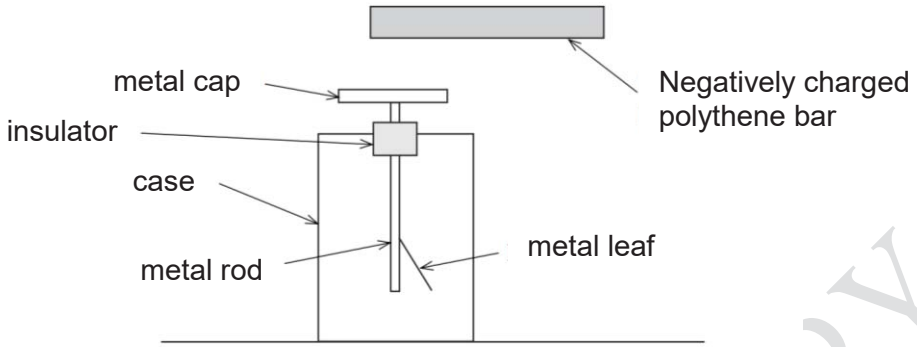
A neutral

B negatively charged

C positively charged

D cannot be deduced

29 The diagram shows a negatively-charged polythene bar held near the metal cap of an uncharged leaf electroscope, causing the leaf to deflect.



Why did the metal leaf deflect away from the metal rod?

A The positive charges in both the leaf and the rod move towards the cap and the bottom of the rod and the leaf are negatively charged.

B Excess electrons move towards the leaf and the bottom of the rod and leaf are negatively charged.

C Electrons move towards the bottom of the rod and the rod repels the neutral leaf.

D Electrons move to the cap and the rod repels the neutral leaf.

30 The current in the lightning strike is 7800 A. One electron has a charge of 1.6×10^{-19} C. If a strike last for 230 ms, how many electrons are transferred to the ground?

A 5.42×10^{-18}

B 2.87×10^{-16}

C 1.12×10^{22}

D 1.12×10^{25}

31 Which statement correctly defines potential difference?

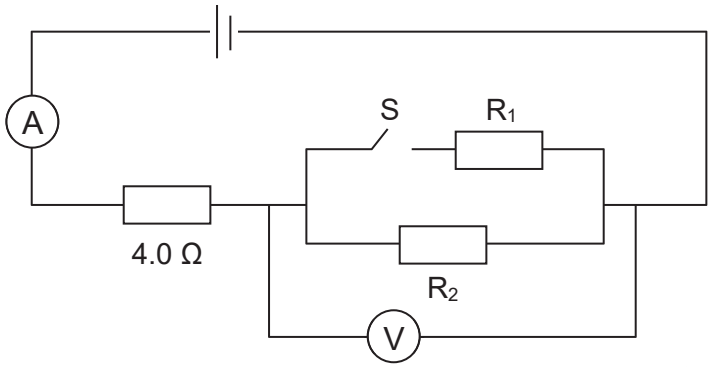
A Work done by a source to drive an electron around a complete circuit.

B Work done by a source to drive a unit charge around a complete circuit.

C Work done to drive an electron through a component.

D Work done to drive a unit charge through a component.

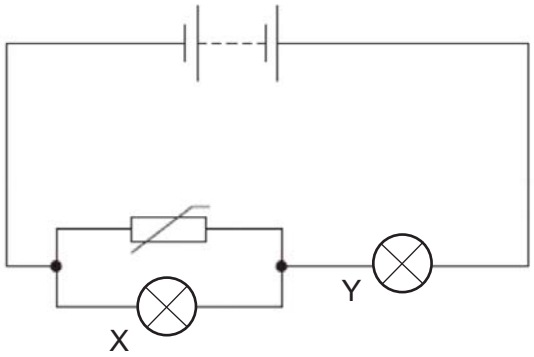
32 Two resistors R_1 and R_2 are connected up in a circuit as shown in the diagram below. When switch S is open, the ammeter reads 1.0 A and the voltmeter reads 8.0 V. When the switch S is closed, the ammeter reads 1.5 A and the voltmeter reads 6.0 V.



What are the resistances of R_1 and R_2?

	R_1 / Ω	R_2 / Ω
A	4.0	4.0
B	4.0	8.0
C	8.0	4.0
D	8.0	8.0

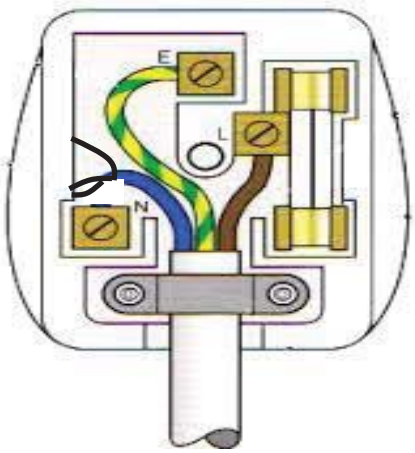
33 The diagram shows a circuit which has two bulbs X and Y, and a thermistor.



How did the brightness of the bulbs change if the temperature of the thermistor increases?

	bulb X	bulb Y
A	brighter	dimmer
B	dimmer	brighter
C	brighter	brighter
D	dimmer	dimmer

34 One of the wires in the three pin plug of a metal toaster was not connected properly as shown.



Which of the following will occur as a result of this error?

A The toaster cannot be switched on.

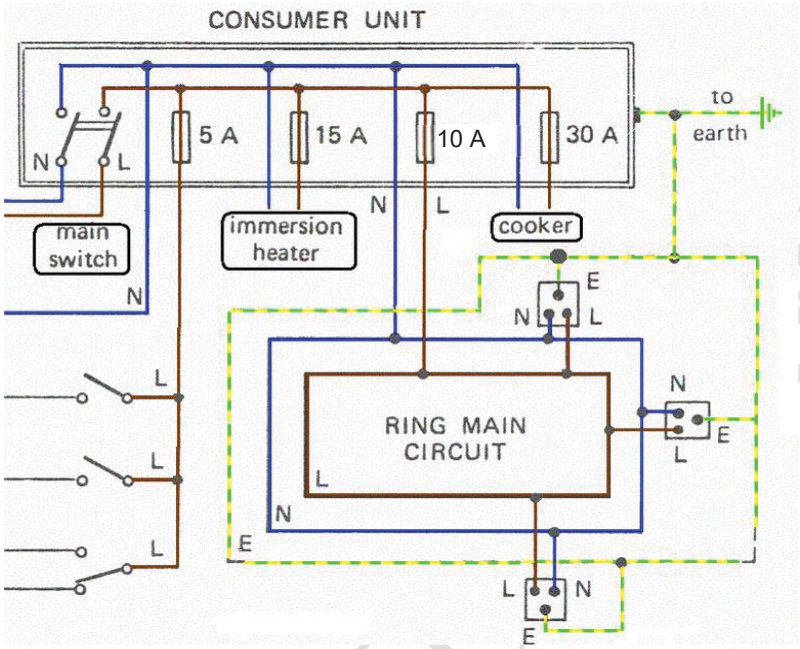
B The fuse will blow but the toaster will still remain live.

C The fuse will blow and the toaster will be cut off from the high voltage.

D The toaster will still be able to work but the current is decreased.

35 The following diagram shows part of a ring main circuit with a live potential of 250 V and the circuit is connected to a 10 A of the consumer unit.

Three identical electric irons, each with a power rating of 1000 W, 250 V are plugged in simultaneously into each of the 3 sockets. Each of the 3 pin-plug is fitted with a 13 A fuse.



Which of the following describe what happens when the 3 irons are switched on simultaneously?

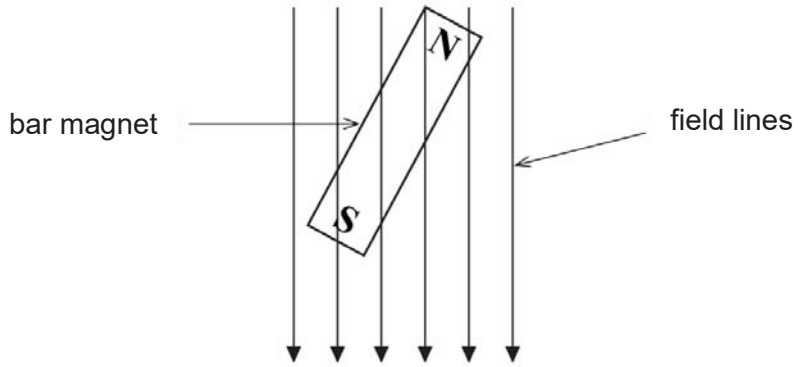
A None of the fuses in the plugs and the 10 A fuse will blow.

B All of the fuses in the plugs and the 10 A fuse will blow.

C The 10 A fuse will blow but the fuses in the plugs will not blow.

D The fuses in the plugs will blow but the 10 A fuse will not blow.

