Class / Index Number	Centre Number / 'O' Level Index Number	Name
/	/	

新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION

SECONDARY FOUR

PHYSICS **6091/01**

Paper 1 Multiple Choice **1 September 2020**

1 hour

Additional Materials:
Optical Test Answer Sheet (OTAS) – 1 sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Answer Sheet.

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 answer in **soft pencil** on the separate Answer Sheet.

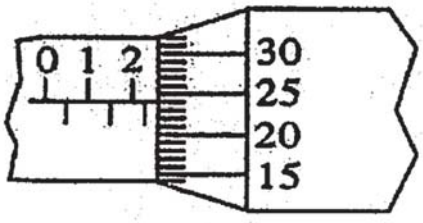
Read the instructions on the Answer Sheet very carefully.

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

The total number of marks for this paper is 40.

At the end of the examination, hand in the following separately:
(1) Optical Test Answer Sheet (OTAS)
(2) Question Paper

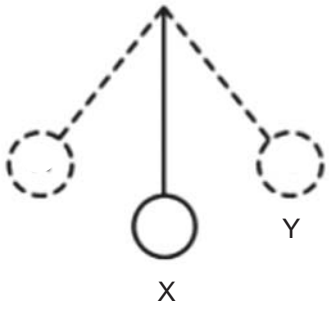
1 A student used a micrometer screw gauge to measure the thickness of an ancient coin.



What is the thickness of the coin if the micrometer screw gauge has a positive zero error of 0.03 mm?

A 2.21 mm **B** 2.24 mm **C** 2.71 mm **D** 2.74 mm

2 The time taken for a pendulum to swing from position X to position Y is 0.75 s.



How many periods are there in one minute of oscillations?

A 10 **B** 20 **C** 50 **D** 100

3 A cyclist, riding at a speed of 10 m/s, brakes with uniform deceleration and stops in 3 m.

How long does the cyclist take to stop?

A 0.3 s **B** 0.6 s **C** 6.7 s **D** 67 s

4 Two objects have the same size and shape but one is lighter than the other. They are each dropped from rest.

Comparing the two objects, the lighter object has

A the lower initial acceleration and the lower terminal velocity.

B the lower initial acceleration and the same terminal velocity.

C the same initial acceleration and the lower terminal velocity.

D the same initial acceleration and the same terminal velocity.

5 An astronaut lands on a planet where the acceleration of free fall at its surface is greater than that on Earth.

Which one of the following will be the same as on Earth?

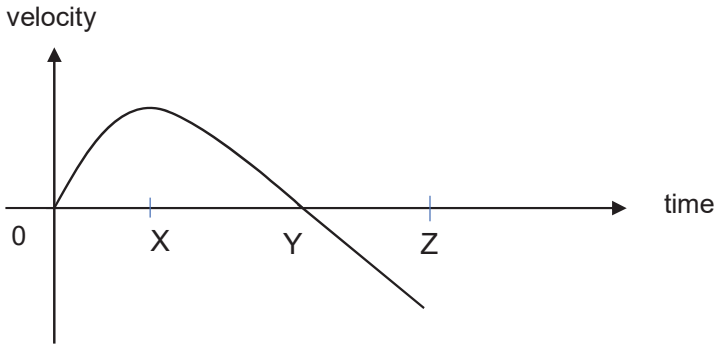
A period of oscillation of a simple pendulum.

B weight of the astronaut.

C easiness in changing the motion of a swinging can of water.

D height reached by the astronaut when he jumps with the same initial velocity.

6 A water rocket is launched vertically upwards. The velocity-time graph below shows the variation of the rocket's velocity with time from the instant it was launched.



Which of the following statement(s) is/are correct?

(1) The rocket reaches the highest position at instant X.
(2) The resultant force acting on the rocket is zero at instant Y.
(3) The rocket is still in the air at instant Z.

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

7 Which statement is correct about velocity and acceleration of the motion of an object?

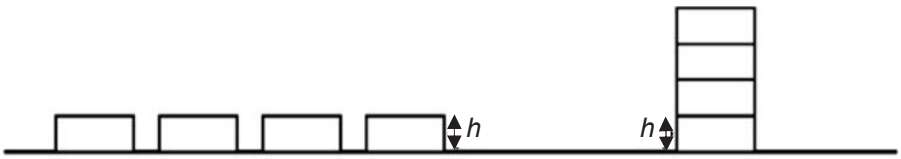
A Acceleration cannot be greater than velocity.

B Velocity and acceleration are always in the same direction.

C When the velocity of the object is zero, the acceleration need not be zero.

D When there is acceleration, there must be a change in speed.

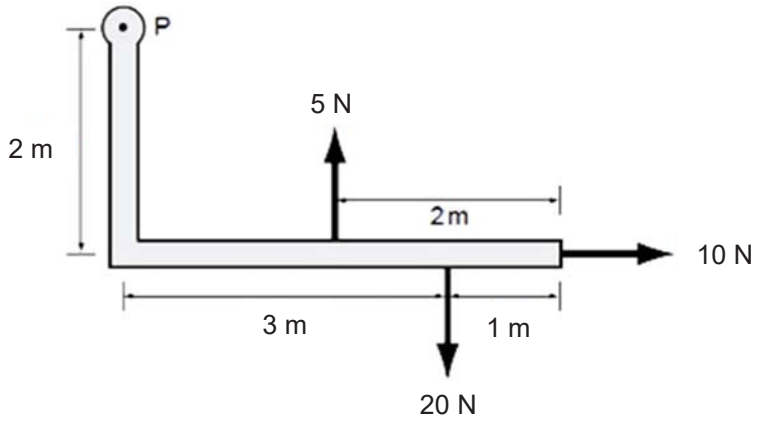
8 Initially, four identical uniform blocks, each of mass m and thickness h, are spread out on a table.



How much work is done on the blocks in stacking them up one on top of another? There is no frictional forces. (Take the Earth's gravitational field strength to be *g*.)

A 4 m*g*h **B** 6 m*g*h **C** 8 m*g*h **D** 12 m*g*h

9 An L-shaped rigid lever arm is pivoted at point **P**.



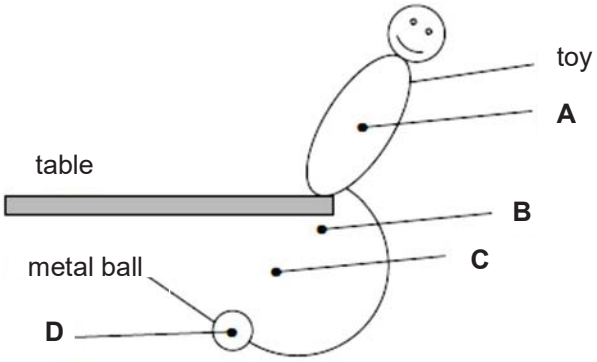
Three forces act on the lever arm, as shown in the diagram.

What is the magnitude of the resultant moment of these forces about point **P**?

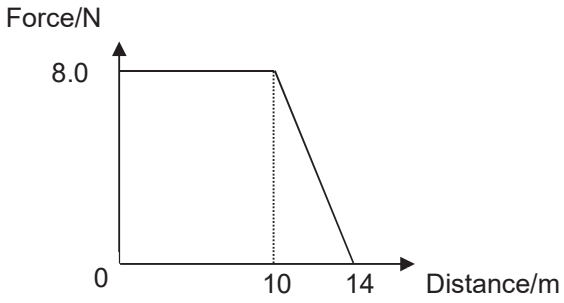
A 30 Nm **B** 35 Nm **C** 50 Nm **D** 90 Nm

10 The diagram shows a toy balanced on the edge of a table and at rest. The toy has a metal ball attached to it.

Where is the likely centre of gravity of the toy?



11 A trolley is pushed along a horizontal path with a force through a distance. The variation of the force with the distance moved is shown in figure below.



The total work done by the force in moving the trolley for a distance of 14 m is

A 64 J **B** 80 J **C** 96 J **D** 112 J

12 A man rides a bicycle and accelerates up a hill.
As the man moves up the slope, how do his gravitational potential energy and kinetic energy change?

	gravitational potential energy	kinetic energy
A	decreases	decreases
B	decreases	increases
C	increases	increases
D	increases	decreases

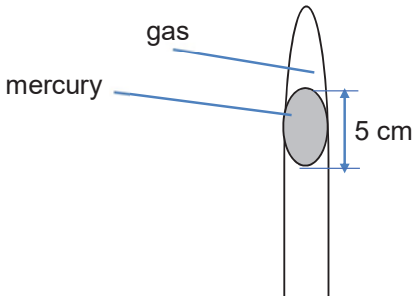
13 A 600 N delivery man carries a heavy box of mass 25 kg through a flight of staircases from ground floor to the fourth storey. He climbs a vertical height of 30 m in 2 minutes.

What is the power produced by the delivery man?

A 213 W **B** 440 W

C 9380 W **D** 93800 W

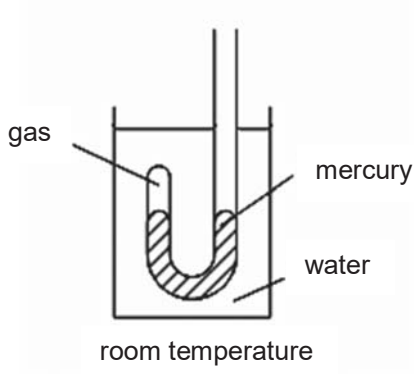
14 The diagram shows a capillary tube with a 5 cm column of mercury.



Calculate the pressure of the gas in Pa given that the atmospheric pressure is 760 mm Hg and the density of mercury is 13600 kg m^{-3}.

A 96.6 kPa **B** 103 kPa **C** 104 kPa **D** 110 kPa

15 The diagram shows a tube containing gas and mercury in a beaker of water at room temperature.



What will happen to the volume and pressure of the gas as the beaker of water is heated to a higher steady temperature?

	volume	pressure
A	decreases	decreases
B	no change	increases
C	increases	no change
D	increases	increases

16 The emf of a certain thermocouple with one junction P in pure melting ice and the other junction Q in steam is 4.1 mV.

With junction P still in melting ice, junction Q is placed in boiling liquid. The emf is now -3.0 mV.

The temperature of the boiling liquid in ^{o}C is _____.

A -73 **B** -170

C +27 **D** +70

17 A man places object A and object B of the same size into a freezer.

When the two objects are taken out of the freezer after one day, the man uses his right hand to hold object A and his left hand to hold object B.

He feels that object A is much colder than the object B.

Why?

A Object A is a better conductor compared to object B.

B Object B is a better conductor compared to object A.

C Object A has a lower temperature than object B.

D His right hand is more sensitive than his left hand.

18 A student uses a microscope to observe the behaviour of smoke particles placed in an air-filled container. He observes bright specks of light.

Where is this light coming from?

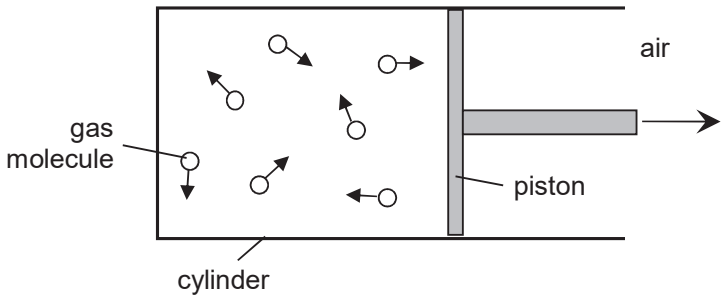
A air particles and smoke particles moving randomly

B air particles and smoke particles vibrating

C smoke particles vibrating

D smoke particles moving randomly

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



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

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

20 1.5 kg of liquid X is heated up by an immersion heater of power 100 W for 7.5 min in a vessel of heat capacity 20 J/°C.

The temperature of X and the vessel is raised from 20 °C to 30 °C and 600 J of energy is lost to the surroundings.

What is the specific heat capacity of X?

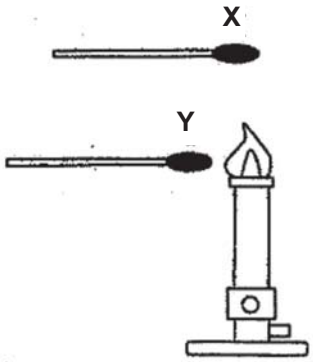
A 10 J/kg °C

B 2950 J/kg °C

C 2960 J/kg °C

D 3050 J/kg °C

21 The matchstick X will start burning faster than matchstick Y because



A Heat conducts upwards faster than to the sides.

B Heat radiates upwards faster than to the sides.

C Matchstick X gains heat from both convection and radiation while matchstick Y gains heat only from radiation.

