

Answers to Paper 1 Prelim Sec 4 Physics 2020

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Question	6	7	8	9	10
Answer	B	C	B	A	B
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Answer	C	C	A	A	D
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Answer	A	A	D	B	B
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Answer	A	A	D	B	D
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Answer	B	B	B	B	C

O Level Centre Number/ Index Number	Class	Name
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新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION

SECONDARY FOUR

PHYSICS

Paper 2

6091/02

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] $t^2 + 6t + 9 + 2t = 1000$ $t^2 + 8t - 991 = 0$ $t = 27.7 \text{ s}$ [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.

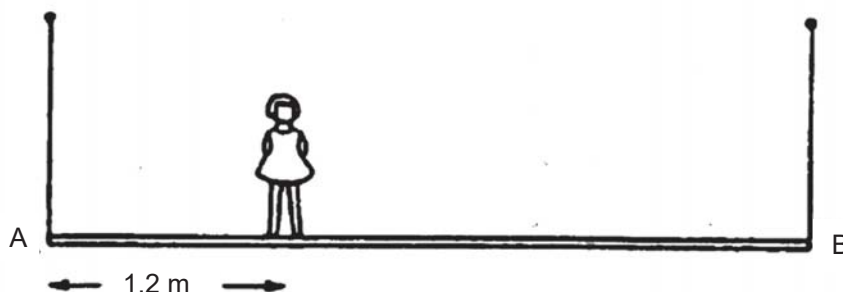


Fig. 2.1

- (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

$$T \times 4.0 \text{ m} = 500 \text{ N} \times 2.0 \text{ m} + 300 \text{ N} \times 1.2 \text{ m}$$

$$T = 340 \text{ N}$$

[M1]

[A0]

tension =[1]

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

Sum of upward forces = Sum of downward forces

$$340 \text{ N} + T_A = 500 \text{ N} + 300 \text{ N}$$

$$T_A = 460 \text{ N}$$

[C1]

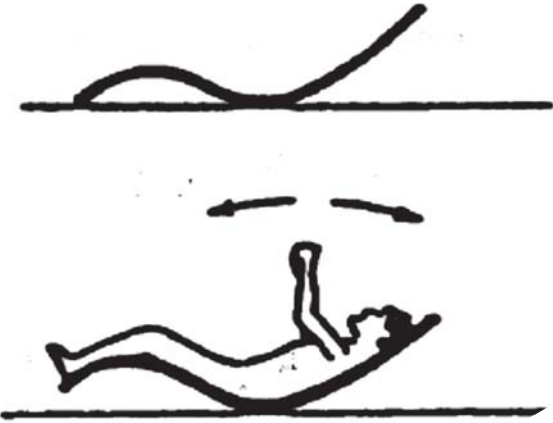
[A1]

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 <u>clockwise moment about the pivot due to the weight</u> of the basketball. The reclining seat will tilt in a clockwise direction and <u>come to rest in a new position.</u> [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 4.5×10^{-5} kg and the electric force acting on **A** is 1.5×10^{-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]

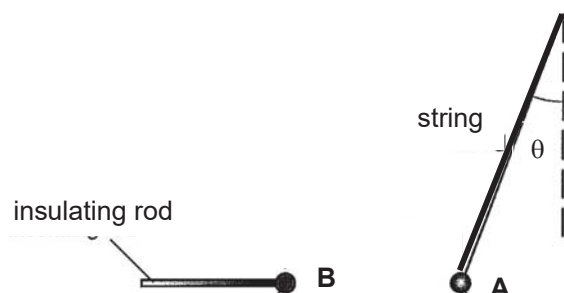
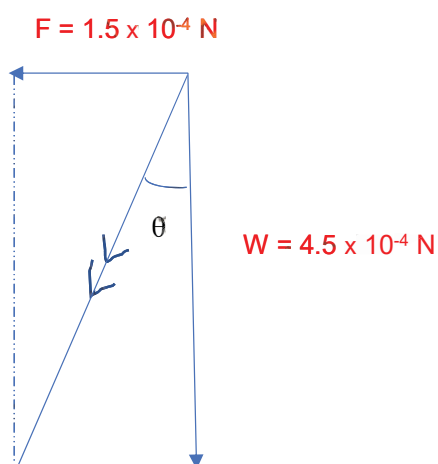