36 The diagram shows a bar magnet in a magnetic field.



When the magnet is released, how will it move?

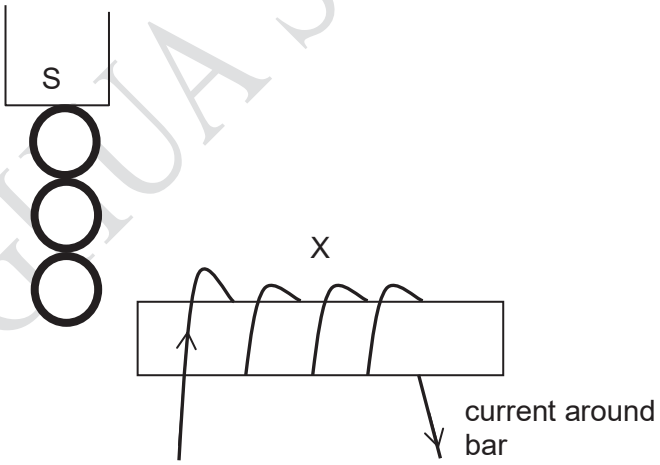
A Rotate clockwise

B Rotate anti-clockwise

C Remain stationary

D Move to the bottom of the page

37 The diagram shows a strong magnet holding a chain of three small iron rings. If a steel bar solenoid X, is brought close to the end of the last ring, the chain of rings will



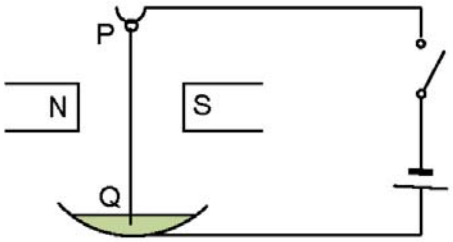
A bend towards X.

B bend away from X.

C remain stationary.

D touch X and repel away from X.

38 A copper wire PQ, is hung at pivot P between two strong permanent magnets. The end Q of the wire is dipped in a copper dish of mercury.



When the switch is closed, the wire PQ moves

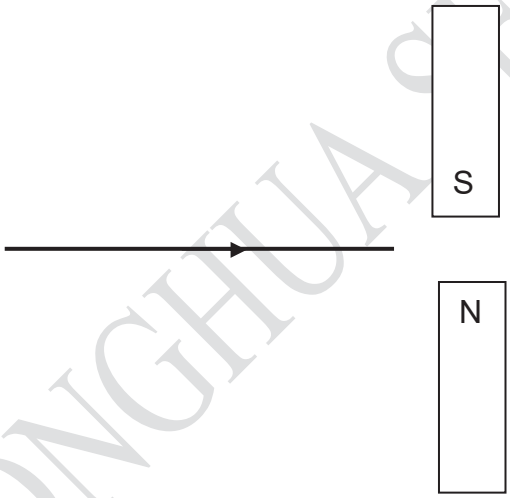
A left of paper.

B right of paper.

C out of paper.

D into the paper.

39 The diagrams a beam of electrons traveling towards two pieces of magnets.



What is the effect of the magnetic field on the beam of electrons?

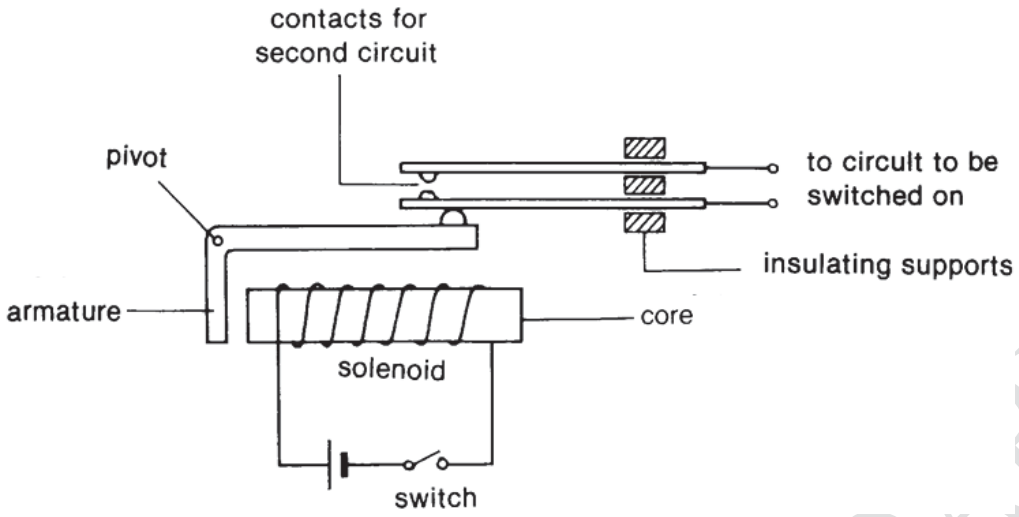
A They are deflected to the top of the paper.

B They are deflected to the bottom of the paper.

C They are deflected out of the paper.

D They are deflected into the paper.

40 The diagram shows a relay.



What statement is correct?

A The armature is attracted to the solenoid when the switch is closed and closes the contacts for the second circuit.

B The armature is repelled away from the solenoid when the switch is closed and closes the contacts for the second circuit.

C The armature is made of steel so that it can retain its magnetism.

D The core is made of steel so that it can retain its magnetism.

END OF PAPER

ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2020

SECONDARY 4E

Candidate's Name	Class	Register Number

PHYSICS **6091 /02**

16 September 2020
1 hour 45 minutes

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 spaces provided on the question paper.

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	/50
11	/10
12	/10
13 ___	/10
Total	/80

Set by: Mr Lawrence Tang and Mrs Ngiam-Fok Kar Yin
Vetted by: Mr Tan Jun Hong

Section A

Answer **all** the questions.

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

1 Fig. 1.1 shows positions (not to scale) of three charges, Q_1, Q_2 and Q_3.

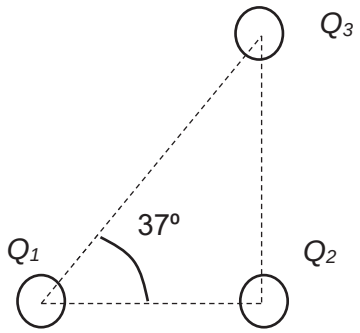


Fig. 1.1

The three charges interact with each other and produce electrostatic forces.

The information about the three charges and their forces are as follows.

- Q_1 and Q_2 are positive charges, Q_3 is a negative charge.
- Q_2 acts on Q_1 with a force of F_A = 5.0 N and Q_3 acts on Q_1 with a force F_B of 3.0 N.

Determine the resultant force of F_A and F_B acting on charge Q_1 by means of a scaled diagram.

scale 1 cm : _____ N

[4]

2 Fig. 2.1 shows four rays, R_1, R_2, R_3 and R_4 (not to scale) emerging from a lamp 1.2 m below a swimming pool. The critical angle of water is 49º.

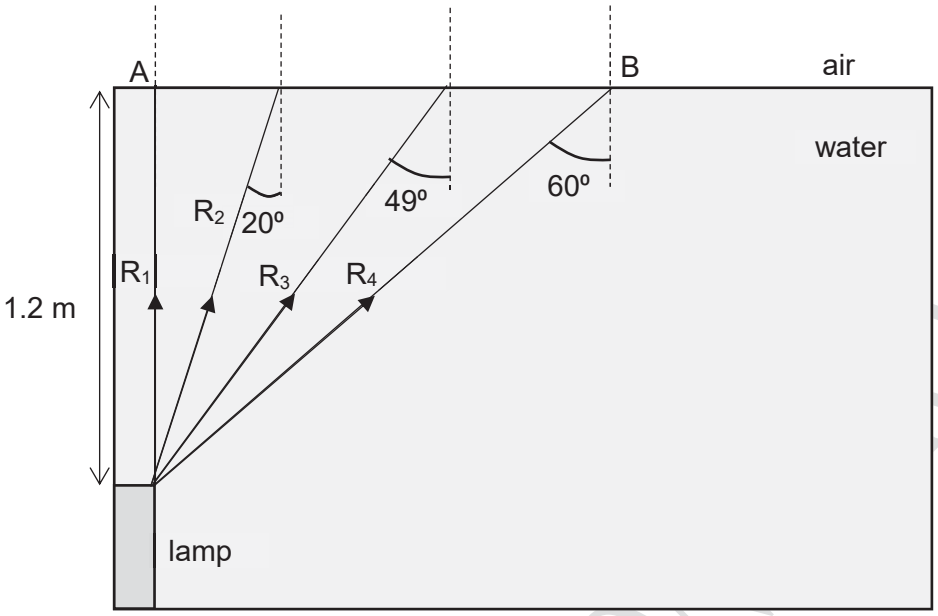


Fig 2.1

(a) Complete the subsequent path of the 4 rays in Fig. 2.1. [2]

(b) Calculate the refractive index of the water and hence the angle of refraction for R_2.

refractive index = ... [1]

angle of refraction = ... [1]

(c) Fig 2.2 shows how the rays of light from the lamp form a bright semi-circle (with radius AB) when viewed from above the pool.