D Matchstick X gains heat from both conduction and radiation whereas matchstick Y gains heat only from radiation.

22 A solid P is in thermal equilibrium with a solid Q, which is at the same temperature as a third solid R. The three bodies are of different materials and masses.

Which one of the following statements is correct?

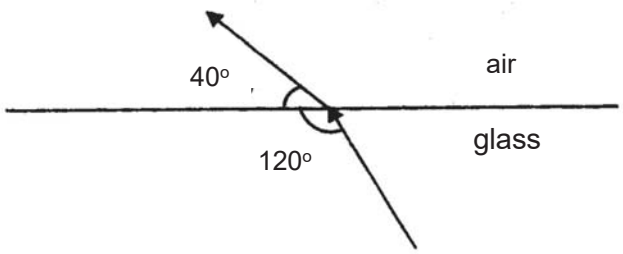
A P and Q have the same heat capacity.

B Q and R have the same internal energy.

C Q is not in thermal equilibrium with R.

D There is no net transfer of energy if P is placed in thermal contact with R.

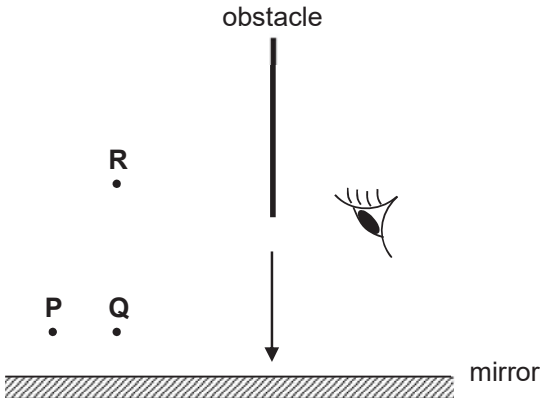
23 The diagram below shows a ray of light passing from glass into air.



What is refractive index of the glass?

A 0.75 **B** 1.2 **C** 1.5 **D** 4.0

24 Three point objects, P, Q and R, are viewed through a plane mirror as shown below.



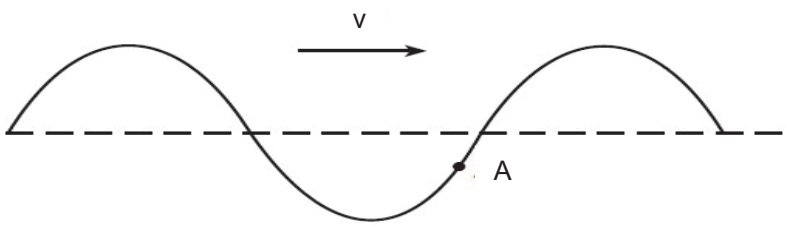
When an obstacle is moved towards the mirror, which image disappears first and which one disappears last?

	disappears first	disappears last
A	image of P	image of Q
B	image of P	image of R
C	image of Q	image of R
D	image of R	image of Q

25 What are the characteristics of an image formed by the thin converging lens in the human eye?

A real, inverted and diminished
B real, upright and diminished
C real, upright and magnified
D virtual, inverted and diminished

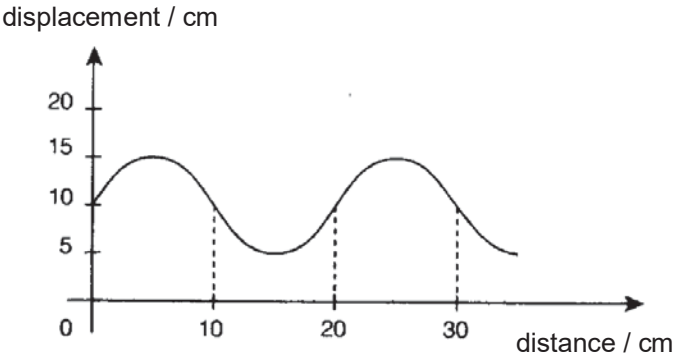
26 The diagram represents a transverse wave travelling to the right through a medium. Point A represents a particle of the medium.



In which direction will particle A move in the next instant of time?

A up **B** down **C** left **D** right

27 The graph below shows the displacement-distance graph of a transverse wave on a slinky.



Given that the period is 1.5 s, which of the following correctly states the amplitude and velocity of the wave?

	amplitude / cm	velocity / cm s^{-1}
A	5.0	13
B	5.0	30
C	10.0	13
D	10.0	30

28 Which one of the following statements about electromagnetic waves is correct?

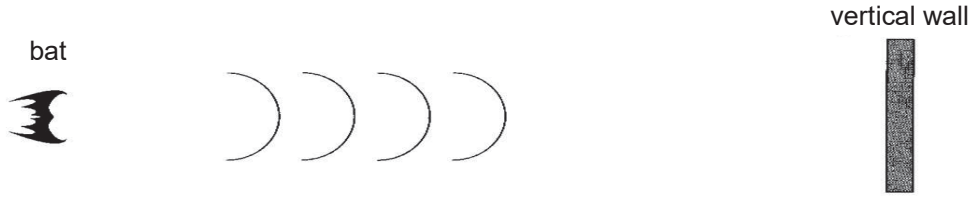
A All electromagnetic waves can ionise and damage living cells.

B All electromagnetic waves travel at the same speed.

C All transverse waves are electromagnetic waves.

D Electromagnetic waves do not require a medium to propagate.

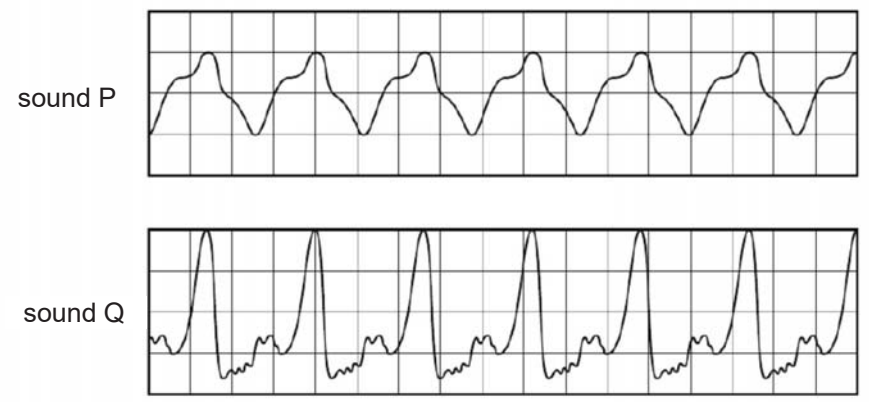
29 A bat flying towards a wall at 0.50 m s^{-1} emits a sound wave of frequency 40 kHz towards it. The bat receives an echo after 20 ms.



What is the distance between the bat and the wall if the wavelength of the sound is 8.5 x 10^{-3} m?

A 3.4 m **B** 6.8 m **C** 13.6 m **D** 17.0 m

30 The sounds, P and Q, produced by two musical instruments are directed towards a microphone connected to a cathode ray oscilloscope (c.r.o.). The sound signal picked up by the microphone is converted to an electrical signal to show the variation of the air particles' displacement over time. The waveforms produced on the screen are shown. For both waveforms, the settings of the c.r.o. remain the same.



Which statement about the two sounds is correct?

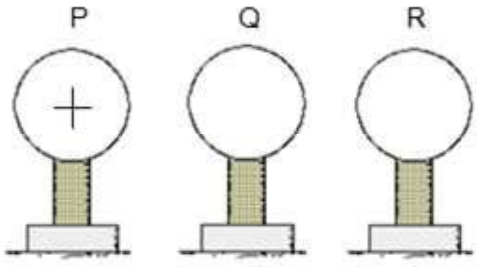
A Sound P travels slower than sound Q.

B Sound P has a lower pitch than sound Q.

C Sound Q is louder than sound P.

D Sound Q has a higher pitch and is louder than sound P.

31 P, Q and R represent copper spheres mounted on insulating stands and they are separated from each other. At the start of the experiment, P is given some positive charges but Q and R are left electrically neutral.



When R is momentarily earthed, which of the following statements describe the charges on Q and R correctly?

A Q remains neutral but R carries negative charges.

B Q remains neutral but R carries positive charges.

C Q carries negative charges but R carries positive charges.

D Q and R both carry negative charges.

32 Which can attract a stream of water?

(1) a negatively charged insulator
(2) a positively charged conductor
(3) a neutral conductor
(4) a magnetised conductor

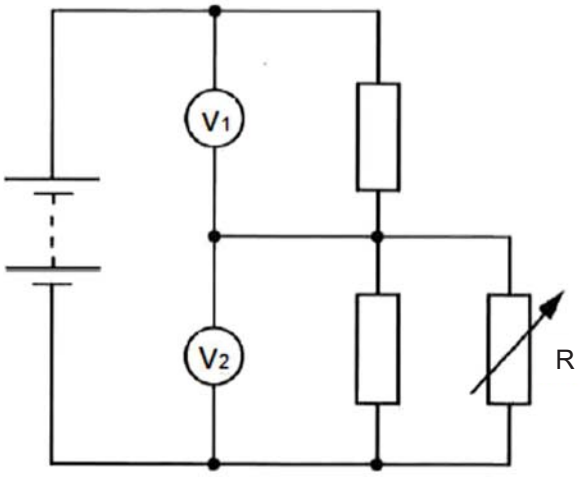
A (1) and (2) only
B (1) and (4) only
C (2) and (3) only
D (1), (2) and (3)

33 The resistance of a cylindrical conductor of length L with a cross-sectional radius, r, is **R**. Another similar conductor has a length of 2L and a cross-sectional radius of r/2.

What is its resistance?

A 1/8 **R** **B** 1/4 **R** **C** 4 **R** **D** 8 **R**

34 The circuit diagram shows a variable resistor R connected in parallel to the lower half of a potential divider.

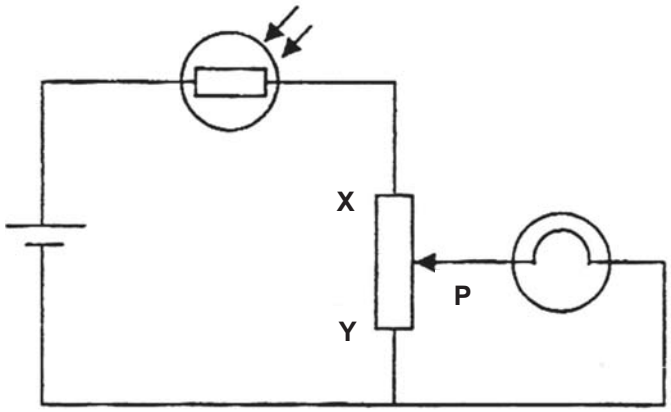


The resistance of R increases.

What happen to the voltmeter readings?

	reading on V_1	reading on V_2
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

35 In the diagram below, the lamp is brightest when _____.



A the LDR is covered and P is moved to Y.

B the LDR is covered and P is moved to X.

C light is incident on the LDR and P is moved to Y.

D light is incident on the LDR and P is moved to X.

36 The metal casing of an electric heater is earthed. The plug to the heater contains a 5 A fuse. There is a current of 4 A when the heater works normally.

The cable to the heater becomes worn out such that the live wire makes electrical contact with the case.

What happens?

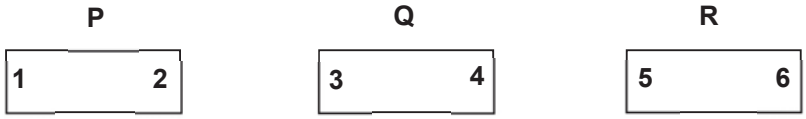
A The current flows to earth and the fuse is not affected.

B The fuse melts and switches off the circuit.

C The metal case becomes live and dangerous.

D The metal case becomes very hot.

37 Three metal bars, **P**, **Q** and **R** are identical in shape and size with ends as shown.



Tests were carried out and it was found that there is attraction between three pairs of poles (ends): **1** and **6**, **2** and **4**, and **2** and **6**.

However there was repulsion between ends **2** and **3**.

Which of the following statements could be concluded from the above tests?

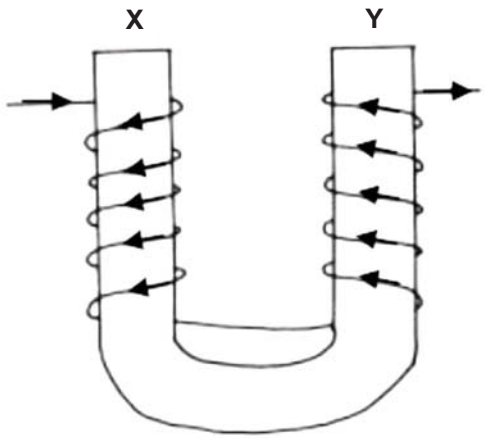
A Only **P** is a magnet.