Fig. 3.1

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



Resultant force = 4.8×10^{-4} N

Hence,

$T = 4.8 \times 10^{-4}$ N

Angle = 18°

Correct orientation of diagram. labels &

All arrows drawn correctly –

[B1]

Answer for tension – accept 4.3 to 5.3×10^{-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} .

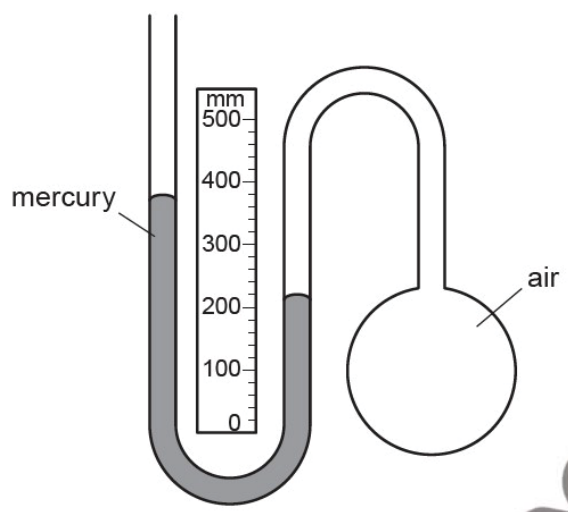


Fig. 4.1

- (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.

$$\begin{aligned}
 P &= 760/10 + (380 - 220)/10 \\
 &= 92 \text{ cm Hg} \\
 &= 0.92 \text{ m Hg} & [C1] \\
 \text{Pressure} &= h\rho g \\
 &= 0.92 \times 13600 \times 10 \\
 &= 125120 \text{ Pa} \\
 &= 125000 \text{ Pa (to 3sf)} & [A1]
 \end{aligned}$$

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]

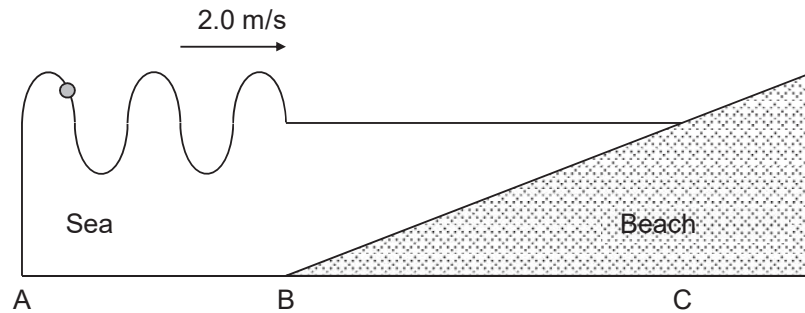
The molecules collide with the walls of the flask with lower frequency and smaller force. The average force per unit area and thus pressure decreases. [B1]

- (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 $4.2 \text{ kJ kg}^{-1} \text{ K}^{-1}$ and specific heat capacity of ice is $2.04 \text{ kJ kg}^{-1} \text{ K}^{-1}$.	
(a)	Define the term <i>specific latent heat of fusion</i> . It is the amount of heat energy required to change <u>1 kg of the substance</u> from solid to liquid state <u>without a change in temperature</u> . [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 , $Q_1 = mc_i \Delta\theta$ $= 0.2 \times 2040 \times 10^\circ\text{C}$ $= 4080 \text{ J}$ Heat required to melt, $Q_2 = m l_f$ $= 0.2 \text{ kg} \times 340\,000 \text{ J kg}^{-1}$ $= 68\,000 \text{ J}$ [C1] Heat required to raise temperature, $Q_3 = mc_w \Delta\theta$ $= 0.2 \text{ kg} \times 4200 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1} \times 63^\circ\text{C}$ $= 52\,920 \text{ J}$ [C1] Total heat required = $Q_1 + Q_2 + Q_3$ $= 125\,000 \text{ J}$ [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, $P = E / t$ $= 125000 \text{ J} / (20 \times 60 \text{ s})$ [C1] (ecf) $= 104 \text{ W}$ [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.