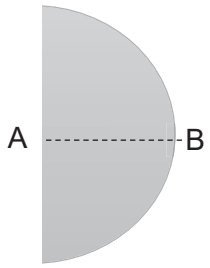


Fig 2.2

Calculate the distance AB.

distance AB = ... [1]

3 Fig 3.1 shows an object O placed in front of a thin converging lens. The resulting image I is also shown.

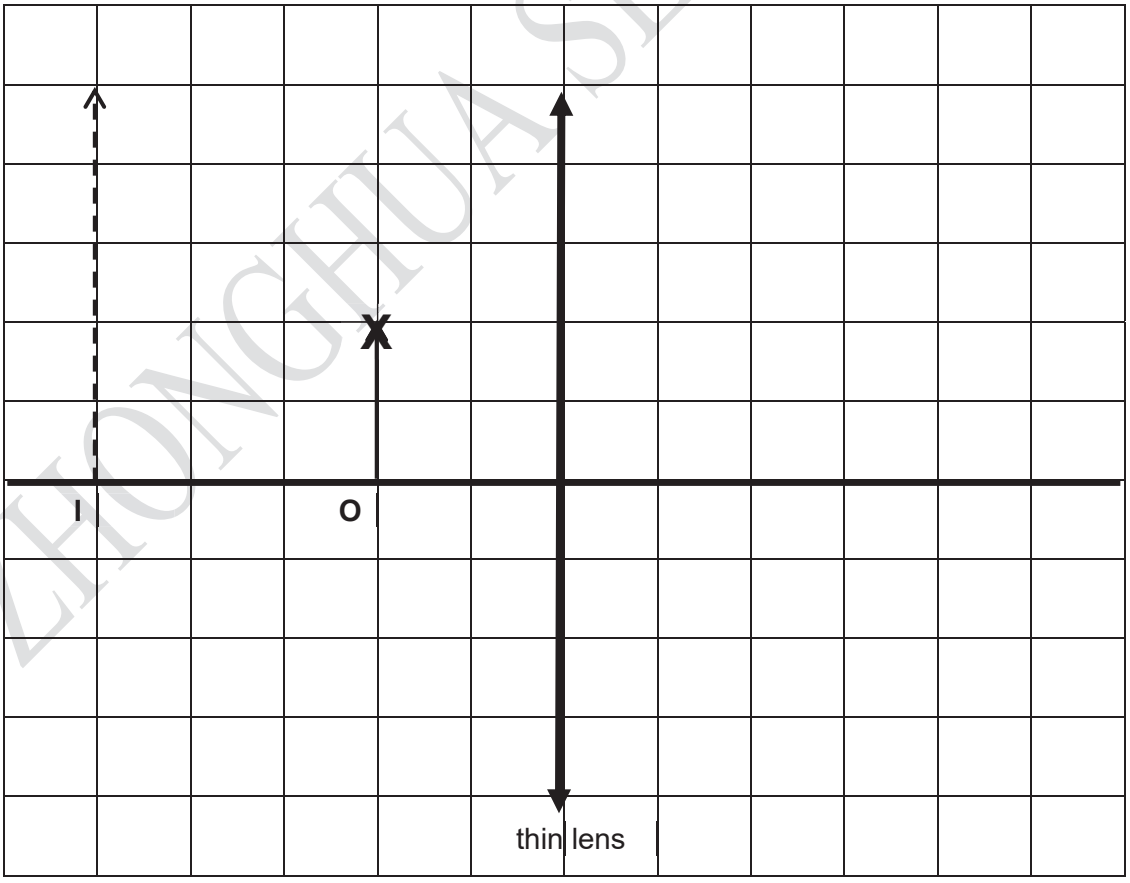


Fig. 3.1

(a) Draw two sets of rays (incident, refracted and virtual rays) from point X on object O to show how I is formed. [2]

(b) Label the focal length *f* clearly in Fig 3.1. [1]

(c) State two characteristics of the virtual image formed.

.....

..... [1]

4 Fig. 4.1 shows a reservoir on a hill that will be used to supply water to a new housing development project. The gate holding the water in the reservoir is not opened yet.

The reservoir is 40 m above the lowest point of the water pipe. The reservoir's water volume is estimated to be 1.3×10^7 m^3.

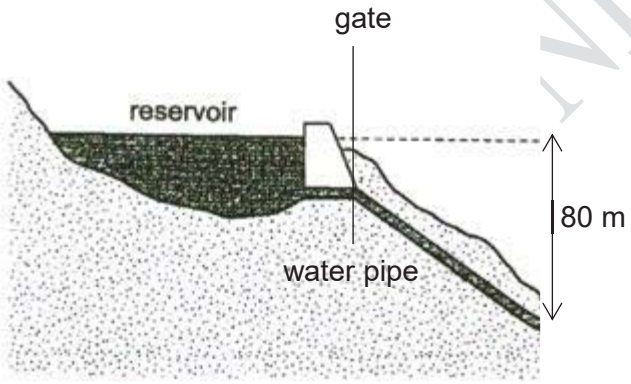


Fig. 4.1

(a) Calculate the mass of the water if the density of water is 1000 kg/m^3.

mass of water = ... [1]

(b) After the water pipes are constructed, the gate is opened and the water rushes into the pipes. The thermal losses due to the frictional forces in the pipes are estimated at 10%.

Calculate the velocity of the water when it reaches the bottom of the pipes.

velocity = ... [3]

(c) Fig 4.2 shows the completed housing development project.

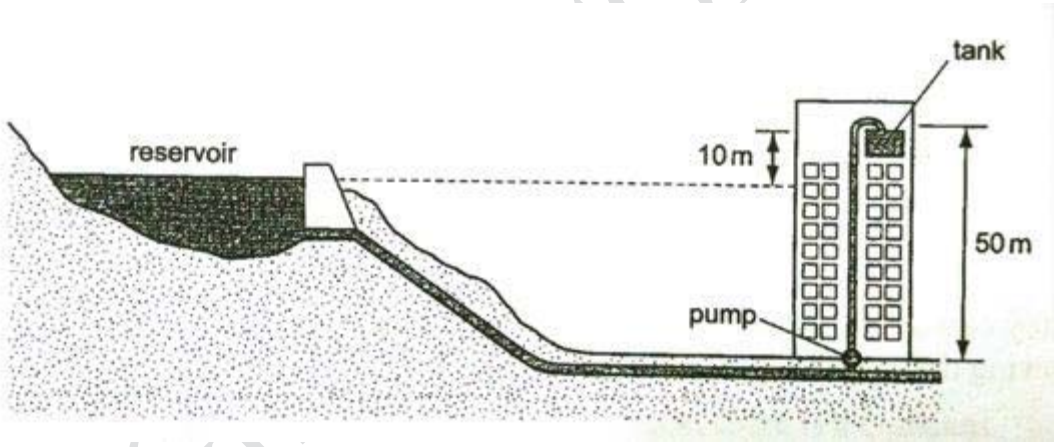


Fig. 4.2

A pump is needed to transport the water for storage in a water tank.

(i) Calculate the work done by the pump to transport 1 kg of the reservoir water to the tank.

work done = ... [1]

(ii) Explain how you obtained your answer in **(c)(i)**.

.....

.....

.....

..... [2]

5 Fig. 5.1 shows an analysis of two forces acting on the forearm bone when it carries an exercise ball.

The weight W of the ball is 30 N. The bicep muscle exerts a force F_B on the bone to hold the ball at rest.

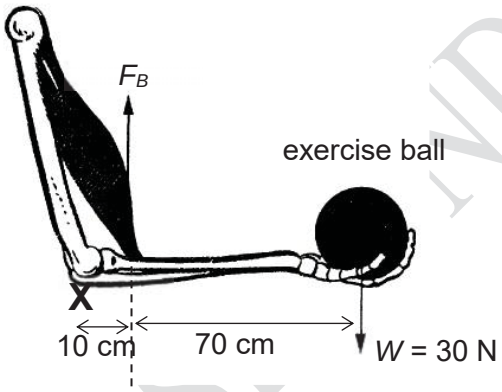


Fig. 5.1

(a) By taking moments about X, calculate F_B.

F_B = ... [1]

(b) There are actually three forces acting on the bone. The third force F_x acts on X. Calculate the magnitude of F_x and state its direction.

F_x = ... [1]

direction of F_x = ... [1]

(c) Fig 5.2 shows a change in the direction of F_B.