B Only **P** and **Q** are magnets.

C Only **P** and **R** are magnets.

D **P**, **Q** and **R** are magnets

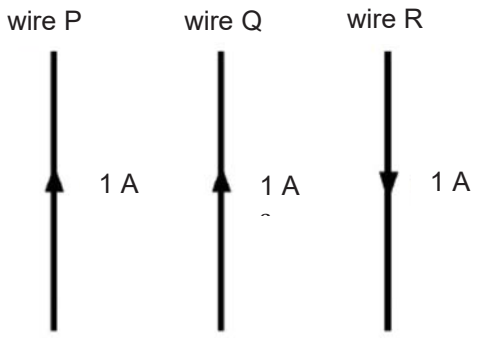
38 A soft iron core is magnetised by passing a direct current into the coil of insulated wires as shown in the diagram.



The polarities at **X** and **Y** are

	X	**Y**
A	N	S
B	S	S
C	N	N
D	S	N

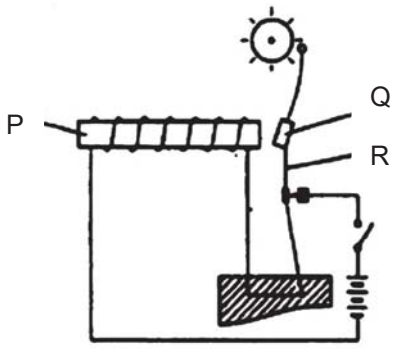
39 Three wires P, Q and R are each carrying a current of 1A in the direction as shown in the diagram below.



What are the directions of forces acting on the three wires?

	wire P	wire Q	wire R
A	left	right	right
B	right	left	right
C	left	left	left
D	right	left	left

40 The diagram shows an electric bell.



What materials would be suitable for the parts labelled P, Q and R?

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

End of Paper

Class / Index Number	Centre Number / 'O' Level Index Number	Name
/	/	

新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION

SECONDARY FOUR

PHYSICS **6091/02**

Paper 2 **26 August 2020**

1 hour 45 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

This is Section A of the paper.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

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

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper (sections A and B) is 80.

At the end of the examination, hand in the following separately:
(1) Section A
(2) Section B

For Examiner's Use	
Section A	50
Section B	30
Total	80

This document consists of 12 printed pages inclusive of this cover page.

Section A

Answer **all** questions in this section.

1 Car A moves from X to Y in a straight road at a constant acceleration of 2.0 m s^{-2} from rest. After 3.0 seconds from the time when car A moved off, car B starts to move from Y to X at a speed of 2.0 m s^{-1}. Car B maintains the same speed throughout the whole journey. The timing of the cars' journeys, *t*, is measured from the instant that car B starts to move.

(a) In Fig. 1.1, sketch the velocity-time graph of car A and car B. Take the direction from X to Y as the positive direction. [2]

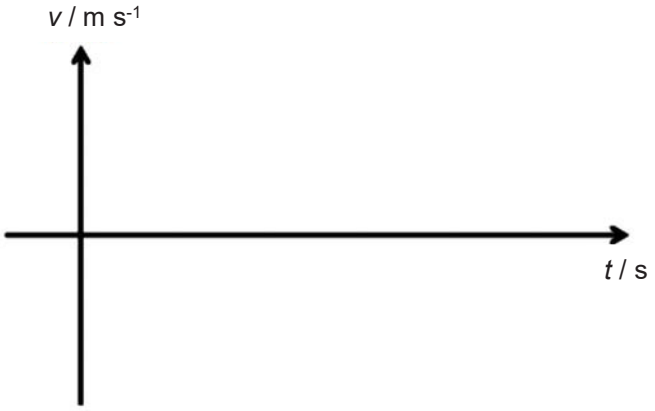


Fig. 1.1

(b) The distance between X and Y is 1000 m. Both cars meet at time, *t*.

(i) Show that the distance, *d*, travelled by car A when both cars meet is $(t + 3)^2$.

distance = ……..……[1]

(ii) Hence, determine the time, *t*, when both cars meet.

time = ……..…..[2]

[Total: 5]

2 **(a)** A uniform plank AB of length 4.0 m and weight 500 N is suspended by a vertical rope at each end. A girl of weight 300 N stands in the position shown, 1.2 m from the end A.

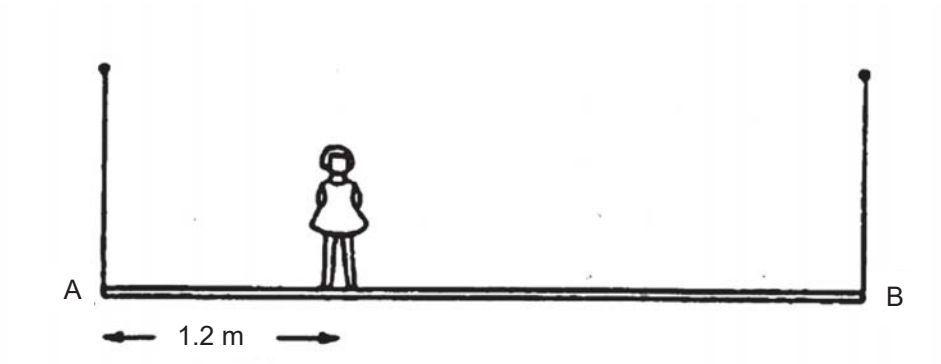


Fig. 2.1

(i) As shown in Fig. 2.1, show that the tension in the rope supporting the end B is 340 N.

tension = ……..[1]

(ii) Hence, calculate the tension in the rope supporting the end A.

tension = ……..[2]

(iii) When the girl walks towards the end B, without further calculations, state and explain the effect of the girl's position on the tension in A.

……..

……..

……..

……..[2]

(b) **(i)** Fig. 2.2 shows a reclining seat.

Fig. 2.2

A boy lying on the seat discovers that he can balance in the position shown, and can rock himself forward or backward simply by moving his arms as shown by the arrows.
Explain this.

……..

……..

……..

……..[2]

(ii) In the position shown in Fig. 2.2, if the boy holds a basketball upright with both hands, explain what will happen to the reclining seat.

……..

……..[1]

[Total: 8]

3 A small positively charged metal sphere **A** is hung from an insulating string. Fig. 3.1 shows the effect on **A** when a negatively charged sphere **B** on an insulated rod is positioned close to it. The string makes an angle θ with the vertical.

The mass of sphere **A** is 4.5 x 10^{-5} kg and the electric force acting on **A** is 1.5 x 10^{-4} N. Draw a well labelled vector diagram to determine the tension of the string and the angle θ made by the string with the vertical.

[3]

Fig. 3.1

tension of string = …….

angle θ = …….

[Total: 3]

4 A round-bottomed flask is connected to a mercury manometer as shown in Fig. 4.1. Density of mercury is taken to be 13600 kg m^{-3}.

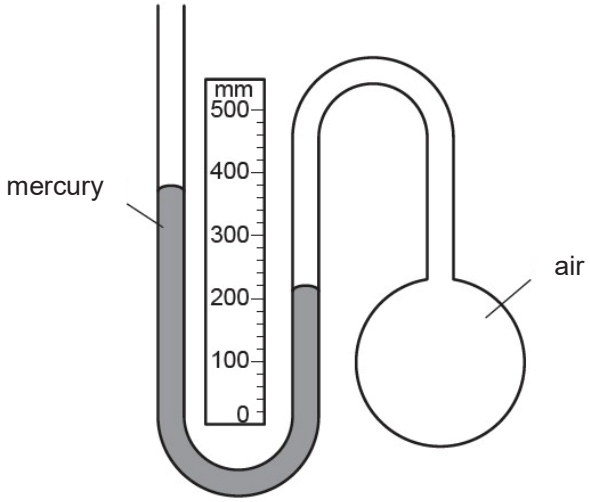


Fig. 4.1

(a) **(i)** Atmospheric pressure is equal to 760 mm of mercury.

Determine the pressure of the air inside the flask. Give your answer in Pa.

pressure = ……...[2]

(ii) The air inside the flask cools.

Explain, using ideas about molecules, how this causes the pressure inside the flask to decrease.

……...

……...

……...

……....[2]

(iii) Suggest a real-life application for the mercury manometer shown in Fig. 4.1.

……..……[1]

[Total: 5]

5 An experiment is conducted by placing a tray of ice cubes in an oven. The specific latent heat of fusion of ice is 340 kJ kg^{-1}, specific heat capacity of water is 4.2 kJ kg^{-1} K^{-1} and specific heat capacity of ice is 2.04 kJ kg^{-1} K^{-1}.

(a) Define the term *specific latent heat of fusion*.

……

……[1]

(b) Calculate the heat required to melt 0.20 kg of ice completely to water and raise its temperature from -10.0 °C to 63.0 °C.

heat required = ……..……..[3]

(c) Calculate the total power used by the oven if it takes 20 minutes for the temperature of the ice to reach 63.0 °C, assuming there is no heat loss to the surroundings.

total power = ……..……..[2]

(d) The experimental power value from **(c)** is different from the power rating shown on the oven.

Suggest whether the value in **(c)** is higher or lower and explain the difference.

……

……

……

……[2]
[Total: 8]

6 **(a)** Fig. 6.1 shows a wave approaching a beach at a speed of 2.0 m/s and the depth of the seabed at the beach.

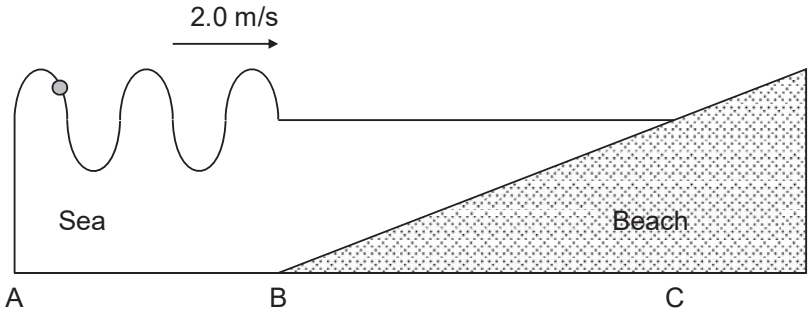


Fig. 6.1

(i) State the meaning of 'a wavefront'.

……

……..[1]

(ii) The wave takes 3.0 s to travel from A to B.

Determine the frequency of the wave.

frequency = ……[2]

(b) A student sits in the middle of a large rectangular hall which is 17 m wide, as shown in Fig. 6.2. When the student bangs a drum, two echoes are heard, 50 ms and 80 ms, respectively, after the bang.

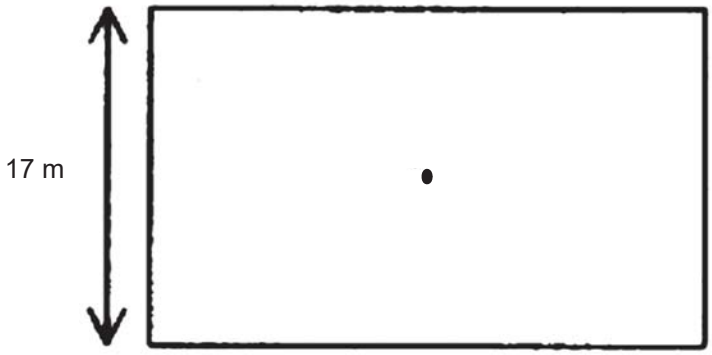


Fig. 6.2

Assuming that there is no echo from the ceiling, calculate

(i) the speed of sound in air,

speed of sound in air = ……..[2]

(ii) the length of the hall.

length of the hall = ……..[1]

[Total: 6]

7 An electrostatic air filter is used to remove dust particles from the air. A fan causes dusty air to flow through several metal rods and plates as shown in Fig 7.1.

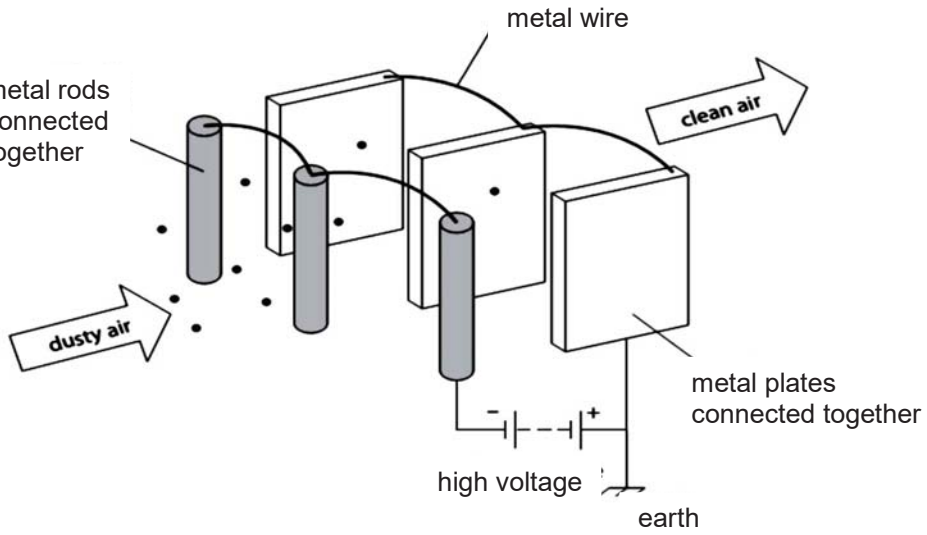


Fig. 7.1

(a) When the dusty air flows past the metal rods, the dust particles become negatively charged. Explain how this happens.