$$\begin{aligned} \text{Distance between A and B} &= \text{speed} \times \text{time} \\ &= 2.0 \times 3 = 6.0 \text{ m} \end{aligned}$$

The distance between A and B is 6.0 m

$$\begin{aligned} \text{Wavelength of the wave} &= 6.0 / 2.5 \\ &= 2.4 \text{ m} \end{aligned}$$

The Wavelength of the wave is 2.4 m [M1]

$$\begin{aligned} \text{Frequency} &= \text{speed} / \text{wavelength} \\ &= 2.0 / 2.4 \\ &= 0.833 \end{aligned}$$

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.

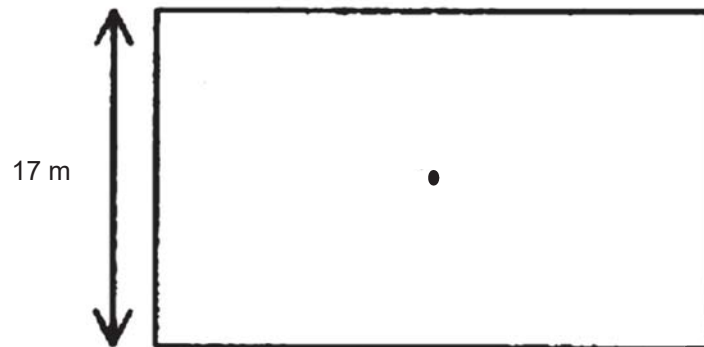


Fig. 6.2

Assuming that there is no echo from the ceiling, calculate

- (i) the speed of sound in air,

$$\begin{aligned} \text{Speed} &= d/t \\ &= 17 \text{ m} / 0.05\text{s} & [\text{M1}] \\ &= 340 \text{ m/s} & [\text{A1}] \end{aligned}$$

speed of sound in air =[2]

- (ii) the length of the hall.

$$\begin{aligned} \text{Length} &= 340 \text{ m/s} \times 0.08\text{s} & \text{ecf} \\ &= 27.2 \text{ m} & [\text{A1}] \end{aligned}$$

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.

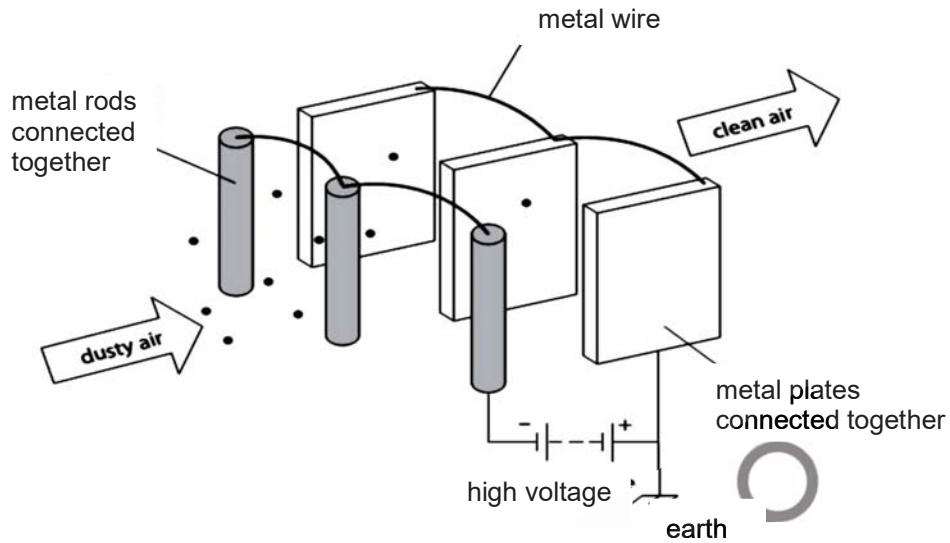


Fig. 7.1

- (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.