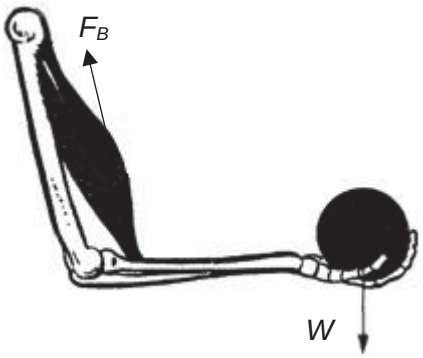


Fig. 5.2

Assuming all the other conditions remaining the same, state and explain the effect of the change in direction of F_B on its magnitude.

.....

.....

.....

..... [2]

6 The apparatus in Fig. 6.1 can be used to measure the density of liquid A. Atmospheric pressure is 1.0×10^5 Pa, h_B = 12.0 cm and density of B is 1000 kg/m^3.

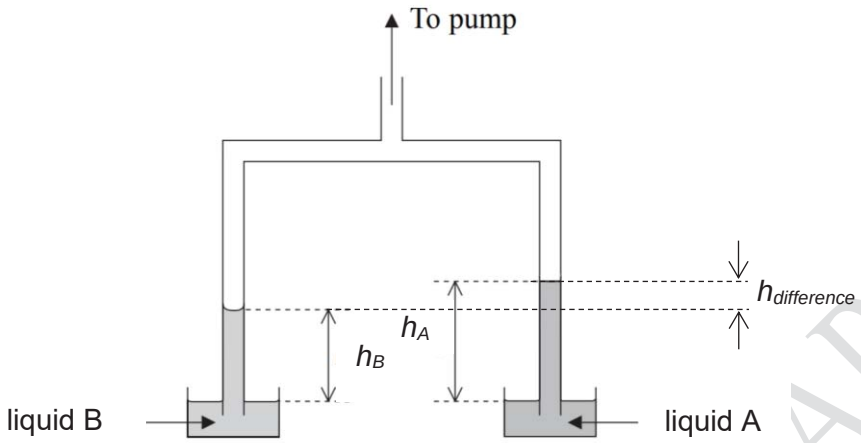


Fig. 6.1

The graphs in Fig. 6.2 show how the density of liquids A and B varies with temperature between –20 °C and 120 °C.

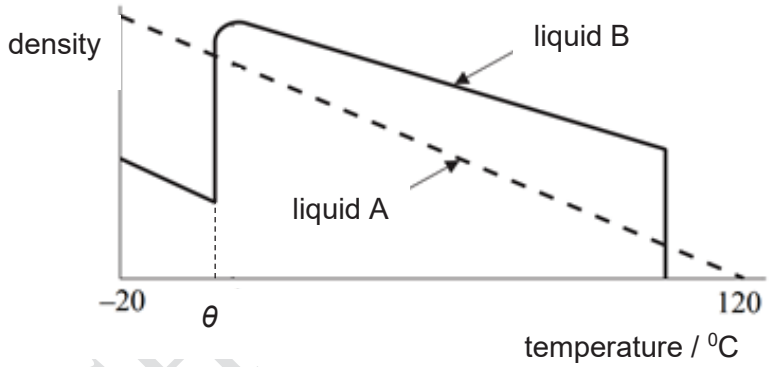


Fig. 6.2

(a) Refer to Fig. 6.1 and state and explain which liquid has a higher density.

.....

.....

[1]

(b) Refer to Fig 6.2 and hence explain if the temperature of the set-up in Fig. 6.1 is more or less than θ.

.....

.....

[1]

7 'Flyaway' hair is hair that spreads and sticks out in all directions, as shown in Fig. 7.1. Instinctively, most people try to tame 'flyaways' with rigorous combing, but this action only worsens the hair condition.

Fig. 7.1

To tame 'flyaways', hair conditioners, which are products that provide smoothening effect to hair, can be used. These products contain cationic polymers – polymers that are positively-charged at one end while the other 'oily' end remains electrically-neutral. When used on wet hair, these polymers attached themselves to the hair strands and remain in place after washing, giving hair a soft, silky feel.

(a) Explain why rigorous combing worsens 'flyaway' hair.

.....

.....

.....

..... [2]

(b) Fig. 7.2 shows a polymer attracted to a strand of hair that is charged due to rigorous combing. Draw the charges in the strand of hair and the polymer in Fig. 7.2.

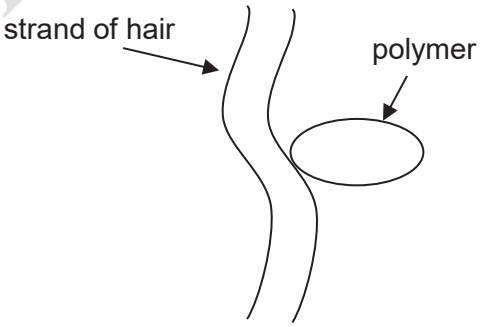


Fig. 7.2

[2]

(c) Hence, explain how hair conditioners are able to tame 'flyaway' hair.

.....

..... [1]

8 A light-emitting diode (LED) needs a minimum voltage to make it emit light. The student investigates this minimum voltage using the circuit shown in Fig. 8.1.

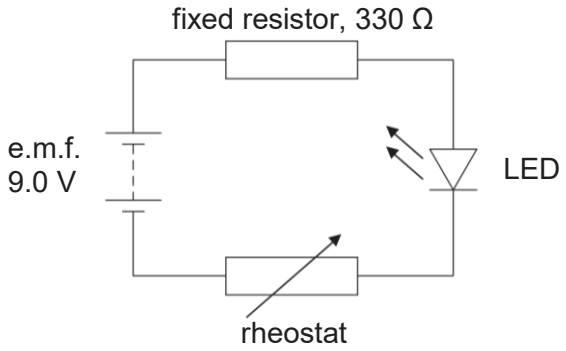


Fig. 8.1

The student gradually increases the voltage across the LED and records the minimum voltage at which the LED emits light. Different colours of light are emitted from the LED when the voltage across it changes. The results for some different LEDs are shown in Fig. 8.2.

colour of light from LED	minimum voltage / V
red	1.7
blue	3.6
yellow	2.1
orange	2.0
green	3.0

Fig. 8.2.

(a) The rheostat is set at 500 Ω and the minimum voltage is recorded by the student when the LED just turns green. Calculate the resistance of the LED.

resistance = ... [2]

(b) Explain what the student can do to change the LED from green to red light.

.....

.....

.....

..... [2]

(c) A potentiometer can also be used to vary the voltage across the LED. Draw the new circuit in the space below that includes the following parts: LED, wires, DC supply and potentiometer. Draw an ammeter and a voltmeter in the correct positions that measure the current and potential difference across the LED.

[2]

9 Fig. 9.1 shows a circuit used to investigate currents in a parallel circuit when the variable voltage supply is varied. The circuit has an ammeter A and a voltmeter V as shown.

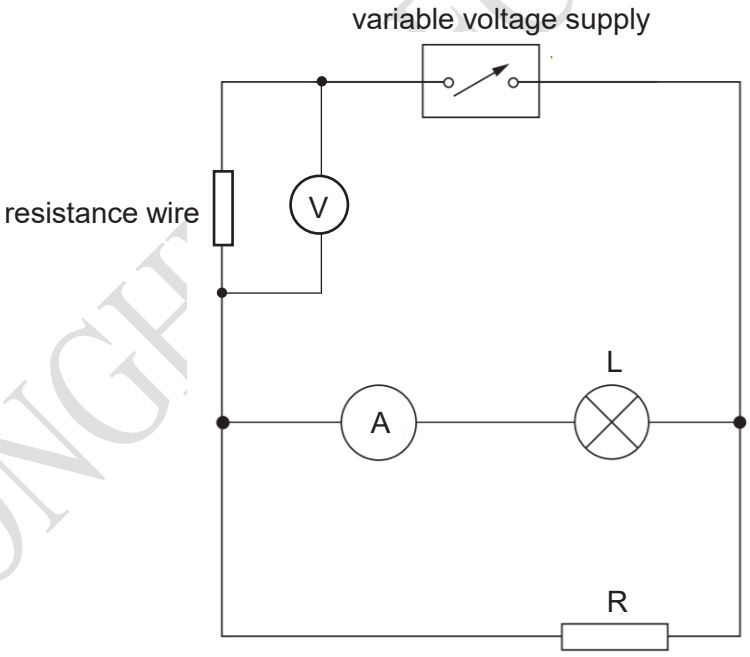


Fig. 9.1

Fig. 9.2 shows how the current in L and R changes with the voltage across them.