……

……

……

……[1]

(b) Explain how the air filter is able to remove the dust particles from the air.

……

……[2]

(c) Fig 7.2 shows an enlarged negatively charged dust particle next to one of the metal plates in the air filter.

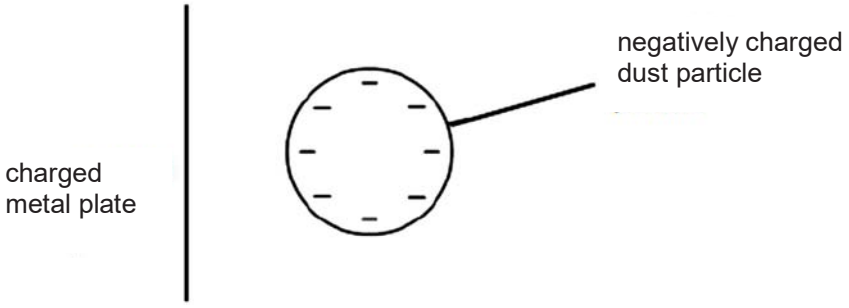


Fig. 7.2

On Fig 7.2, draw the electric field pattern between the dust particle and the charged metal plate. [2]

(d) Suggest a disadvantage of using the electrostatic air filter.

……

……...[1]

[Total: 6]

8 A slide projector is a device for showing photographic slides. In a slide projector, light from a lamp is converged on to a slide AB and a lens is used to form an image of the slide on a screen.
Fig. 8.1 shows the slide, lens and screen.

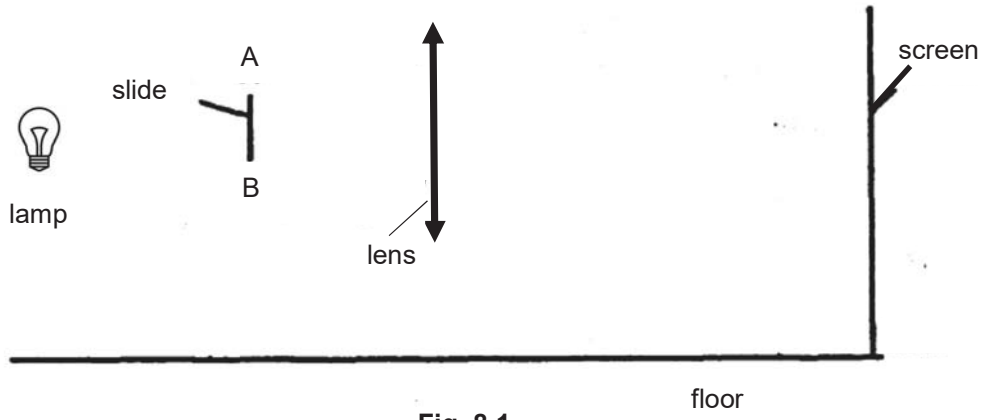


Fig. 8.1

(a) On Fig. 8.1, draw two rays from A and two rays from B to show how a focused image of the slide is formed on the screen. [2]

(b) Describe the image formed on the screen.

……...……[1]

(c) When a projector is first turned on, the image formed is often not in focus. Describe how the operator can focus the image on the screen.

……

……[1]

(d) Describe how the slide should be placed in the projector to obtain an image that is upright.

……[1]

[Total: 5]

9 Fig. 9.1 shows a d.c. motor attached to a power source.

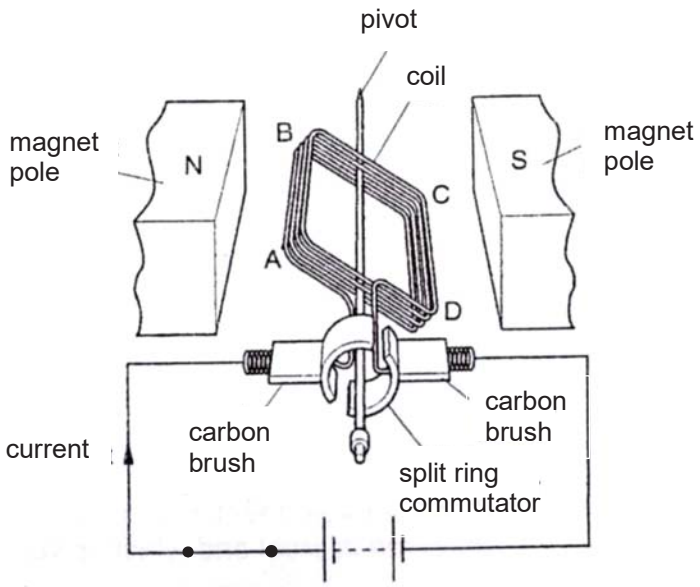


Fig. 9.1

(a) State the energy transformation in the motor.

……[1]

(b) State the direction of movement of AB.

……[1]

(c) Explain why the coil turns when the switch is closed.

……

……

……

……[2]

[Total: 4]

END OF SECTION A

Class / Index Number /	Centre Number / 'O' Level Index Number /	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION

SECONDARY FOUR

PHYSICS **6091/02**

Paper 2 **26 August 2020**

1 hour 45 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

This is Section B of the paper.
Answer all three questions. The last question is in the form either/or.
Answer all questions in the spaces provided.
For Question 12, circle your choice of question ('either' or 'or').
Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper (sections A and B) is 80.

At the end of the examination, hand in the following separately:
(1) Section A
(2) Section B

For Examiner's Use	
Question 10	10
Question 11	10
Question 12 Either / Or	10
Total	30

This document consists of 11 printed pages inclusive of this cover page.

Section B

Answer all three questions in this section.

The last question is in the form of an either/or and only one of the alternatives should be attempted.

10 A student conducted an experiment to investigate how the thickness of a copper wire affects the potential difference across it. The set-up of his experiment is shown in Fig.10.1. The length of all the copper wires used is 0.050 m.

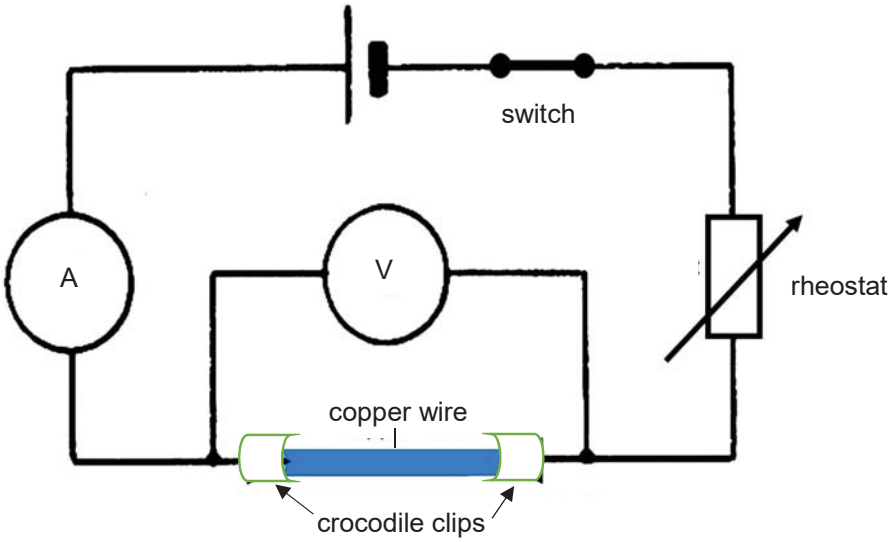


Fig. 10.1

(a) Each piece of copper wire is clamped, in turn, between two crocodile clips. When the ammeter reading is set to 2.0 A, the voltmeter reading is recorded. Fig. 10.2 shows the cross-sectional areas of the different copper wires and their corresponding voltmeter readings.

Wire	Cross-sectional area / m^2	Voltmeter reading / V
K	0.0020×10^{-6}	0.85
L	0.0040×10^{-6}	0.43
M	0.0080×10^{-6}	0.21
N	0.016×10^{-6}	0.11
O	0.032×10^{-6}	
P	0.064×10^{-6}	0.028

Fig. 10.2

(i) Explain the function of the rheostat in the circuit.

……

……...[1]

(ii) State the relationship between the cross-sectional area of the wire and the potential difference across it.

……

……..…….[1]

(iii) Explain how the data in Fig 10.2 suggest the relationship stated in **(ii).**

……

……

……

……[2]

(iv) Using data from Fig 10.2, predict the voltmeter reading when wire O is connected to the circuit.

voltmeter reading = …… [2]

(b) Another copper wire, **P** with a different cross-sectional area is cut into 3 pieces of identical length. Each piece has a resistance of 0.20 Ω. The wires are arranged in a circuit as shown in Fig 10.3.

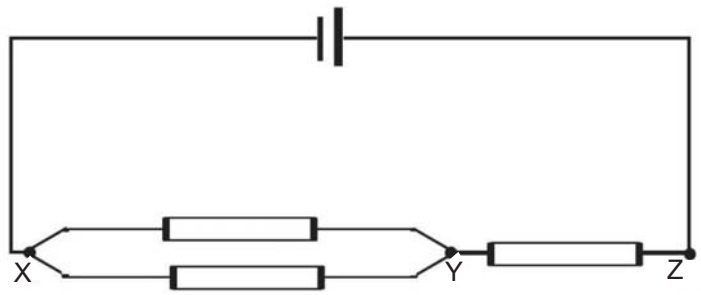


Fig. 10.3

(i) The potential difference across YZ is 1.0 V.
Calculate the e.m.f. of the cell.

e.m.f. = ……[2]

(ii) Another identical piece of wire similar to P is connected in parallel to XY.
Explain if there is any change to the potential difference across YZ.

…….

…….....

……..

……..[2]

[Total: 10]

11 **(a)** Parallel rays of light travel towards a converging lens as shown in Fig. 11.1. The focal points of the lens are labelled as F.

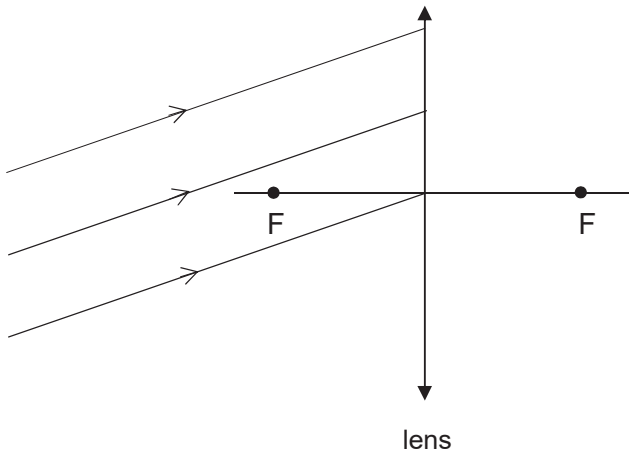


Fig. 11.1

(i) From Fig.11.1, state whether the object is a distant object.
Explain your answer.

……

……

……

……..….[2]

(ii) Continue the paths of light in Fig. 11.1 to show how the rays bend after passing through the lens. Include any working lines in your answer. [2]

(iii) Name one optical instrument which makes use of an image formed in this way.

……....[1]

(iv) The lens is now placed in water. The rays of light strike the lens at the same angle. The refractive index of water and lens is 1.3 and 1.5 respectively.

State how the path of the rays of light will be changed (compared to when lens is in air) when they travel out of the lens.

……

……..….[1]

(b) Fig. 11.2 shows a semi-circular glass prism with a light ray directed towards O, the midpoint between A and B. The refractive index of the glass prism is 1.5.