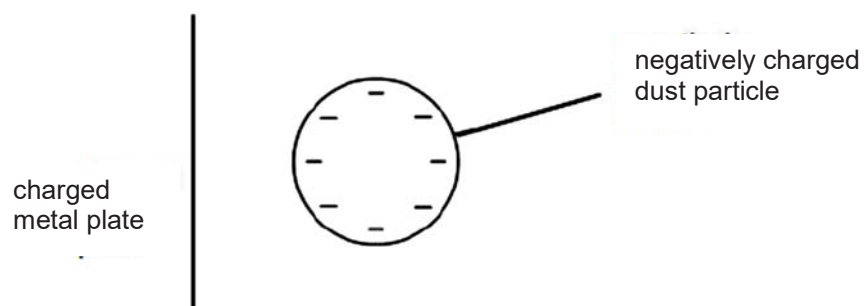
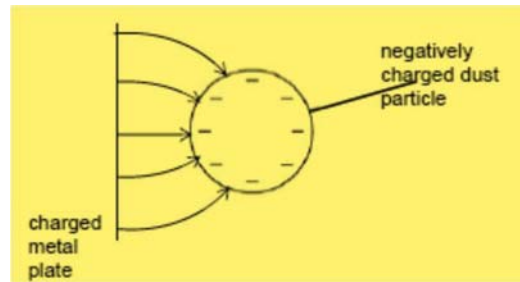


Fig. 7.2

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.

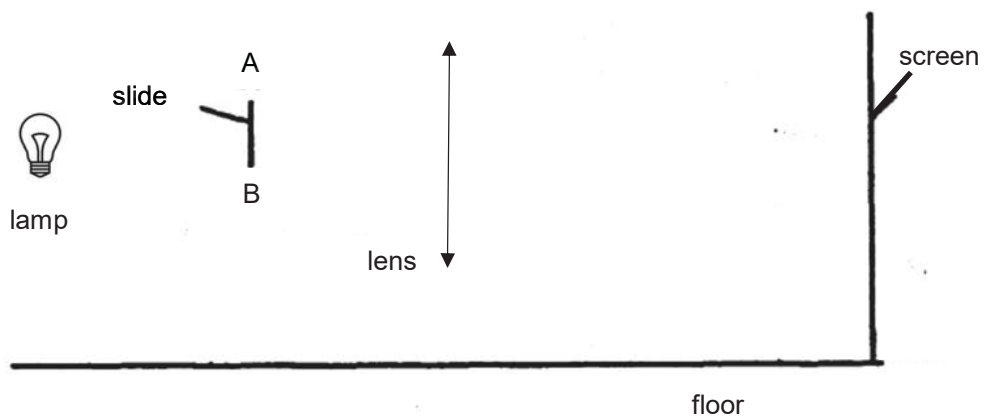
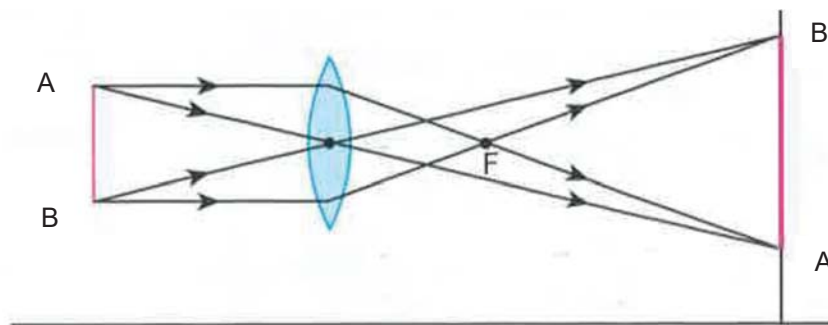


Fig. 8.1

- (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.

