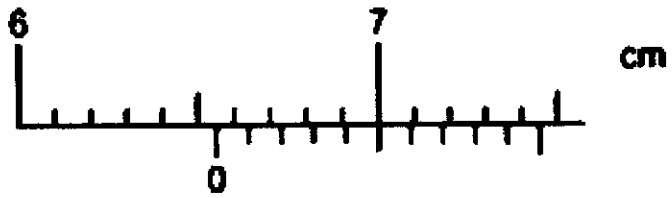
Bendemeer Secondary School
2021 Preliminary Examination
Science (Physics) 2

1 Which of the following shows the closest estimate for the height of a 30-storey HDB flat?

A 0.1 dm **B** 10 km **C** 100 Gm **D** 10 000 cm

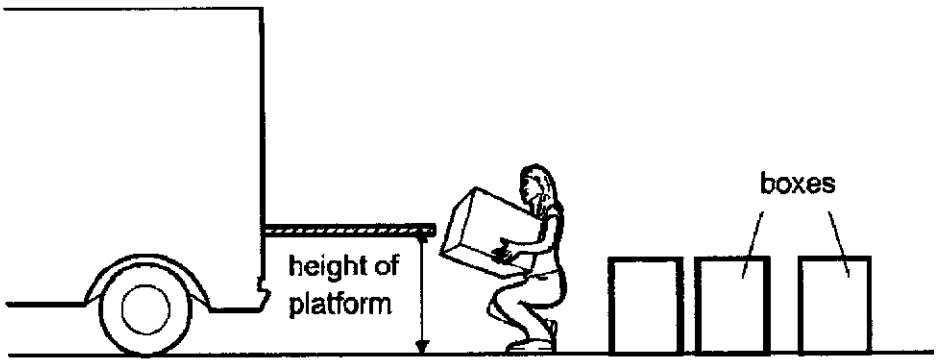
2 The diagram shows a vernier scale.



What is the reading on the vernier scale?

A 6.50 cm **B** 6.55 cm **C** 7.00 cm **D** 7.05 cm

3 A person lifts boxes of equal weight onto a platform.



Which quantity will not affect the total work done by the person?

A the height of the platform above the ground
B the number of boxes lifted
C the time taken to lift the boxes
D the weight of the boxes

[Turn over

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4 A gravitational field is a region in which a body with mass experiences a force.

Which statement about this force is correct?

A It can be attractive or repulsive.
B It depends on the charge of the body.
C It depends on the volume of the body.
D It keeps a planet in orbit around the Sun.

5 What causes Brownian motion of dust particles in the air?

A convection current in the air
B dust particles falling towards the ground
C random collisions between the dust particles
D random collisions of air molecules with the dust particles

6 A piece of ice cube feels cool to the skin when touched.

Which of the following statements is correct?

A Coldness is transferred from the ice cube to the skin.
B Coldness is transferred from the skin to the ice cube.
C Heat is transferred from the ice cube to the skin.
D Heat is transferred from the skin to the ice cube.

7 Molten glass is poured onto a stick to be moulded into a glass ball. The glass cools to its freezing point and begins to solidify.

What happens as the glass solidifies?

A Its temperature decreases and energy is lost from the glass.
B Its temperature decreases and no energy is lost from the glass.
C Its temperature remains the same and energy is lost from the glass.
D Its temperature remains the same and no energy is lost from the glass.

[Turn over

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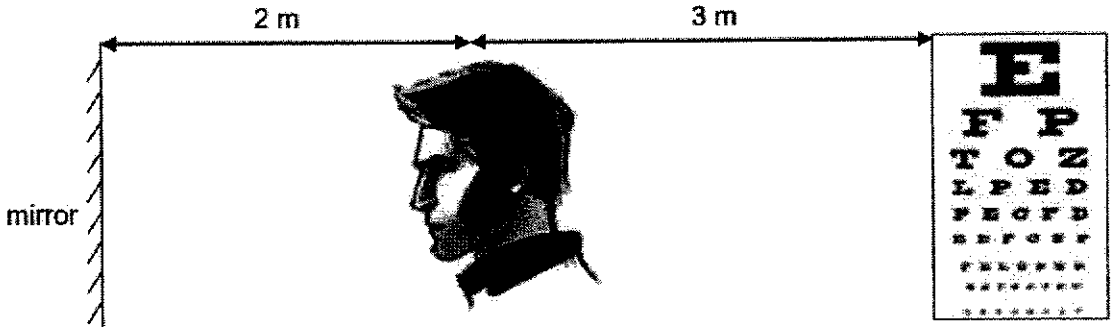
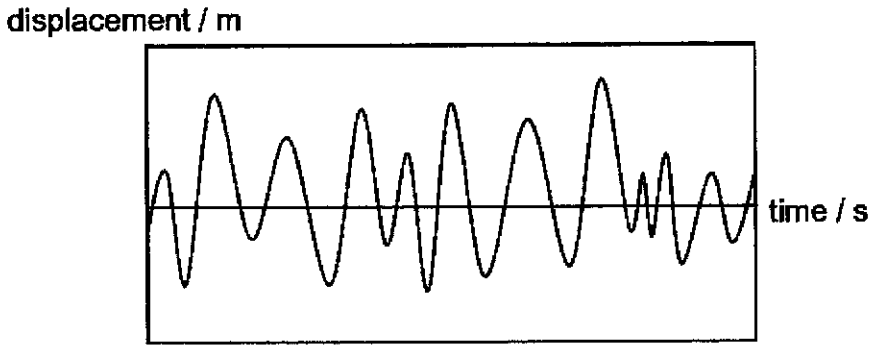
8 Mr Tay is having his eyes tested. A chart with letters on it is placed behind him and he sees the chart reflected in a plane mirror.