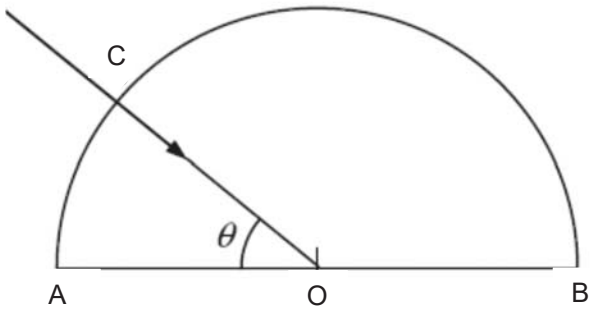


Fig. 11.2

(i) State the two conditions that must be satisfied in order that a light ray can undergo total internal reflection.

……

……

……

……...[2]

(ii) Calculate the maximum angle θ, such that the light ray will not emerge from the edge AB.

maximum angle θ = ……..[2]

[Total: 10]

12 EITHER

Fig. 12.1 shows the variation with time of the speed of a car as it travels along a level road. The car brakes when the time t = 20 s, and comes to rest when t = 24 s.

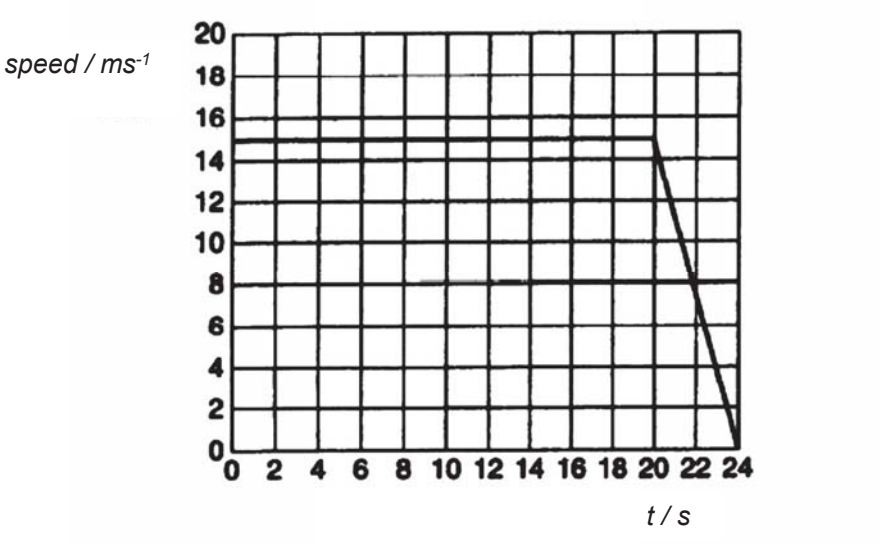


Fig. 12.1

The car has a mass of 800 kg and the forward driving force on the wheels is 1200 N.

(a) For the first 20 s of the motion shown in Fig. 12.1, calculate the power supplied by the driving force.

power supplied = ……[3]

(b) (i) Describe the energy changes in the first 20 seconds.

……

……[1]

(ii) Calculate the kinetic energy of the car while it is travelling at constant speed.

kinetic energy = ……[2]

(c) Calculate the work done in overcoming the braking force during the last 4.0 seconds.

work done = ……[2]

(d) With reference to your answer in **(c)**, explain whether it would be worthwhile to develop a system whereby, when the car slows down, its kinetic energy would be stored for re-use when the car speeds up again.

……

……

……

……[2]

[Total: 10]

OR

(a) Fig. 12.2 shows a DC circuit. You can assume that the voltmeters have infinite internal resistance and the ammeters have negligible internal resistance.

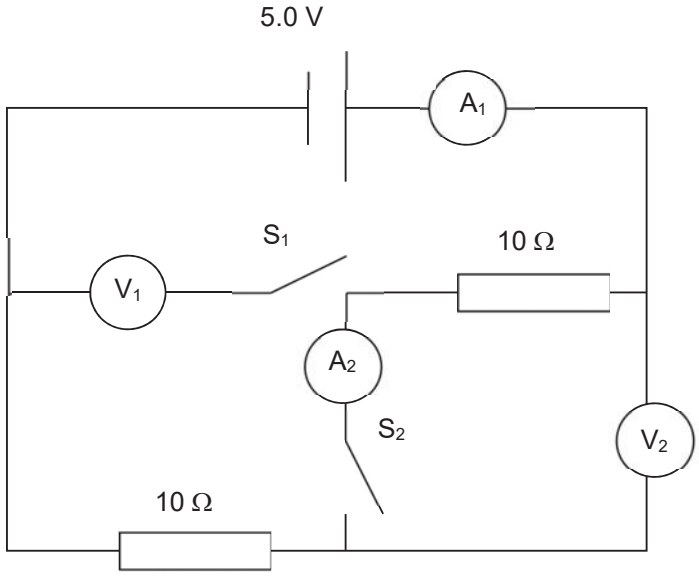


Fig. 12.2

Determine the reading in all voltmeters and ammeters when

(i) S_1 and S_2 are opened, [2]

V_1 = ...

V_2 = ...

A_1 = ...

A_2 = ...

(ii) S_1 is opened and S_2 is closed, [2]

V_1 = ...

V_2 = ...

A_1 = ...

A_2 = ...

(iii) S_1 and S_2 are closed. [2]

V_1 = ...

V_2 = ...

A_1 = ...

A_2 = ...

(b) Fig. 12.3 shows three bulbs L, M and N connected to a 12.0 V battery, which has negligible internal resistance. Bulb L is labelled "6.0 V, 12.0 W", while bulbs M and N are identical and each has a constant resistance of 6.0 Ω. When the circuit is switched on, all the bulbs are lit with normal brightness.

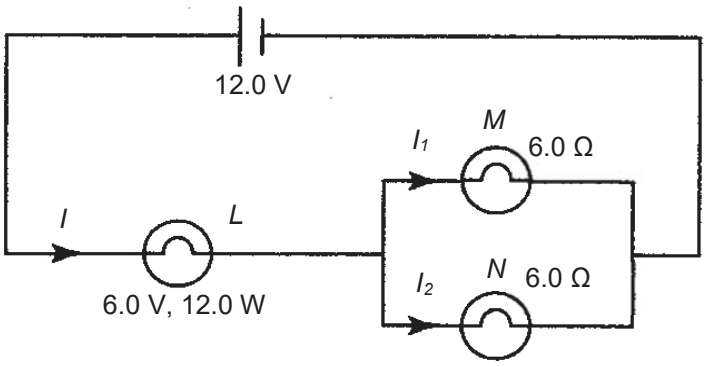


Fig. 12.3

(i) Calculate the current I_2.

I_2 = ……..[2]

(ii) If the filament of bulb N burns out, how would it affect the brightness of bulbs L and M?
With calculations, explain your answer.

……

……

……

……[2]
[Total:10]

END OF SECTION B

Answers to Paper 1 Prelim Sec 4 Physics 2020

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

O Level Centre Number/ Index Number	Class	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION

SECONDARY FOUR

PHYSICS **6091/02**

Paper 2 **26 August 2020**

1 hour 45 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

This is Section A of the paper.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

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

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper (sections A and B) is 80.

At the end of the examination, hand in the following separately:
(1) Section A
(2) Section B

For Examiner's Use	
Section A	50
Section B	30
Total	80

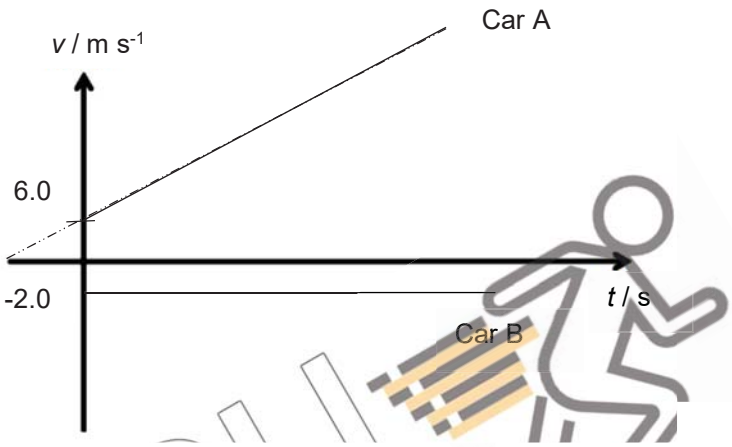
This document consists of 12 printed pages inclusive of this cover page.

Section A

Answer **all** questions in this section.

1 Car A moves from X to Y in a straight road at a constant acceleration of 2.0 m s^{-2} from rest. After 3.0 seconds from the time when car A moved off, car B starts to move from Y to X at a speed of 2.0 m s^{-1}. Car B maintains the same speed throughout the whole journey. The timing of the cars' journey, *t*, is measured from the instant that Car B starts to move.

(a) Sketch the velocity-time graph of car A and car B. Taking direction from X to Y as the positive direction. [2]



Car A – Straight line starting from -3.0 s with a gradient of 2.0, label at 6.0 m s^{-1} (+ value) [B1]
Car B – Horizontal line at -2.0 m s^{-1} (-value) [B1]

(b) The distance between X and Y is 1000 m. Both cars meet at time, *t*.

(i) Show that the distance,d, travelled by car A when both cars meet is $(t + 3)^2$.

Distance travelled by A = Area under the v-t graph.
$d = \frac{1}{2}(t+3)(2[t+3])$
$= (t + 3)^2$ [A1]

distance = ……[1]

(ii) Hence, determine the time, *t* when both cars meet.

$(t + 3)^2 + 2t = 1000$ [C1]

$t^2 + 6t + 9 + 2t = 1000$
$t^2 + 8t - 991 = 0$

$t = 27.7$ s [A1]

time = ……[2]

[Total: 5]

2 **(a)** A uniform plank AB of length 4.0 m and weight 500 N is suspended by a vertical rope at each end. A girl of weight 300 N stands in the position shown, 1.2 m from the end A.

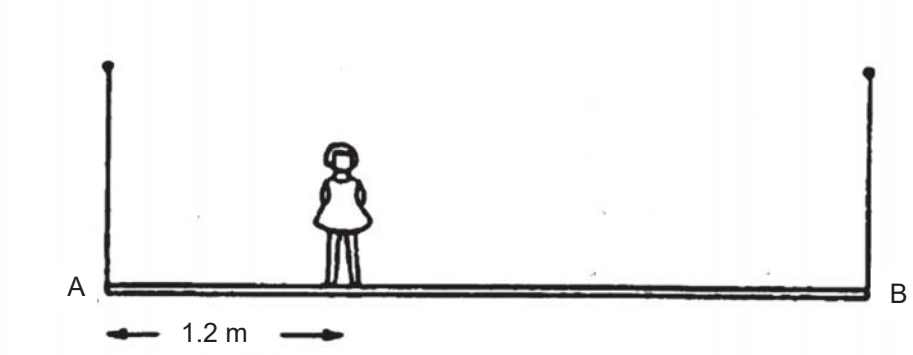


Fig. 2.1

(i) As shown in Fig. 2.1, show that the tension in the rope supporting the end B is 340 N.

The body is in equilibrium,
Take moments about A,
Sum of anticlockwise moments = sum of clockwise moments
$T \times 4.0\ m = 500\ N \times 2.0\ m + 300\ N \times 1.2\ m$ [M1]
$T = 340\ N$ [A0]

tension = ...[1]

(ii) Hence, calculate the tension in the rope supporting the end A.

Sum of upward forces = Sum of downward forces
$340\ N + T_A = 500\ N + 300\ N$ [C1]
$T_A = 460\ N$ [A1]

tension = ...[2]

(iii) When the girl walks towards the end B, without further calculations, state and explain the effect of the girl's position on the tension in A.

Tension of rope at A would become smaller when she walks towards the end B . [B1]
Because the girl would be nearer to B,
by taking moments about B, the moment of the girl about B will become smaller.
Hence, the tension in A is reduced as a smaller clockwise moment is required to balance it. [B1]

(b) **(i)** Fig. 2.2 shows a reclining seat.

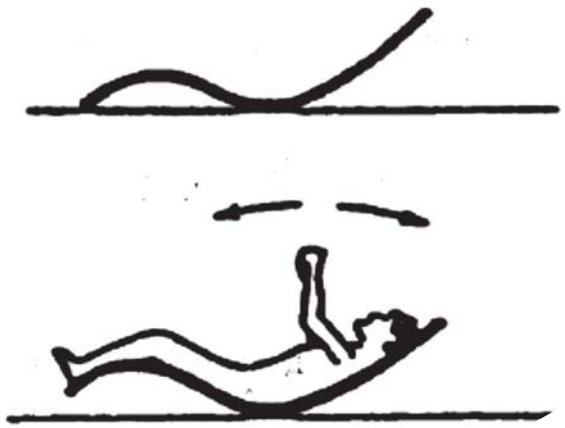


Fig. 2.2

A boy lying in a seat discovers that he can balance in the position shown, and can rock himself forward or backward simply by moving his arms as shown by the arrows.
Explain this.