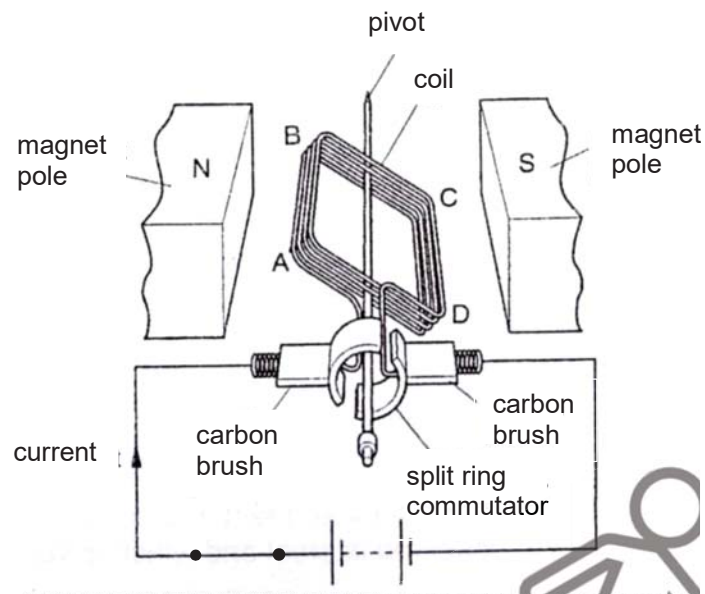


Fig. 9.1

- (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
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新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION

SECONDARY FOUR

PHYSICS

Paper 2

6091/02

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.

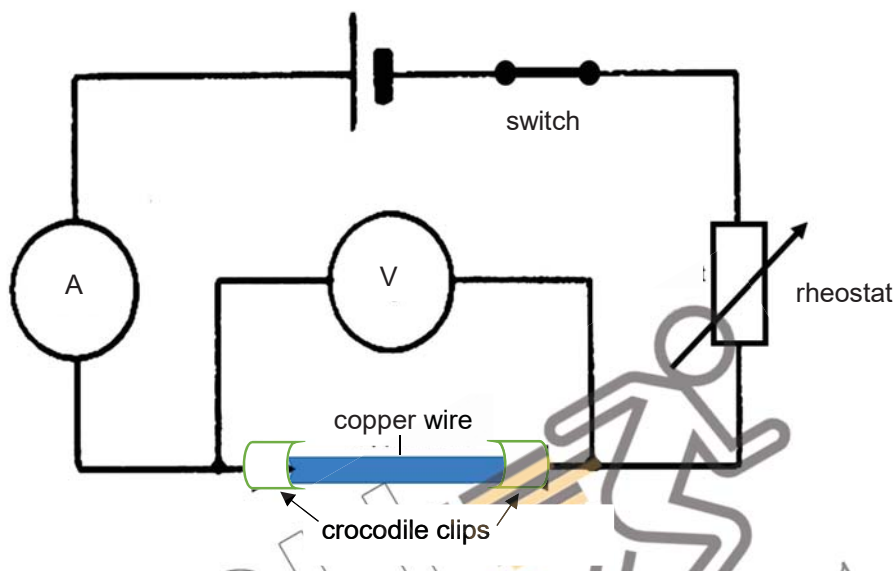


Fig. 10.1

- (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.
(Accept explanation in words)

[B1]

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

$$V = 0.11/2 \quad [M1]$$

$$= 0.055 \text{ V} \quad [A1]$$

$$\text{Or } V = 0.028 \times 2 \quad [M1]$$

$$= 0.056 \text{ V} \quad [A1]$$

$$\text{Or } AV = \text{constant} = 1.7 \times 10^{-9} \quad [M1]$$

$$V = 0.053 \text{ V} \quad [A1]$$

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 $0.20 \, \Omega$. The wires are arranged in a circuit as shown in Fig 10.3.