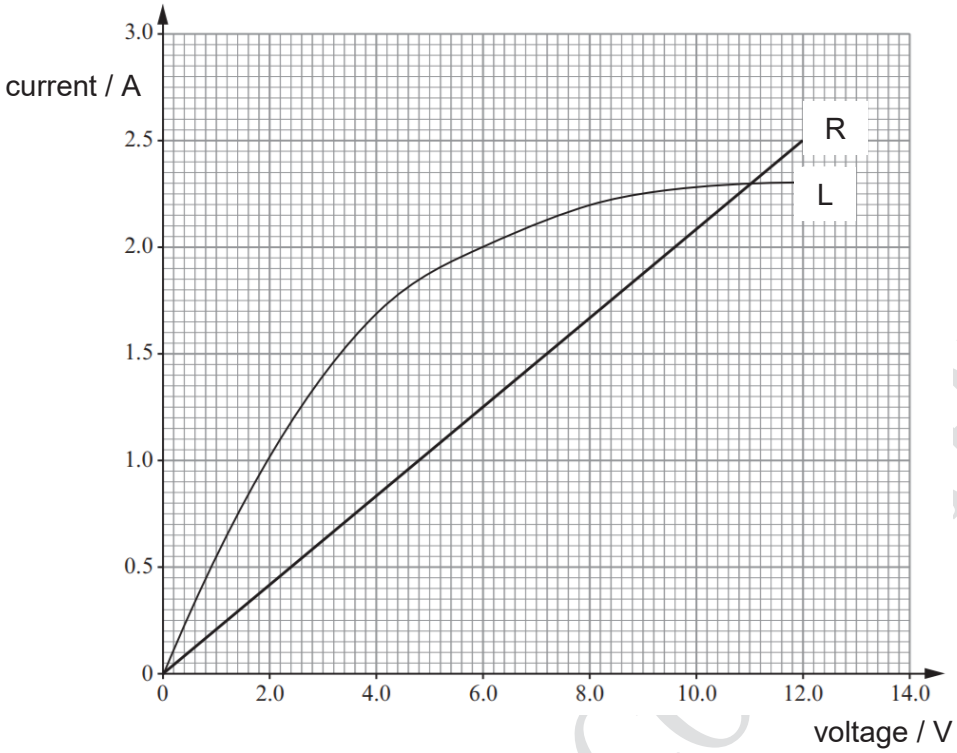


Fig. 9.2

The variable voltage supply is set such that ammeter A is 2.0 A.

(a) Explain if the lamp L obeys Ohm's Law.

.....

..... [1]

(b) Calculate the resistance of the resistance wire if voltmeter V = 6.5 V.

resistance = ... [3]

(c) If the resistance wire is replaced by a new wire of similar material and length but the diameter is doubled, calculate the resistance of the new wire.

resistance = ... [1]

10 Fig 10.1 shows a coil in a magnetic field. The coil is able to rotate about the axis.

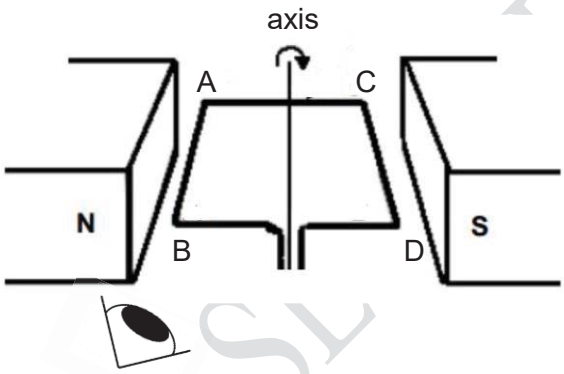


Fig. 10.1

(a) Draw the magnetic field around side AB of the coil due to current only so that the coil turns clockwise, as seen by the eye. [1]

(b) In Fig. 10.1, draw and label the necessary parts to ensure that the coil ABCD turns clockwise continuously. [2]

(c) Fig. 10.2 shows a brushless d.c. motor that can be constructed using three magnets. The magnet in the middle turns clockwise at this instance.

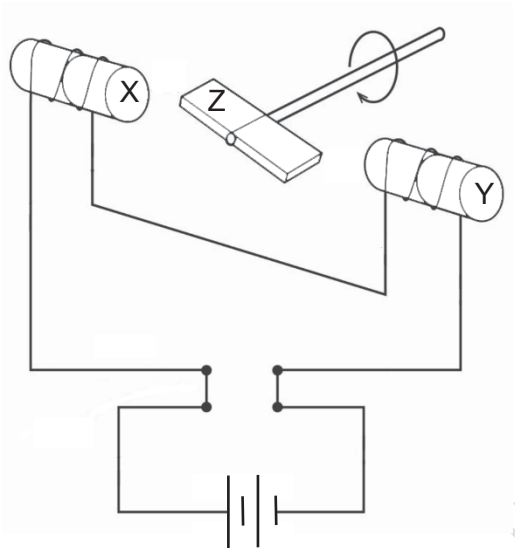


Fig. 10.2

(i) State the polarities of the magnets at positions X, Y and Z. [2]

X: _____ Y: _____ Z: _____

(ii) After the middle magnet rotates half a turn, it remains stationary. Suggest and explain what can be changed to allow it to continue rotating clockwise.

.....

.....

.....

..... [2]

Name: _____ ( )

Class: _____

Section B

Answer all **three** questions, the last question is in the form either/or.
Write your answers in the spaces provided on the question paper.

11 In order to help consumers better identify the more energy efficient models and spur suppliers to offer more efficient products, energy labels are found on electrical appliances such as televisions.

Fig. 11.1 shows the new design of the energy label.

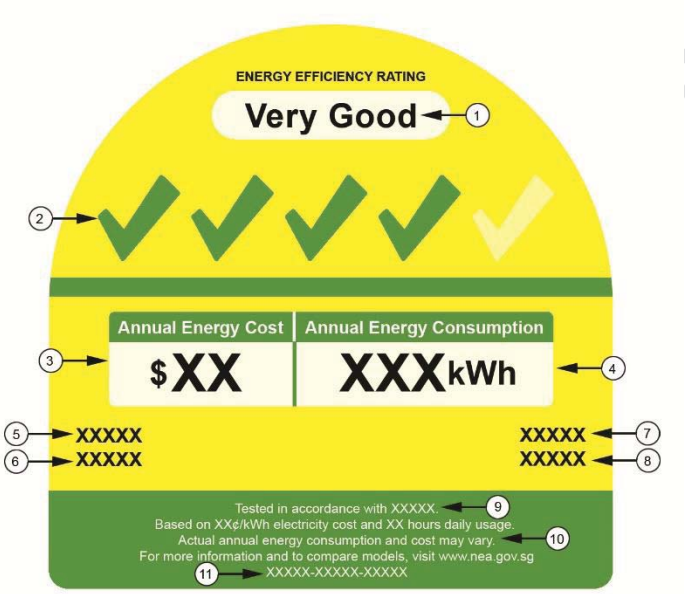


Fig. 11.1

Table 11.1 explains how the energy label is interpreted for features 1, 2, 3 and 4.

Table 11.1

Feature	
(1) Energy Efficiency Rating	<table><tr><th>Ticks</th><th>energy Efficiency Rating</th></tr><tr><td>1</td><td>Low</td></tr><tr><td>2</td><td>Fair</td></tr><tr><td>3</td><td>Good</td></tr><tr><td>4</td><td>Very Good</td></tr><tr><td>5</td><td>Excellent</td></tr></table>
(2) Ticks	The number of ticks shall conform to the Tick Rating System
(3) Annual Energy Cost	Based on 27 cents per kWh electricity cost and 5 hours daily usage
(4) Annual Energy Consumption	Based on 5 hours daily usage, expressed in kWh

Fig. 11.2 shows the energy label for 1 brand of television which has a diagonal screen size of 32 inches (height of 39.9 cm and width of 70.9 cm). The annual energy cost is not shown on the label.

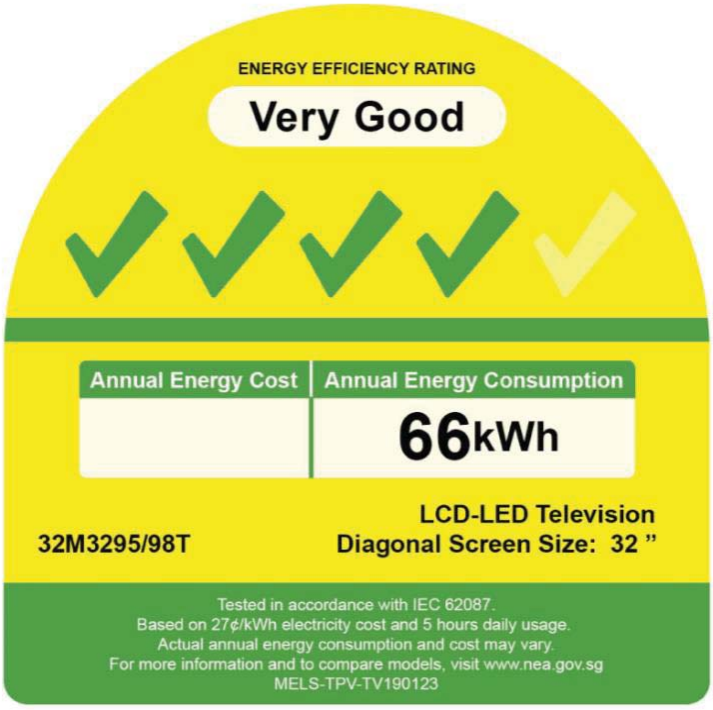


Fig. 11.2

(a) The label in Fig. 11.2 shows that the annual energy consumption of the television is 66 kWh. Assume there are 365 days in a year.