When the boy is at rest, his CG is above the pivot.
When his arms move towards the head, the centre of gravity is moved towards the right. This produces a clockwise moment about P. [B1]
When his arms are moved away from his head, the centre of gravity is restored to the original position. This produces an anti-clockwise moment about the new pivot. [B1]

(ii) In the position shown in Fig. 2.2, if the boy holds a basketball upright with both hands, explain what will happen to the reclining seat.

There will be a **clockwise moment about the pivot due to the weight** of the basketball. The reclining seat will tilt in a clockwise direction and come to rest in a new position. [B1]

[Total: 8]

3 A small positively charged metal sphere **A** is hung from an insulating string. Fig. 3.1 shows the effect on **A** when a negatively charged sphere **B** on an insulated rod is positioned close to it. The string makes an angle θ with the vertical.

The mass of sphere **A** is 4.5 x 10^{-5} kg and the electric force acting on **A** is 1.5 x 10^{-4} N. Draw a well labelled vector diagram to determine the tension of the string and the angle θ made by the string with the vertical. [3]

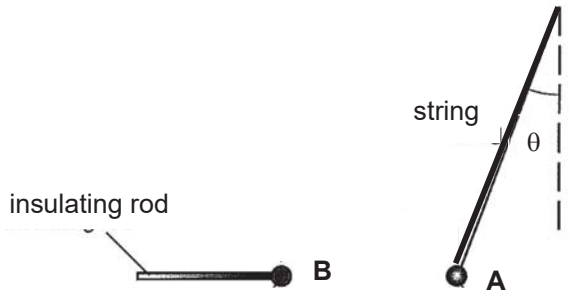
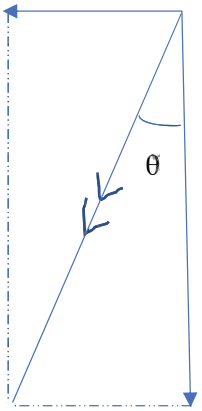


Fig. 3.1

Scale: Let 1 cm represent 0.5 × 10^{-4} N

F = 1.5 x 10^{-4} N



W = 4.5 x 10^{-4} N

Resultant force = = 4.8 x 10^{-4} N

Hence,

T = 4.8 x 10^{-4} N

Angle = 18°

Correct orientation of diagram. labels &
All arrows drawn correctly – [B1]
Answer for tension – accept 4.3 to 5.3 x 10^{-4} N [A1]
Answer for angle – accept 16° - 20° [A1]

[Total: 3]

4 A round-bottomed flask is connected to a mercury manometer as shown in Fig. 4.1.
Density of mercury is taken to be 13600 kg m^{-3}.

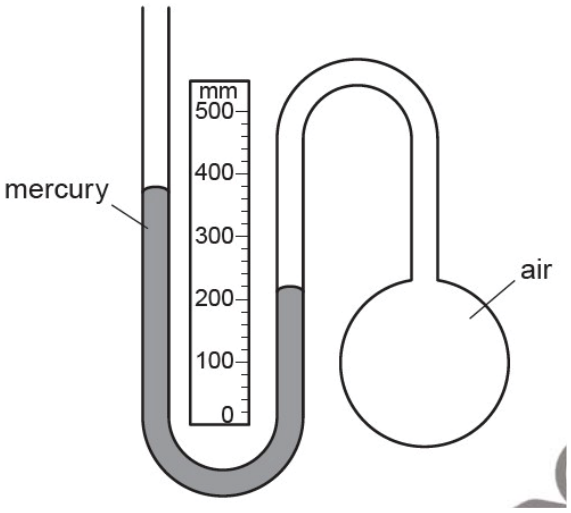


Fig. 4.1

(a) (i) Atmospheric pressure is equal to 760 mm of mercury.

Determine the pressure of the air inside the flask. Give your answer in Pa.

P = 760/10 + (380 – 220)/10
= 92 cm Hg
= 0.92 m Hg [C1]
Pressure = hpg
= 0.92 × 13600 × 10
= 125120 Pa
= 125000 Pa (to 3sf) [A1]

pressure = ……..[2]

(ii) The air inside the flask cools.

Explain, using ideas about molecules, how this causes the pressure inside the flask to decrease.

As the flask cools, the molecules slow down and loses kinetic energy. [B1]

The molecules collide with the walls of the flask with lower frequency and smaller force. The average force per unit area and thus pressure decreases. [B1]

(iii) Suggest a real-life application for the mercury manometer shown in Fig. 4.1.

To measure the pressure of gas in a gas-pipe / flowrate of air in a pipe/ filter pressure drop/meter calibrations/ leak testing/tank liquid level. [B1]

[Total: 5]

5 An experiment is conducted by placing a tray of ice cubes in an oven. The specific latent heat of fusion of ice is 340 kJ kg^{-1}, specific heat capacity of water is 4.2 kJ kg^{-1} K^{-1} and specific heat capacity of ice is 2.04 kJ kg^{-1} K^{-1}.

(a) Define the term *specific latent heat of fusion*.

It is the amount of heat energy required to change 1 kg of the substance from solid to liquid state without a change in temperature. [B1]

(b) Calculate the heat required to melt 0.20 kg of ice completely to water and raise its temperature from -10.0 °C to 63.0 °C.

Total heat required = (Heat required to raise ice temp from -10°C to 0°C) +(Heat required to melt) + (Heat required to raise temperature)

Heat required to raise ice temp from -10°C to 0°C, $Q_1 = mc_I \Delta\theta$
$= 0.2 \times 2040 \times 10°C$
$= 4080$ J

Heat required to melt, $Q_2 = m l$
$= 0.2$ kg x 340 000 J kg^{-1}
$= 68\,000$ J [C1]

Heat required to raise temperature, $Q_3 = mc \Delta\theta$
$= 0.2$ kg x 4200 J kg^{-1} $°C^{-1}$ x 63 °C
$= 52\,920$ J [C1]

Total heat required = $Q_1 + Q_2 + Q_3$
$= 125\,000$ J [A1]

heat required = ……..……..[3]

(c) Calculate the total power used by the oven if it takes 20 minutes for the temperature of the ice to reach 63.0 °C assuming there is no heat loss to the surroundings.

Total power, P = E / t
= 125000 J / (20 × 60 s) [C1] (ecf)
= 104 W [A1]

total power = ……..……..[2]

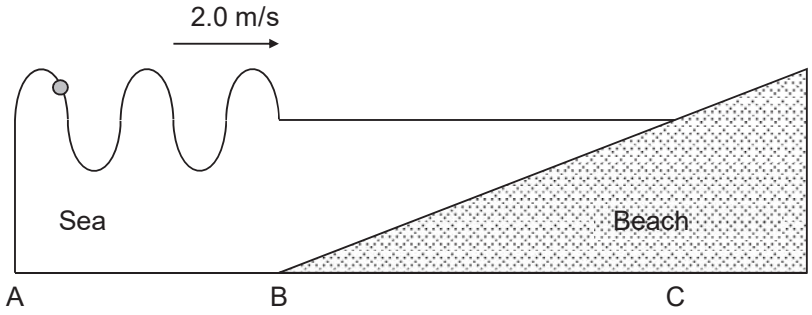
(d) The experimental power value from **(c)** is different from the power rating shown on the oven.

Suggest whether the value in **(c)** is higher or lower and explain the difference.

The power rating shown on the oven is higher than the value from (c). [A1]
There is energy loss to the surrounding. [B1]
(It takes 20 min to reach 63.0 °C, the experiment took longer to reach 63.0 °C compared to ideal state.

[Total: 8]

6 **(a)** Fig. 6.1 shows a wave approaching a beach at a speed of 2.0 m/s and the depth of the seabed at the beach.



(i) State the meaning of 'a wavefront'.

A wavefront is an imaginary line on a wave that joins all adjacent points that are in phase. [B1]

(ii) The wave takes 3.0 s to travel from A to B.

Determine the frequency of the wave.

Distance between A and B = speed × time
= 2.0 × 3 = 6.0 m
The distance between A and B is 6.0 m

Wavelength of the wave = 6.0 / 2.5
= 2.4 m
The Wavelength of the wave is 2.4 m **[M1]**

Frequency = speed / wavelength
= 2.0 / 2.4
= 0.833
The frequency of the wave is 0.833 Hz **[A1]**

frequency = ...[2]

(b) A student sits in the middle of a large rectangular hall which is 17 m wide, as shown in Fig. 6.2. When the student bangs a drum, two echoes are heard, 50 ms and 80 ms, respectively, after the bang.

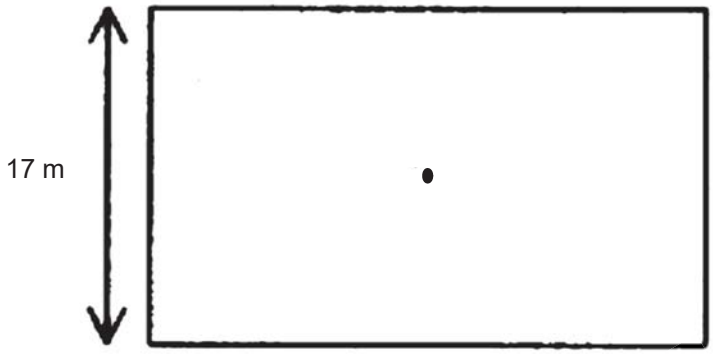


Fig. 6.2

Assuming that there is no echo from the ceiling, calculate

(i) the speed of sound in air,

Speed = d/t
= 17 m / 0.05s [M1]
= 340 m/s [A1]

speed of sound in air = ...[2]

(ii) the length of the hall.

Length = 340 m/s × 0.08s ecf
= 27.2 m [A1]

length of the hall = ...[1]

[Total: 6]

7 An electrostatic air filter is used to remove dust particles from the air. A fan causes dusty air to flow through several metal rods and plates as shown in Fig 7.1.

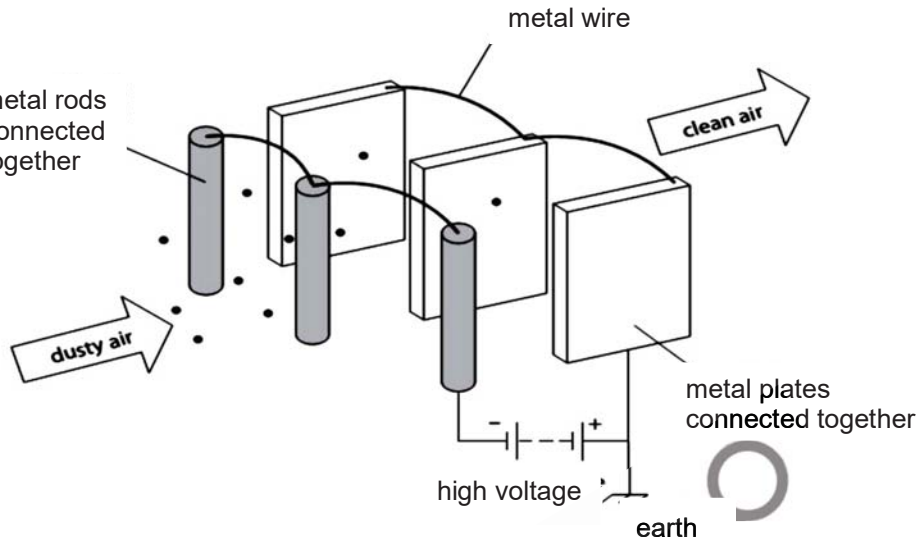


Fig. 7.1

(a) When the dusty air flows past the metal rods, the dust particles become negatively charged. Explain how this happens.

As the dust particle comes into contact with the rods, electrons from the rods are transferred to the dust particles. [B1]

(b) Explain how the air filter is able to remove the dust particles from the air.

As the metal plates are positively charged,[B1] the dust particles are attracted to it as unlike charges attract. [B1]

(c) Fig 7.2 shows an enlarged negatively charged dust particle next to one of the metal plates in the air filter.