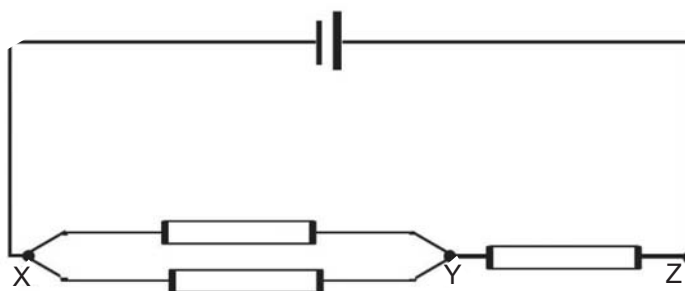


Fig. 10.3

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

$$\begin{aligned} V_{XY} &= 0.50 \text{ V} \\ \text{Emf} &= 0.50 + 1.00 & [C1] \\ &= 1.50 \text{ V} & [A1] \end{aligned}$$

Alternatively,

$$\begin{aligned} I &= 1.00 / 0.200 = 5.00 \text{ A} & [C1] \\ V &= R \times I = 5.00 \times 0.300 \Omega = 1.50 \text{ V} & [A1] \end{aligned}$$

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.

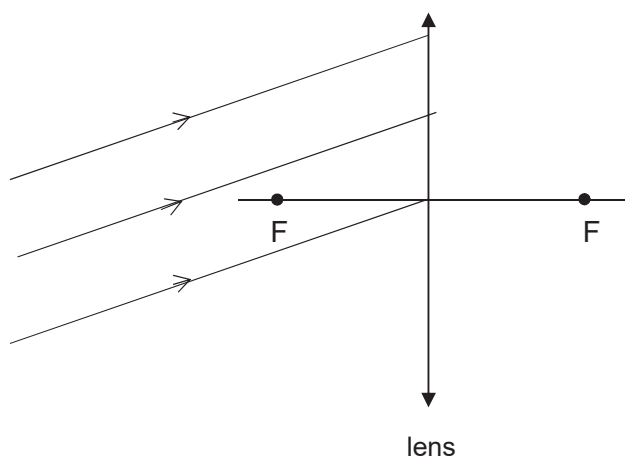
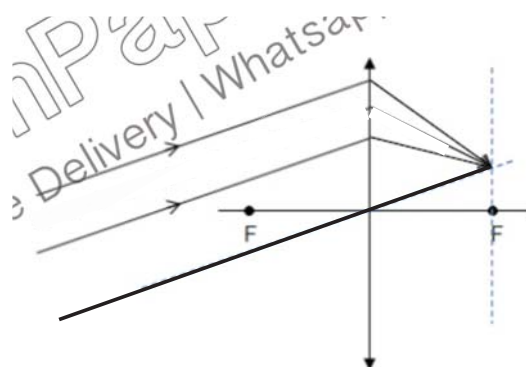


Fig. 11.1

- (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.

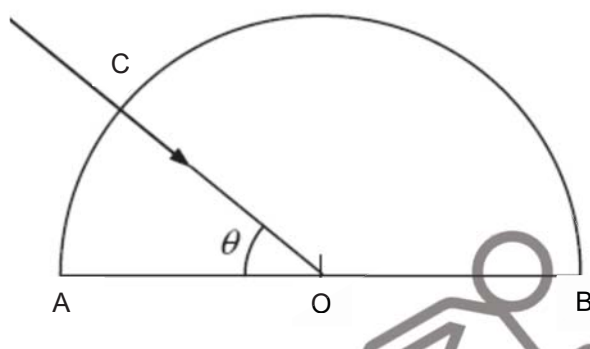


Fig. 11.2

- (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.

$$n = 1 / \sin c$$

$$1.5 = 1 / \sin c$$

$$\sin c = 1 / 1.5$$

$$\sin c = 0.67$$

$$c = 41.8^\circ$$

[M1]

$$\text{therefore, angle } \theta = 90^\circ - 41.8^\circ$$

$$= 48.2^\circ$$

[A1]

maximum angle $\theta = \dots\dots\dots$ [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.