How far away from Mr Tay is the image of the chart?

A 2 m **B** 5 m **C** 7 m **D** 10 m

9 The diagram shows a displacement-time graph of a note produced by strumming a guitar string.



If the same note is produced again but at a louder volume, how will the wave change?

A The amplitude of the wave would decrease.

B The amplitude of the wave would increase.

C The peaks of the wave would be closer to one another.

D The peaks of the wave would be further from one another.

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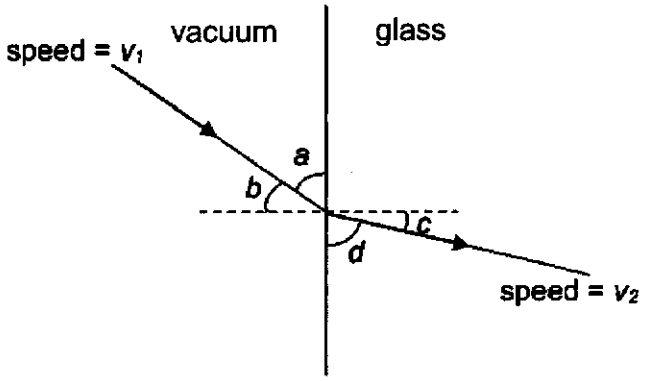
10 A ray of light travels from vacuum into glass.



What is the refractive index of the glass?

A sin *a* / sin *d*

B sin *c* / sin *b*

C v_1 / v_2

D v_2 / v_1

11 What is meant by the term *wavefront*?

A the distance between successive peaks of a wave

B the distance between the trough and the peak of a wave

C a line joining points along the peak of a wave

D a line joining the trough and the peak of a wave

12 When sections of a large metal pipe have been welded together, they are checked to discover whether there are any cracks in the joints.

Which component of the electromagnetic spectrum is used for this purpose?

A infra-red

B radiowaves

C ultra-violet

D X-rays

[Turn over

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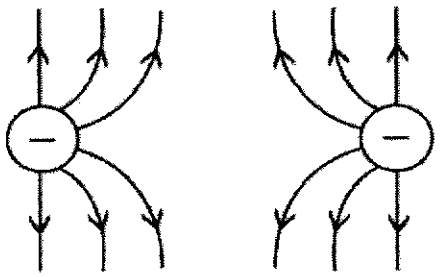
13 When an ebonite rod is rubbed with a duster, the rod becomes negatively charged.

Why is this so?

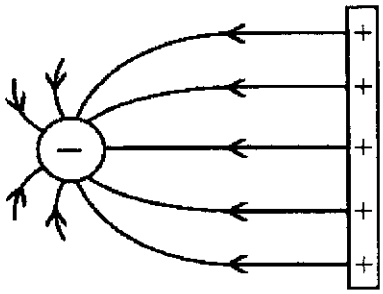
A the duster gains protons
B the duster loses electrons
C the rod gains protons
D the rod loses electrons

14 Which diagram shows the incorrect electric field lines between two charged objects?

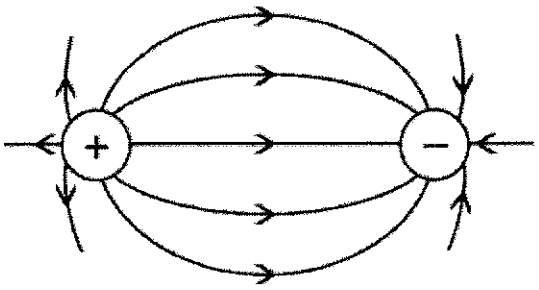
A



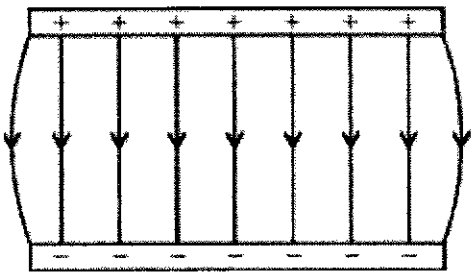
B



C



D



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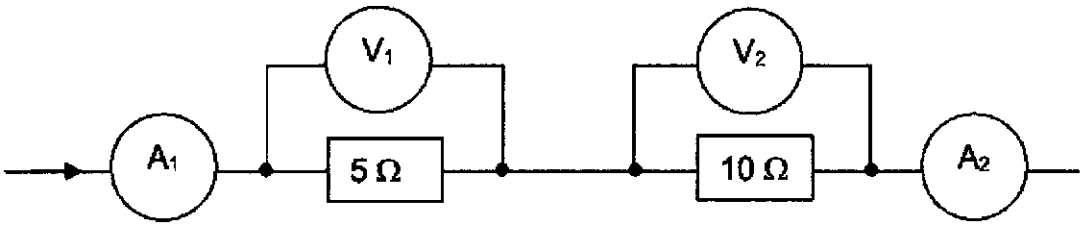
15 A piece of wire has a resistance of 16 Ω.