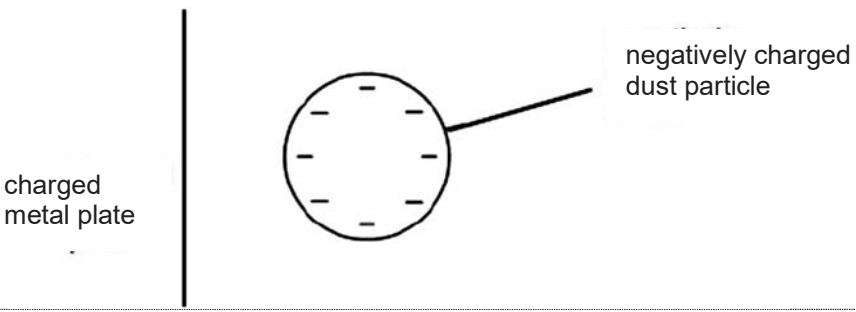
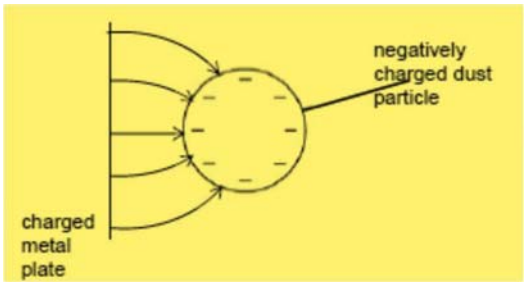


Fig. 7.2

On Fig 7.2, draw the electric field pattern between the dust particle and the charged metal plate.



Draw correctly at least three lines – (B1)
Draw the direction correctly – (B1)

(d) Suggest a disadvantage of using the electrostatic air filter.

Debris build-up / affects the flow-rate
Or
Costly to run and maintain [B1]

[Total: 6]

8 A slide projector is a device for showing photographic slides. In a slide projector, light from a lamp is converged on to a slide AB and a lens is used to form an image of the slide on a screen.
Fig. 8.1 shows the slide, lens and screen.

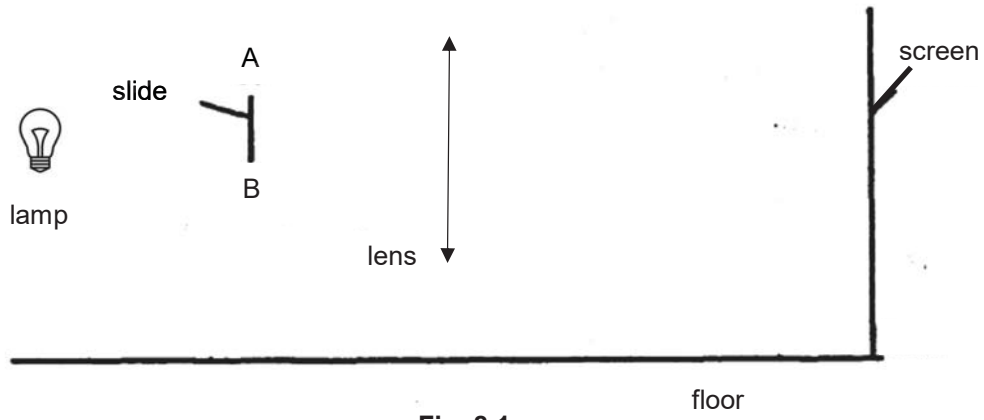
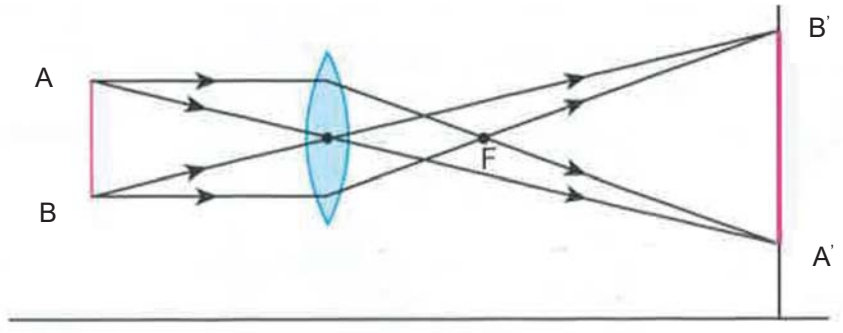


Fig. 8.1

(a) On Fig. 8.1, draw two rays from A and two rays from B to show how a focused image of the slide is formed on the screen. [2]



Two rays from A correctly drawn – [B1]
Two rays from B correctly drawn – [B1]

(b) Describe the image formed on the screen.

Real,enlarged and inverted [B1]

(c) When a projector is first turned on, the image formed is often not in focus. Describe how the operator can focus the image on the screen.

By adjusting the position of the lens (nearer or further away from the screen) [B1]

(d) Describe how the slide should be placed in the projector to obtain an image that is upright.

The slide must be placed upside down to obtain an upright image. [B1]

[Total: 5]

9 Fig. 9.1 shows a d.c. motor attached to a power source.

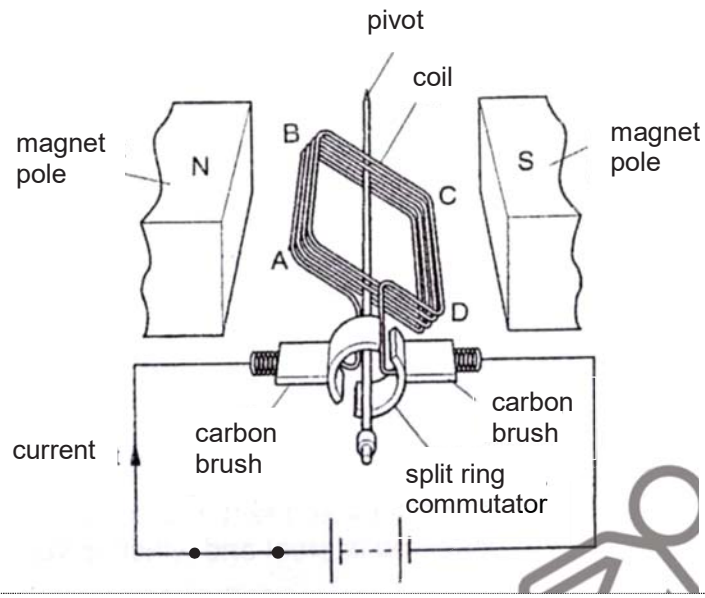


Fig. 9.1

(a) State the energy transformation in the motor.

Electrical energy is converted to mechanical / kinetic energy . [B1]

(b) State the direction of movement of AB.

Downwards ……[B1]

(c) Explain why the coil turns when the switch is closed.

The interaction of the two magnetic fields due to the permanent magnet and the current in the coil resulted in a stronger magnetic field forms above AB / below CD. [B1]

The difference between magnetic field strength results in a net force that acts towards the weaker field. [B1]

[Total: 4]

END OF SECTION A

O Level Centre Number/ Index Number	Class	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION

SECONDARY FOUR

PHYSICS **6091/02**

Paper 2 **26 August 2020**

1 hour 45 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

This is Section B of the paper.
Answer **all** questions. Question 12 has a choice of parts to answer.
Write your answers in the spaces provided on the question paper.
For Question 12, circle your choice of question ('either' or 'or').
Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper (sections A and B) is 80.

At the end of the examination, hand in the following separately:
(1) Section A
(2) Section B

For Examiner's Use	
Question 10	10
Question 11	10
Question 12 Either / Or	10
Total	30

This document consists of 11 printed pages inclusive of this cover page.

Section B

Answer **all** questions in this section.
Answer only one of the two alternative questions in **Question 12.**

10 A student conducted an experiment to investigate how the thickness of a copper wire affects the potential difference across it. The set-up of his experiment is shown in Fig.10.1. The length of all the copper wires used is 0.050 m.

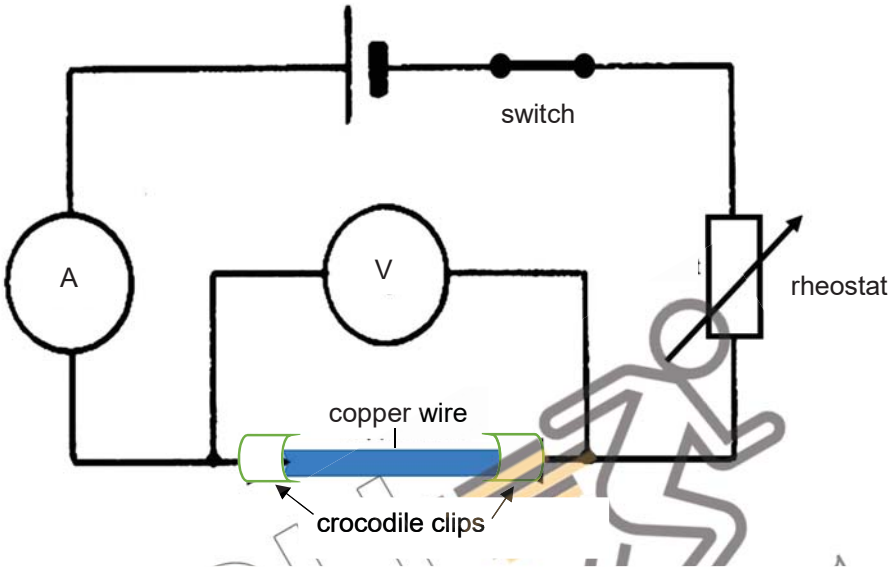


Fig. 10.1

(a) Each piece of copper wire is clamped, in turn, between two crocodile clips. When the ammeter reading is set to 2.0 A, the voltmeter reading is recorded. Fig. 10.2 shows the cross-sectional areas of the different copper wires and their corresponding voltmeter readings.

Wire	Cross-sectional area / m^2	Voltmeter reading / V
K	0.0020×10^{-6}	0.85
L	0.0040×10^{-6}	0.43
M	0.0080×10^{-6}	0.21
N	0.016×10^{-6}	0.11
O	0.032×10^{-6}	
P	0.064×10^{-6}	0.028

Fig. 10.2

(i) Explain the function of the rheostat in the circuit.

Rheostat is needed to change the effective resistance in the circuit so that current can be kept constant. [B1]

(ii) State the relationship between the cross-sectional area of the wire and the potential difference across it.

The cross sectional area of the wire is inversely proportional to its potential difference. [B1]

(iii) Explain how the data in Fig 10.2 suggest the relationship stated in **(ii).**

As the cross sectional area of the wire is doubled, when the data for wire K and wire L is used, the p.d is halved. [B1]
For the wires K, L, M , N and P, the product of V and A is a constant.

Wire	A/ m^2	V / V	VA / V m^2
K	0.0020×10^{-6}	0.85	1.7×10^{-9}
L	0.0040×10^{-6}	0.43	1.7×10^{-9}
M	0.0080×10^{-6}	0.21	1.7×10^{-9}
N	0.016×10^{-6}	0.11	1.8×10^{-9}
O	0.032×10^{-6}		
P	0.064×10^{-6}	0.028	1.8×10^{-9}

Show at least 3 working for VA. [B1]
(Accept explanation in words)

(iv) Using data from Fig 10.2, predict the voltmeter reading when wire O is connected to the circuit.

V = 0.11/2 [M1]
= 0.055 V [A1]

Or V = 0.028 x 2 [M1]
= 0.056 V [A1]

Or AV = constant = 1.7×10^{-9} [M1]
V = 0.053 V [A1]

voltmeter reading = ... [2]

(b) Another copper wire, P with a different cross-sectional area is cut into 3 pieces of identical length. Each piece has a resistance of 0.20 Ω. The wires are arranged in a circuit as shown in Fig 10.3.

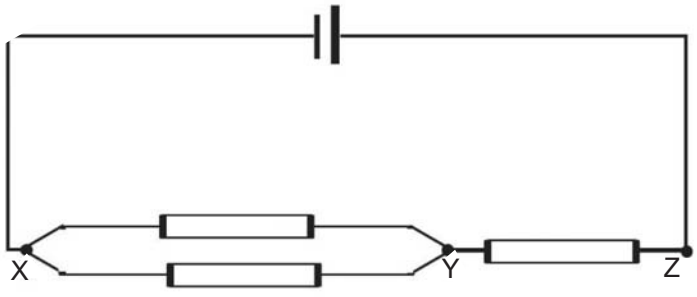


Fig. 10.3

(i) The potential difference across YZ is 1.0 V.
Calculate the e.m.f. of the cell.

V_{XY} = 0.50 V
Emf = 0.50 +1.00 [C1]
= 1.50 V [A1]

Alternatively,

I = 1.00 / 0.200 = 5.00 A [C1]
V= R x I = 5.00 x 0.300 Ω = 1.50 V [A1]

e.m.f. = ……[2]

(ii) Another identical piece of wire similar to P is connected in parallel to XY.
Explain if there is any change to the potential difference across YZ.

The potential difference across YZ increases. [B1]
Total effective resistance across XY decreases.
Hence, by potential divider principle, more of the e.m.f. will be across YZ. [B1]
Or
Total effective resistance of whole circuit decrease,
hence current flowing through YZ is higher. [B1]

[Total: 10]

11 **(a)** Parallel rays of light travel towards a converging lens as shown in Fig. 11.1. The focal points of the lens are labelled as F.