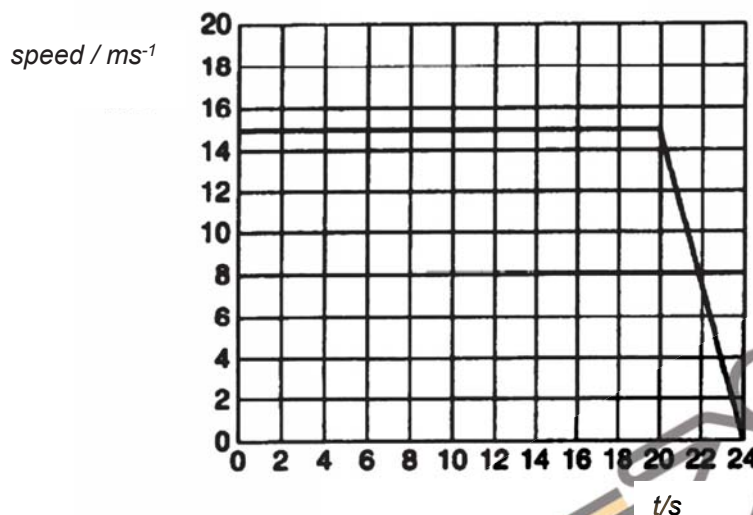


Fig. 12.1

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.

$$\begin{aligned}
 \text{Distance travelled} &= \text{speed} \times \text{time} \\
 &= 15 \times 20 \\
 &= 300 \text{ m}
 \end{aligned}
 \quad \text{[M1]}$$

$$\begin{aligned}
 \text{Work done by the driving force} &= \text{force} \times \text{distance} \\
 &= 1200 \times 300 \\
 &= 360\,000 \text{ J}
 \end{aligned}
 \quad \text{[M1]}$$

$$\begin{aligned}
 \text{Power} &= \text{work done} / \text{time} \\
 &= 360\,000 / 20 \\
 &= 18\,000 \text{ W}
 \end{aligned}
 \quad \text{[A1]}$$

power supplied =[3]

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

Chemical energy $\longrightarrow$ heat + sound [B1]

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

$$\begin{aligned}
 \text{KE} &= \frac{1}{2} m v^2 \\
 &= \frac{1}{2} \times 800 \times 15^2 \\
 &= 90\,000 \text{ J}
 \end{aligned}
 \quad \begin{array}{l} \text{[M1]} \\ \text{[A1]} \end{array}$$

kinetic energy =[2]

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

$$\begin{aligned}\text{Distance travelled in last 4.0 s} &= \text{Area under the v-t graph} \\ &= \frac{1}{2} (15 \times 4) \\ &= 30 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Acceleration of car} &= (0 - 15) / (24 - 20) \\ &= -3.75 \text{ m/s}^2\end{aligned}$$

$$\begin{aligned}\text{Braking force} &= \text{mass} \times \text{deceleration} \\ &= 800 \times 3.75 \\ &= 3000 \text{ N}\end{aligned} \quad [\text{C1}]$$

$$\begin{aligned}\text{Work done} &= \text{Force} \times \text{distance} \\ &= 3000 \text{ N} \times 30 \text{ m} \\ &= 90000 \text{ J}\end{aligned} \quad [\text{A1}]$$

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.