(i) Explain what is meant by *annual energy consumption of 66 kWh*?

.....

..... [1]

(ii) Calculate the on-mode power consumption *P* (power consumed by the television when it produces sound and picture) of the television.

P = ... [2]

(iii) Calculate the annual energy cost of the television, which will be displayed on the energy label in Fig. 11.2.

annual energy cost = ... [1]

(iv) Explain why the annual energy consumption and annual energy cost is only an estimation.

.....

..... [1]

(b) The television is given a rating of four ticks. To be awarded four ticks, the condition is as follows:

"$0.30 \times (20 + 4.3224 \times \text{screen area}) \geqslant P > 0.16 \times (20 + 4.3224 \times \text{screen area})$"

The screen area is expressed in square decimetre.

(i) Calculate the screen area of the 32 inches television and express the area in square decimetre.

area = ... dm^2 [1]

(ii) Explain if the rating of four ticks is accurate.

.....

..... [1]

(c) The power consumption of the television is declared as 50 W. If the voltage supply is 240 V, explain if a fuse rating of 10 A is suitable.

.....

.....

.....

..... [2]

(d) Other than the fuse, describe one possible safety measure that the manufacturer of this television adopts, to prevent consumers from receiving any electrical shocks.

.....

..... [1]

12 Fig. 12.1 shows the construction of a simple loudspeaker.

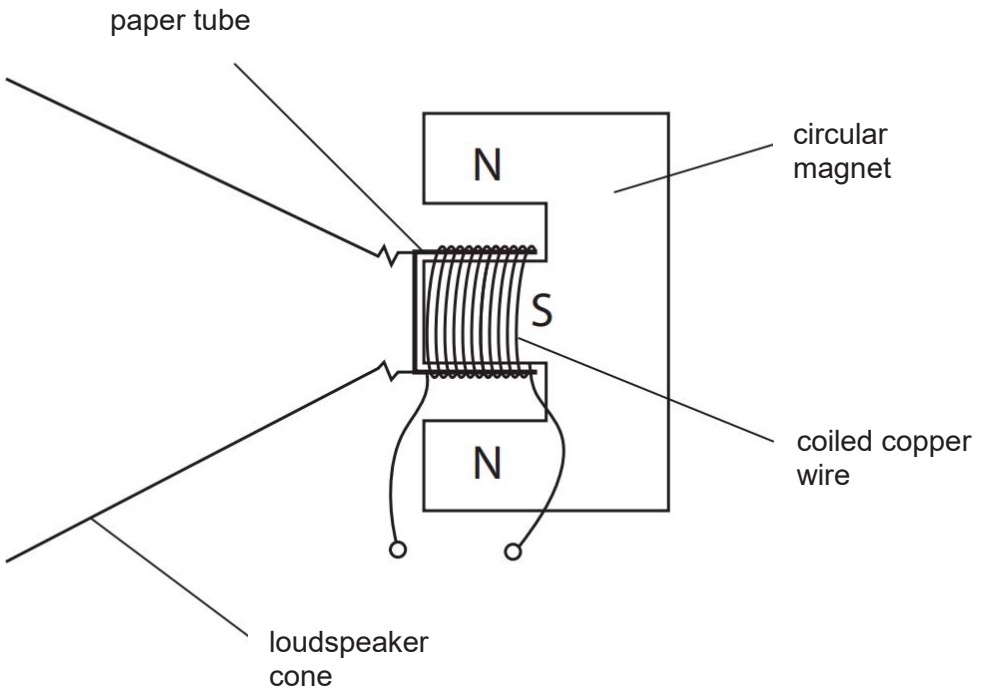


Fig. 12.1

A coil of wire is wrapped around a paper tube attached to the loudspeaker cone. When there is an alternating voltage of 230 V in the coil, the cone moves left or right initially at a frequency of 50 Hz.

(a) Describe what is meant by an *alternating* voltage.

.....

..... [1]

(b) Calculate the period of the motion of the cone.

period = ... [1]

(c) In Fig. 12.1, draw the direction of current in the coiled copper wire if the cone moves left. [1]

(d) Explain your answer for **(c)**.

.....

.....

.....

..... [2]

(e) Describe how the speaker generates a sound wave. You may draw a clearly labelled diagram if it helps your answer.

[3]

(f) Explain how the loudspeaker can produce a louder sound.

[2]

13 EITHER

Fig 13.1 shows a forklift lifting a 2000 N crate on a wooden pallet.

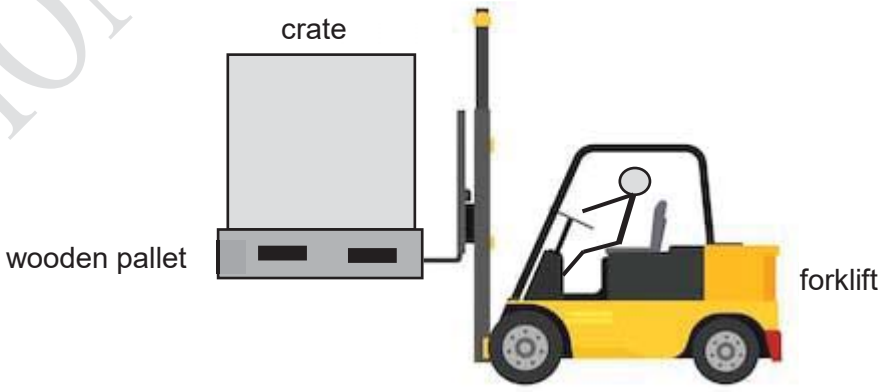


Fig 13.1

Fig 13.2 shows how the vertical velocity of the crate varies over time. It accelerates uniformly for 0.50 s before moving up at constant velocity.

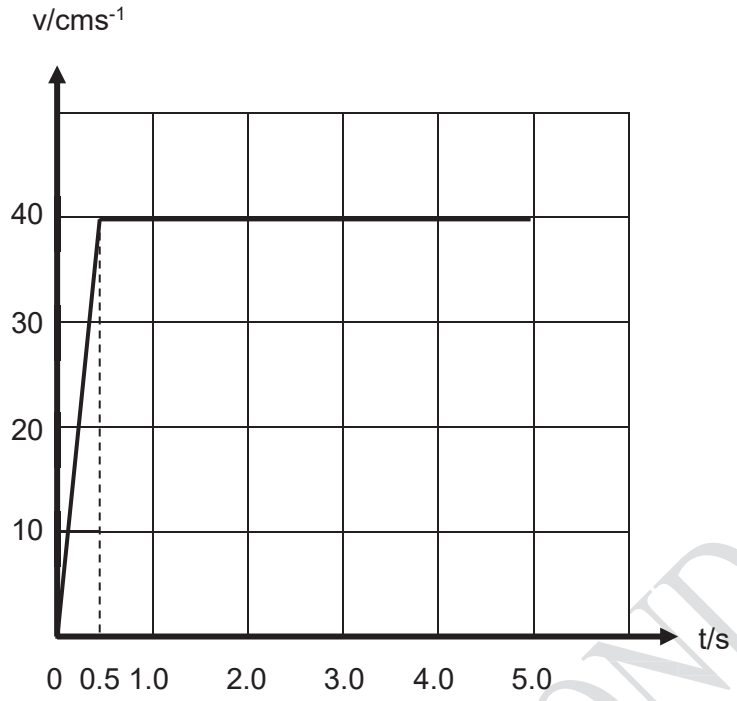


Fig 13.2

(a) Explain what is meant by '*accelerates uniformly for 0.50 s*'.

.....

..... [1]

(b) **(i)** Calculate the acceleration of the crate. Express your answer in SI units.

acceleration = ... [1]

(ii) Calculate the vertical distance travelled the crate in 5.0 s.

vertical distance = ... [1]

(c) Fig 13.3 represents two of the forces due to the interaction between three bodies: the crate, the pallet and the earth. The weight of the pallet is considered to be negligible.