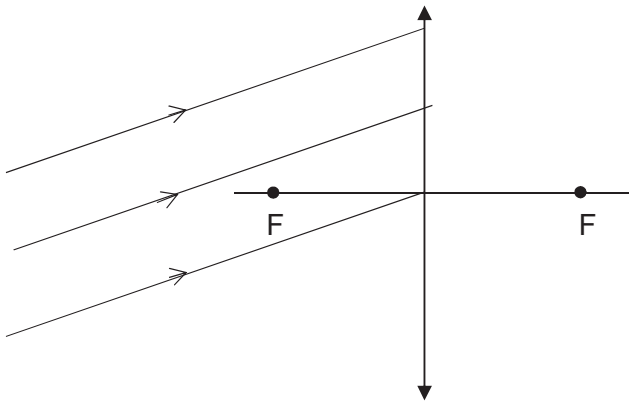
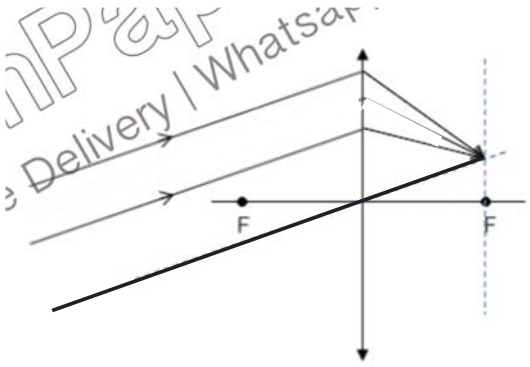


Fig. 11.1

(i) From Fig.11.1, state whether the object is a distant object.
Explain your answer.
The object is a distant object. [A1]
The rays from the object are parallel before they pass through the lens. [C1]

(ii) Continue the paths of light in Fig. 11.1 to show how the rays bend after passing through the lens. Include any working lines in your answer. [2]



1) Correct refracted rays [B1]
2) Correct position of image [B1]

(iii) Name one optical instrument which makes use of an image formed in this way.
object lens of a telescope……..…[B1]

(iv) The lens is now placed in water. The rays of light strike the lens at the same angle.
The refractive index of water and lens is 1.3 and 1.5 respectively.

State how the path of the rays of light will be changed (compared to when lens is in air) when they travel out of the lens.
Rays of light will still bend away from the normal,
but the angle of refraction is decreased / ray bends closer to normal [B1]

(b) Fig. 11.2 shows a semi-circular glass prism with a light ray directed towards O, the midpoint between A and B. The refractive index of the glass prism is 1.5.

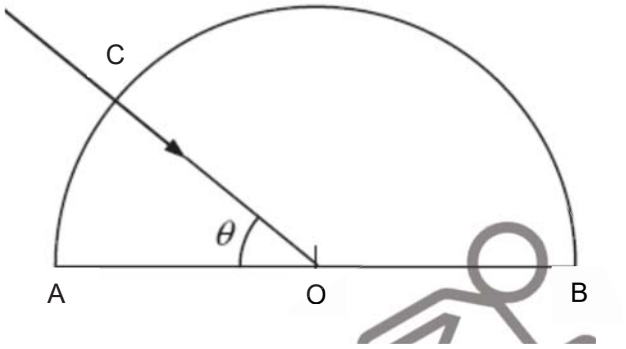


Fig. 11.2

(i) State the two conditions that must be satisfied in order that a light ray can undergo total internal reflection.

1) The light ray travels from an optically denser medium to an optically less dense medium. [B1]
2) The angle of incidence in the optically denser medium must be greater than the critical angle of the optically denser medium. [B1]

(ii) Calculate the maximum angle θ, such that the light ray will not emerge from the edge AB.

There will be total internal reflection at the edge AB.

$n = 1/\sin c$

$1.5 = 1/\sin c$

$\sin c = 1/1.5$

$\sin c = 0.67$

$c = 41.8^o$ [M1]

therefore, angle $\theta = 90^o - 41.8^o$

$= 48.2^o$ [A1]

maximum angle θ = ...[2]

12 EITHER

Fig. 12.1 shows the variation with time of the speed of a car as it travels along a level road. The car brakes when the time t = 20 s, and comes to rest when t = 24 s.

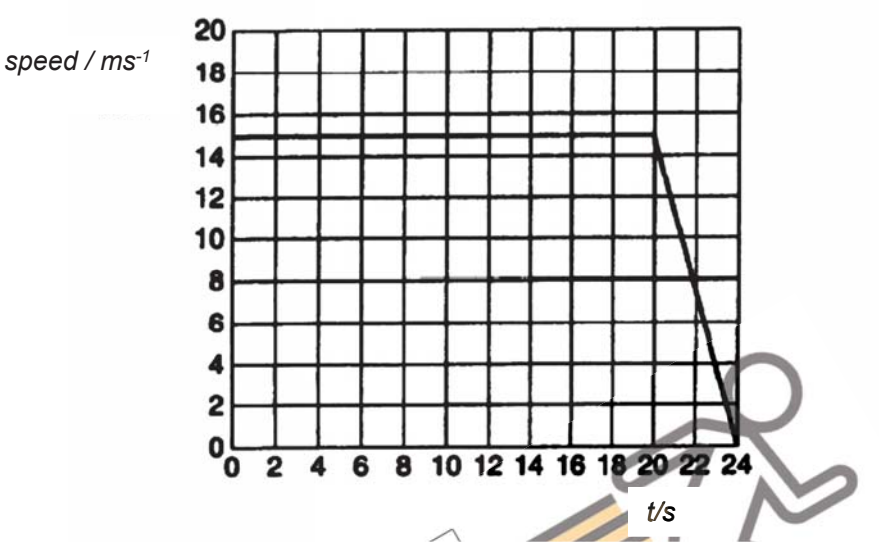


Fig. 12.1

The car has a mass of 800 kg and the forward driving force on the wheels is 1200 N.

(a) For the first 20 s of the motion shown in Fig. 12.1, calculate the power supplied by the driving force.

Distance travelled = speed × time
= 15 × 20
= 300 m [M1]

Work done by the driving force = force × distance
= 1200 × 300
= 360 000 J [M1]

Power = work done / time
= 360 000 / 20
= 18 000 W [A1]

power supplied = ...[3]

(b) (i) Describe the energy changes in the first 20 seconds.

Chemical energy → heat + sound [B1]

(ii) Calculate the kinetic energy of the car while it is travelling at constant speed.

KE = ½ m v^2
= ½ × 800 × 15^2 [M1]
= 90 000 J [A1]

kinetic energy = ……[2]

(c) Calculate the work done in overcoming the braking force during the last 4.0 seconds.

Distance travelled in last 4.0 s = Area under the v-t graph
= ½ (15 × 4)
= 30 m

Acceleration of car = (0 -15) / (24 -20)
= - 3.75 m/s^2

Braking force = mass × deceleration
= 800 × 3.75
= 3000 N [C1]

Work done = Force × distance
= 3000 N × 30 m
= 90000 J [A1]

work done = ……[2]

(d) With reference to your answer in **(c)**, suggest with a reason, whether it would be worthwhile to develop a system whereby, when the car slows down, its kinetic energy would be stored for re-use when the car speeds up again.

For the work done calculated in (c), it is equal to the kinetic energy obtained in b(ii). When the brakes were applied, there was work done against friction. The kinetic energy of the car would be converted to heat and sound. All the KE had been converted to work done in overcoming the braking force. [B1]

So, it is not worthwhile to develop a system to re-use the kinetic energy. [A1]

[Total: 10]

OR

(a) Fig. 12.2 shows a DC circuit. You can assume the voltmeters have infinite internal resistance and the ammeters have negligible internal resistance.

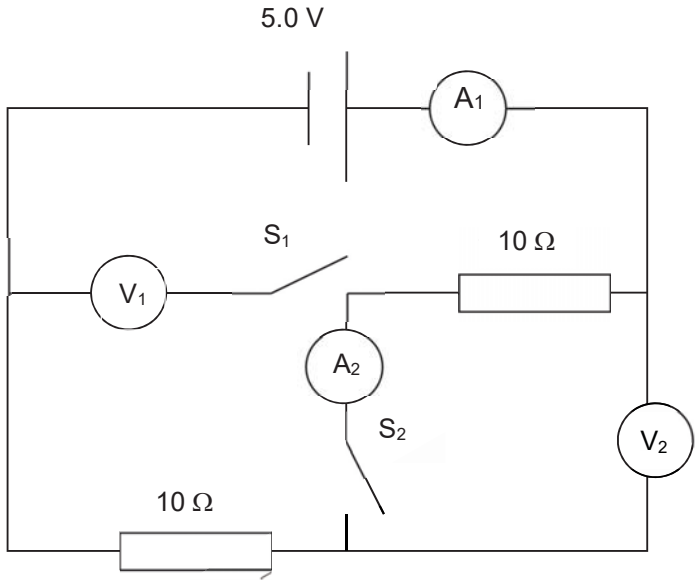


Fig. 12.2

Determine the reading in all voltmeters and ammeters when

(i) S_1 and S_2 are opened,

No current will flow through V_1 and A_2 so they will have 0 value. [A1]

V2 has high resistance so reading will be = e.m.f = 5 V
A1 = 0 since current will be negligible as resistance is almost infinite. [A1]
(two correct – 1 mark, four correct – 2 marks)
Or (one correct – 0 mark, three correct – 1 mark)

V_1 = …0 V……

V_2 = … 5.0 V……

A_1 = … 0 A……

A_2 = … 0 A……

(ii) S_1 is opened and S_2 is closed,

V1 and V2 has almost infinite resistance hence negligible current flowing through.
Hence V1 = 0V, V2 = 2.5 V [A1]
Hence A1 and A2 = 0.25A [A1]
(two correct – 1 mark, four correct – 2 marks)

V_1 = … 0 V……

V_2 = 2.5 V……

A_1 = 0.25 A……

A_2 = … 0.25 A……

(iii) S_1 and S_2 are closed. [2]

Total current in the circuit (A1 and A2) = 5 ÷ (10 + 10) = 0.25 A [A1]

Reading on V1 = V2 = 5 ÷ 2 = 2.5 V [A1]

(two correct – 1 mark, four correct – 2 marks)

V_1 = …2.5 V……

V_2 = …2.5 V……

A_1 = …0.25 A……

A_2 = …0.25 A……

(b) Fig. 12.3 shows three bulbs L, M and N connected to a 12.0 V battery, which has negligible internal resistance. Bulb L is labelled "6.0 V, 12.0 W", while bulbs M and N are identical and each has a constant resistance of 6.0 Ω. When the circuit is switched on, all the bulbs are lit with normal brightness.

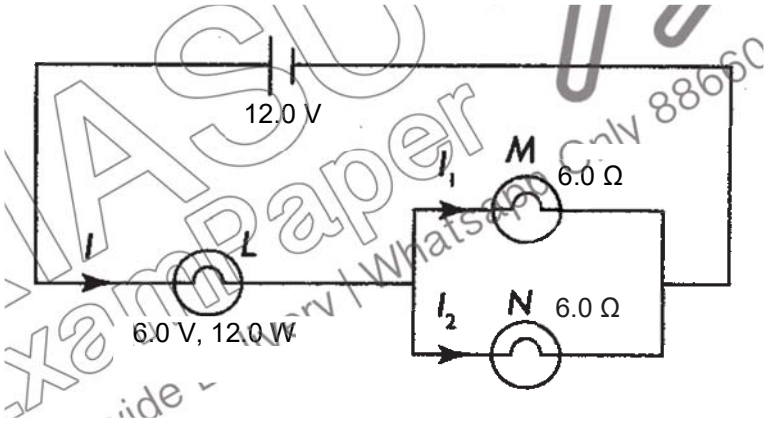


Fig. 12.3

(i) Calculate the current I_2. [2]

To calculate the resistance of Lamp L,

$P = V^2 / R$

$R = V^2 / P = (6.0 \times 6.0) / 12.0 = 3.0\ \Omega$

To calculate the effective resistance of the lamps in parallel,

$R_{//} = (6.0 \times 6.0) / (6.0 + 6.0)$

$R_{//} = 3.0\ \Omega$ [C1]

To calculate the current I_2,

$I = V / R = 12.0 / (3.0 + 3.0) = 2.0$ A

$I_2 = I / 2 = 2.0 / 2 = 1.0$ A [A1]

(ii) If the filament of bulb N burns out, what will happen to the brightness of bulbs L and M?
With calculations, explain your answer.

The brightness of bulb L decreases while the brightness of bulb M increases. [A1]

Working: $I = V / R = 12.0 / (3.0 + 6.0) = 1.3$ A
$I = I_1 = 1.3$ A
The current flowing through lamp L decreases and the current flowing through lamp M increases. [C1]

END OF SECTION B