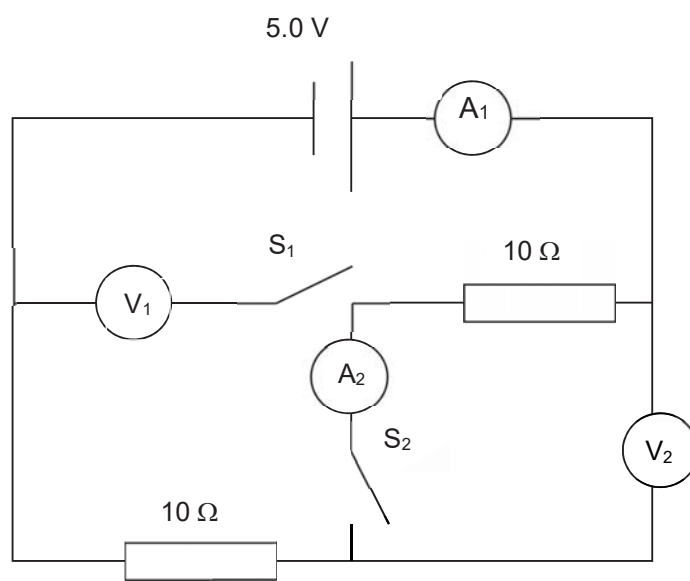


Fig. 12.2

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]

V_2 has high resistance so reading will be = e.m.f = 5 V

$A_1 = 0$ 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)

$V_1 = \dots 0 \text{ V} \dots \dots \dots$

$V_2 = \dots 5.0 \text{ V} \dots \dots \dots$

$A_1 = \dots 0 \text{ A} \dots \dots \dots$

$A_2 = \dots 0 \text{ A} \dots \dots \dots$

- (ii) S_1 is opened and S_2 is closed,

V_1 and V_2 has almost infinite resistance hence negligible current flowing through.

Hence $V_1 = 0 \text{ V}$, $V_2 = 2.5 \text{ V}$ [A1]

Hence A_1 and $A_2 = 0.25 \text{ A}$ [A1]

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

$V_1 = \dots 0 \text{ V} \dots \dots \dots$

$V_2 = \dots 2.5 \text{ V} \dots \dots \dots$

$A_1 = \dots 0.25 \text{ A} \dots \dots \dots$

$A_2 = \dots 0.25 \text{ A} \dots \dots \dots$

(iii) S_1 and S_2 are closed.

[2]

Total current in the circuit (A_1 and A_2) = $5 \div (10 + 10) = 0.25 \text{ A}$ [A1]

Reading on $V_1 = V_2 = 5 \div 2 = 2.5 \text{ V}$ [A1]

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

$V_1 = \dots 2.5 \text{ V} \dots\dots\dots$

$V_2 = \dots 2.5 \text{ V} \dots\dots\dots$

$A_1 = \dots 0.25 \text{ A} \dots\dots\dots$

$A_2 = \dots 0.25 \text{ A} \dots\dots\dots$

- (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 6.0Ω . When the circuit is switched on, all the bulbs are lit with normal brightness.

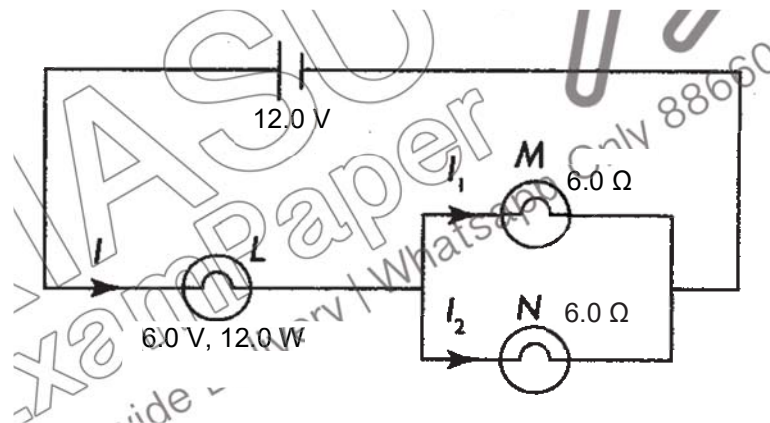


Fig. 12.3

- (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 ,

$$I = V / R = 12.0 / (3.0 + 3.0) = 2.0 \text{ A}$$

$$I_2 = I / 2 = 2.0 / 2 = 1.0 \text{ A}$$

[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: $I = V / R = 12.0 / (3.0 + 6.0) = 1.3 \text{ A}$

$I = I_1 = 1.3 \text{ A}$

The current flowing through lamp L decreases and the current flowing through lamp M increases. [C1]

END OF SECTION B