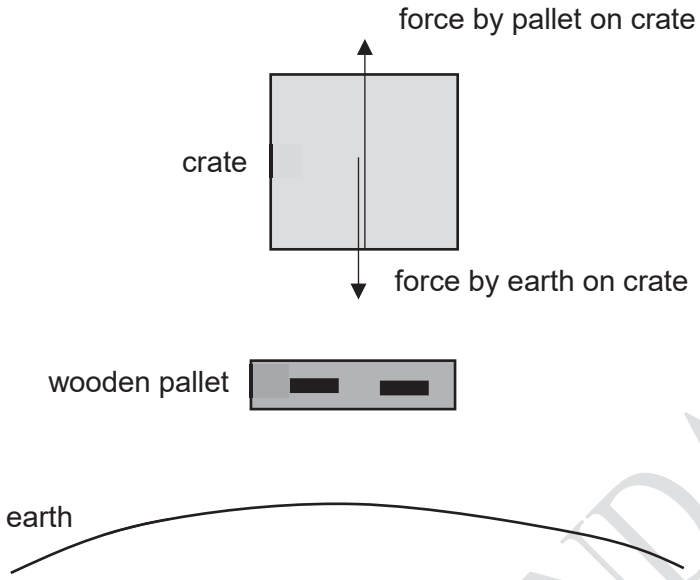


Fig. 13.3

(i) Draw and label the reaction force for each of forces drawn in Fig 13.3. [2]

(ii) By referring to your answers in **(i)**, calculate the resultant force on the crate and hence the force exerted by the pallet on the crate during its acceleration.

resultant force = ...

force by pallet on crate = ... [3]

(iii) Calculate the rate of work done by the fork lift from 0.50 s to 5.0 s.

rate of work done = ... [2]

13 OR

The design of a refrigerated room to store perishable food involves the calculation of a cooling load. A cooling load is the amount of heat that has to be removed from the room in order to maintain the room at a suitable low temperature. Product load and internal cooling load are examples of cooling loads.

Product load Q_p

Part of this cooling load is due to the heat that must be removed from the products or food to keep them fresh. This type of cooling load is known as the product load. The product load is hence the heat that must be removed from the product to maintain it at the refrigerated temperature.

The following is some information needed to calculate the product load of some apples.

- mass of apples = 4000 kg
- initial temperature of apples = 25 ºC
- temperature of refrigerated room = 5 ºC
- specific heat capacity of apples = 3.65 kJ/ (kgºC)

Internal lighting load Q_L

Another cooling load is the amount of heat that must be removed due to the heat generated by lamps.

The following is some information needed to calculate the lighting load.

- Q_L = no. of lamps x hours of use per day x power of lamps
- 3 lamps in cold room rated at 100 W each, running 5 hours per day

https://theengineeringmindset.com/cooling-load-calculation-cold-room/

(a) Explain what is meant by "*specific heat capacity of apples = 3.65 kJ/ (kgºC)*".

.....

.....

.....

..... [2]

(b) **(i)** Calculate the product load Q_P of the apples to keep them refrigerated at 5 ºC.

product load Q_P = ... [1]

(ii) Calculate the internal lighting load, Q_L in a day.

lighting load Q_L = ... [1]

(iii) Every 24 hours, two workers arrive to transport the refrigerated apples to supermarkets and a new batch of 4000 kg of apples is brought in to replace the old batch.

Hence calculate the rate of heat in watts that must be removed from the refrigerated room in a 24 hour day.

rate of heat = ... W [2]

(c) The rate of heat calculated in **(b)(iii)** is an under-estimate of the true cooling load rate. Suggest two reasons why this may be so.

reason 1: .....

.....

reason 2: .....

..... [2]

(d) Explain why the cooling air-conditioning vents are placed at the top of the room instead of at the bottom.

.....

.....

.....

..... [2]

END OF PAPER

Zhonghua Sec School

Answer Scheme

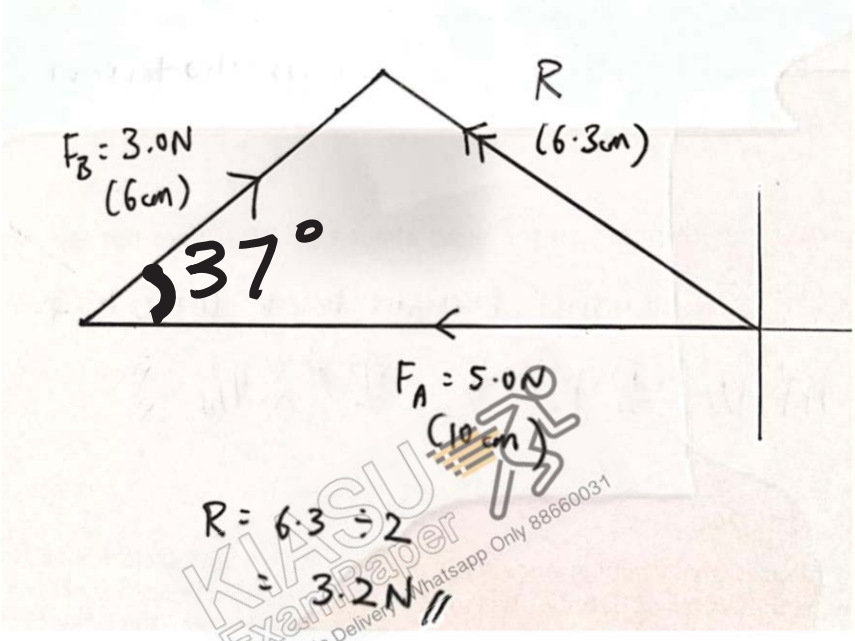
Physics (6091) Prelim 2020

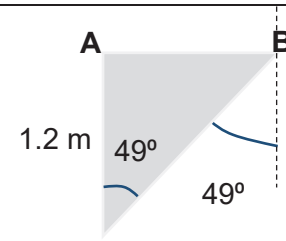
Paper 1

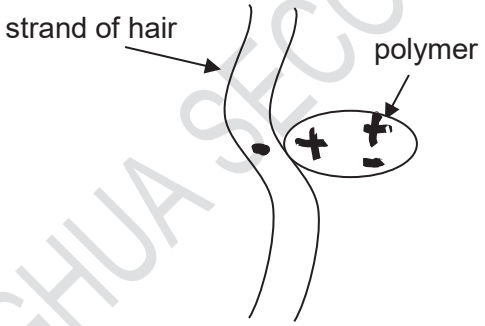
Prelim Paper 1 MCQ Solutions 2020							
1	C	**11**	B	**21**	B	**31**	D
2	A	**12**	C	**22**	D	**32**	D
3	C	**13**	A	**23**	A	**33**	B
4	B	**14**	A	**24**	D	**34**	A
5	B	**15**	A	**25**	C	**35**	C
6	B	**16**	B	**26**	C	**36**	A
7	A	**17**	C	**27**	A	**37**	A
8	C	**18**	C	**28**	B	**38**	D
9	A	**19**	D	**29**	B	**39**	D
10	A	**20**	C	**30**	C	**40**	A

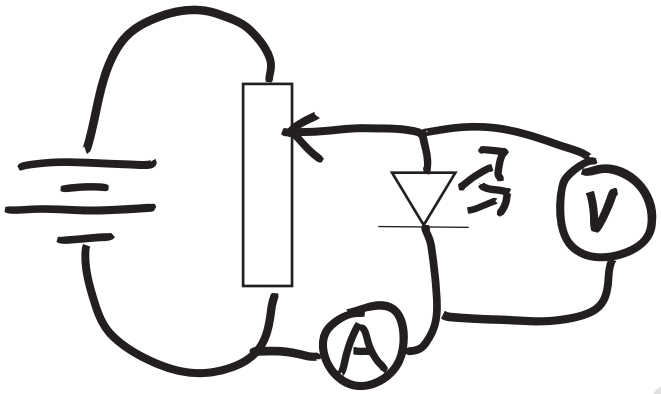
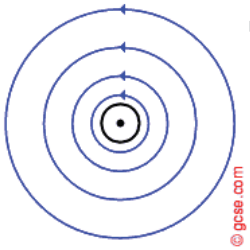
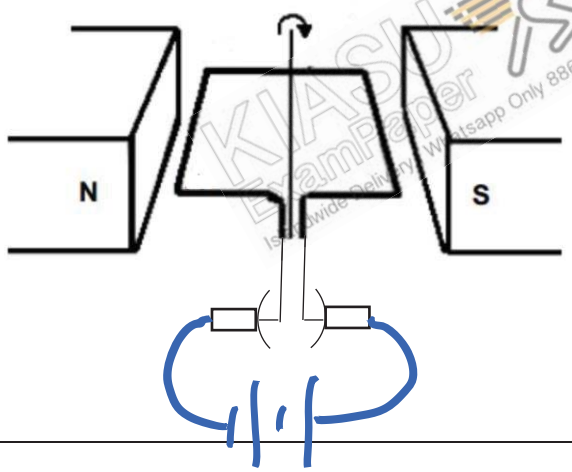
Paper 2

Section A

Question	Answer	Marks
1	Scale: 1cm: 0.5 N  	1 – electric forces direction 1 – arrow + scale 1 – label (includes angle and forces) 1 - ans
2(a)	R_1 passes through with no bending R_2 exits, bends away from normal R_3 skims surface R_4 undergoes total internal reflection	2 rays to get 1 m All to get 2 m

2(b)	n = 1 /sin c = 1 / sin49º = 1.33 1.33 = sin r/sin20º r =26.9 º	 1 1
2(c)	 tan49º = AB/1.2 AB = 1.2 tan49º = 1.38	1
3(a)	3 correct rays	1 m for any correct set of i, r or v rays
3(b)	Label f with indication of length	1
3(c)	Upright, magnified, same side of lens as object (any 2)	1
4(a)	Mass = volume x density = $1.3 \times 10^7\ m^3 \times 1000\ kg/m^3$ = 1.3×10^{10} kg	 1
4(b)	Useful output E / Input E = 0.90 KE / GPE = 0.90 $(½\ v^2) / (gh) = 0.90$ $½\ v^2 = 0.90(10)(80)$ v = 37.9 m/s	Mgh term-1 Eqn -1 Ans – 1
4(ci)	W = mgh where h = 10 m = (1)(10)(10) = 100 J	1
4(cii)	Water in the reservoir will flow until the level in pipes is same as reservoir surface. The pump only needs to lift water up by 10 m.	1 1
5(a)	Taking M about X, CWM = ACM $30(80) = F_B\ (10)$ F_B = 240 N	 1
5(b)	F_B is greater than W, so need downward force to balance Hence F_X is downwards	1

	$F_{up} = F_{down}$ $240 = 30 + F_X$ $F_x = 210$ N	 1
5(c)	F_B increases. As F_B tilts, the <u>perpendicular distance decreases</u>. To maintain the <u>same</u> anti-clockwise <u>moment</u> to balance the clockwise moment, (<u>M = F x d</u>), F_B must increase.	1 1
6(a)	Density of B increases $(h\rho g)_{liquid\ A} = (h\rho g)_{liquid\ B}$ larger h_A × smaller ρ_A = smaller h_B × larger ρ_B OR For the same pressure, the smaller the height of the liquid, the larger the density	1
6(b)	more than θ with reference to Fig. 6.2	1
7(a)	• Rigorous combing results in friction between hair and comb, which results in <u>electrons being transferred from comb to the hair or vice versa.</u> • Hair strands carry like charges and like charges repel.	1 1
7(b)		1: charge of hair 1: charge of polymer (<u>must show neutral region</u>)
7(c)	Positive end of cationic polymers are attracted to the hair strands, as unlike charges attract. <u>Hair strands coated with polymer are neutral,</u> and hence hair strands do not repel each other.	1
8(a)	$V_{led} = [R_{led} / (R_{led} + R_{rheostat} + R_{fix\ resistor})] \times emf$ $3.0 = [R_{led} / (R_{led} + 500 + 330)] \times 9.0$ $R_{led} = 415\ \Omega$ (R LED = 3.0 V / current in circuit) – 1 mark	 1 1
8(b)	Resistance of rheostat must be increased. $V_{led} = [415 / (415 + R_{rheostat} + 330)] \times emf$ Therefore V_{led} will decrease from 3.0 to 1.7 V	1 1

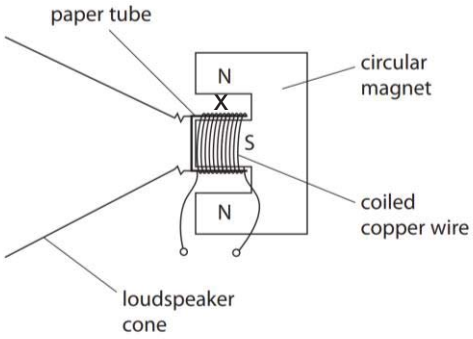
	(state that V is proportional to R. If the resistance of rheostat increases, the voltage will increase too. Since emf = PD of every component, therefore voltage across LED decreases)	
8(c)		1 mark for correct connection of LED and potiometer 2 marks for perfect diagram **A and V in correct position – 1 mark**
9(a)	No because the potential difference across the lamp is not <u>directly proportional</u> to the current through it.	1
9(b)	Current through L = 1.25 A (since L and R has the same potential difference. Current through resistance wire = 2.0 + 1.25 A = 3.25 A Resistance of resistance wire = 6.5 / 3.25 = 2.0 Ω	1 1 1
9(c)	Diameter is doubled implies cross sectional area is increased by a factor of 4 New resistance = 2 / 4 = 0.50 Ω	1
10(a)		1 – dot, direction of B field and multiple B field lines
10(b)		1 – brush and commutator 1 – power supply direction

10(c)(i)	X = Y = Z: South poles	1 – identification of X and Y using RHGR 1 – identification of Z using repulsion principle
10(c)(ii)	The dc supply can be changed to alternating current supply. After half a turn, the X and Z poles will change to north poles and the side magnets will repel the middle magnet and ensure it continues turning CW.	1 1

Paper 2

Section B

Qn	Answer	Marks
11(a)(i)	The television consumes electrical energy of 66 kWh when it is turned on for 5 hours daily, for 365 days. OR Energy consumed in 1 year equals the 66kW appliance being used for an hour	1
11(a)(ii)	66 kWh = power × time 66 000Wh = power × 5 hrs × 365 days power = 36 W	1 1
11(a)(iii)	Annual energy cost = 66 kWh × 27 cents = $17.82	1
11(a)(iv)	The television might not be turned on for 5 hrs, everyday, Or The sound and brightness of the screen might vary.	1
11(b)(i)	height of 39.9 cm and width of 70.9 cm equals height of 3.99 dm and width of 7.09 dm = 28.3 dm^2	1
11(b)(ii)	"0.30 × (20 + 4.3224 × screen area) $\geqslant P >$ 0.16 × (20 + 4.3224 × screen area)" Since 42.7 $\geqslant P >$ 22.8, four ticks is accurate.	1

11(c)	P = VI 50 = 240I I = 0.21 A Fuse rating is unsuitable. Rating should be slightly more than current so that in the event of an electrical fault, it can cut off high voltage supply and appliance is safe to touch. / overheating	 1 1
11(d)	Earth wire is connected to the metal casing of the television Or Switch is located in the live wire. Or Double insulation	1
12(a)	Emf / voltage of power supply changes direction in regular cycles	1
12(b)	Period = 1 / 50 = 0.020 s.	1
12(c)	Current travels to the top of the page	1
12(d)	 At position x: • Using Fleming's LHR, thumb (force), index finger (magnetic field) and middle finger (current) are all perpendicular to one another • Thumb – left of paper, magnetic field – bottom of paper, current – into the paper	 1 1
12(e)	• The direction of current changes and the cone is moves left and right with a period of 0.02 s and vibrates. • The air molecules in front of the cone are being pushed and pulled, setting up regions of compressions and rarefactions (can be drawn) • Wave travels parallel to propagation of energy / longitudinal wave	1 1 1
12(f)	• The current in the wire is increased so that the resultant magnetic force is increased • The amplitude of the sound wave is increased.	1 1
Either		

(a)	For 0.50 s, the object changes (accept increases) its velocity by the same amount.	1
(b)i)	V = 40 cm/ s = 0.40 m/s a = (v – u) / t = (0.40 – 0) / 0.50 = 0.80 m/s^2	 1
(b)ii)	Distance = area under v-t graph = ½ (0.50)(40) + 4.5(40) = 10 + 180 = 190 cm (or 1.90 m)	 1
(c)i)	F by crate on pallet (downwards on pallet) F by crate on earth (upwards on earth)	1 1
(ii)	Resultant force on crate = ma = 200(0.80) = 160 N $F_{\text{by pallet on crate}}$ - W = 160 F – 2000 = 160 F = 2160 N	 1 1 1
(iii)	Work done = weight x d = weight x (speed x time) = 2000 (0.40 x 4.5) = 3600 J Rate of W = 3600 / 4.5 = 800 J/s (or W)	 1 (any Fd) 1
OR		
(a)	3.65 kJ of energy needed to heat 1 kg of apple by 1 K.	2
(b) i)	Q_P= mc $\Delta\theta$ = (4000)(3.65 x 10^3)(25-5) = 2.92 x 10^8 J	 1
(ii)	Q_L = 3 x 5 x 3600 x 100 = 5.4 x 10^6 J or 1500 wH	1

(iii)	Rate of heat = (total heat) / time = (2.92 x 10^{8} + 5.4 x 10^{6}) / (24 x 3600) = 3440 W	1 - (Sum of E)/ time 1 – the rest
(c)	Heat is gained from the surroundings Two workers add heat to the room	1 1
(d)	Cold air <u>sinks as it is denser</u>, allows <u>convection currents</u> to cool whole room.	Sinks alone – 1 Rest - 2nd mark