The wire is 20 cm long and has a cross-sectional area of 2 mm^2.

Which wire of the same material has a resistance of 8 Ω?

	length / cm	cross-sectional area / mm^2
A	10	1
B	10	4
C	20	1
D	20	4

16 Current flows in two resistors connected in series as shown in the diagram. A_1 and A_2 are the readings on the ammeters. V_1 and V_2 are the reading on the voltmeters.



Which of the following correctly describes the ammeter and voltmeter readings?

	ammeter readings	voltmeter readings
A	A_1 is equal to A_2	V_1 is less than V_2
B	A_1 is equal to A_2	V_1 is equal to V_2
C	A_1 is less than A_2	V_1 is less than V_2
D	A_1 is less than A_2	V_1 is greater than V_2

17 A plug for a lamp contains a fuse with a 5.0 A rating.

Which statement is correct?

A The fuse blows and breaks the circuit if the current exceeds 5.0 A.
B The fuse contains an electromagnet.
C The fuse is connected to the earth pin of the plug.
D The fuse keeps the current at 5.0 A.

[Turn over

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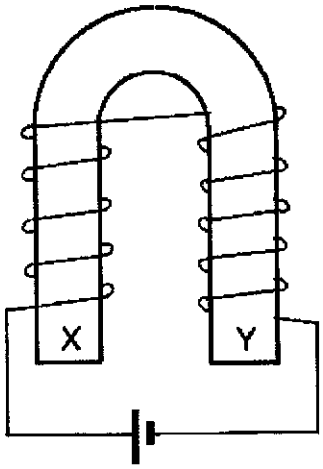
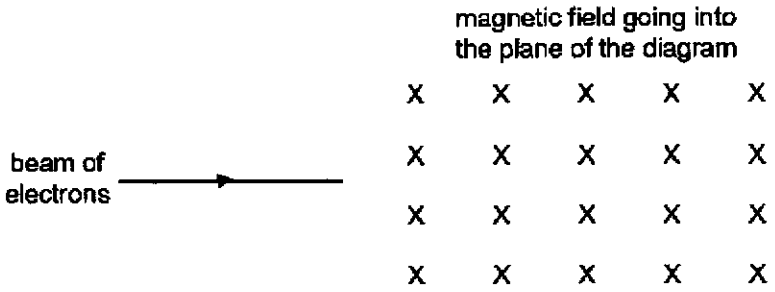
18 What are the poles of the electromagnet at X and Y?



	X	Y
A	North	North
B	North	South
C	South	North
D	South	South

19 The diagram shows a beam of electrons entering a magnetic field.



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

A They are deflected into the plane of the diagram.
B They are deflected out of the plane of the diagram.
C They are deflected towards the bottom of the diagram.
D They are deflected towards the top of the diagram.

[Turn over

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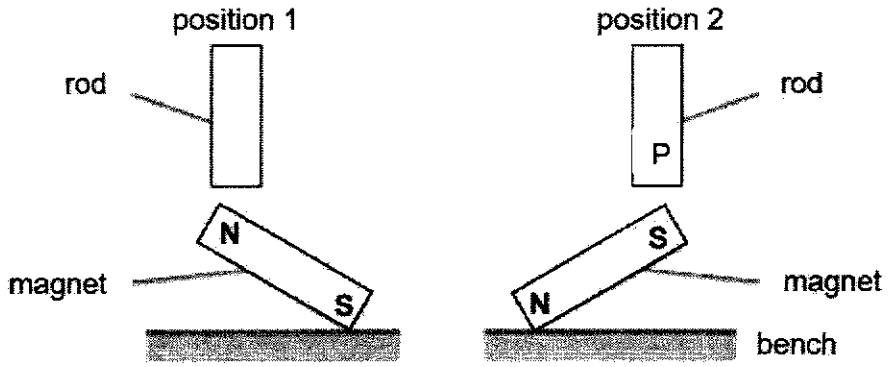
20 One end of a rod picks up the N-pole of a bar magnet when in position 1. The same end of the rod is then brought to position 2. The rod picks up the S-pole of the bar magnet when in position 2.



Which material is the rod made from and what is the pole at P of the rod when in position 2?

	material	pole at P
A	iron	N-pole
B	iron	S-pole
C	steel	N-pole
D	steel	S-pole

[Turn over

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Section A [45 marks]

Answer **all** the questions in the spaces provided.

1 Fig. 1.1 shows an apparatus used to demonstrate the motor effect. *P* is a short length of bare copper wire resting on two other bare copper wires.

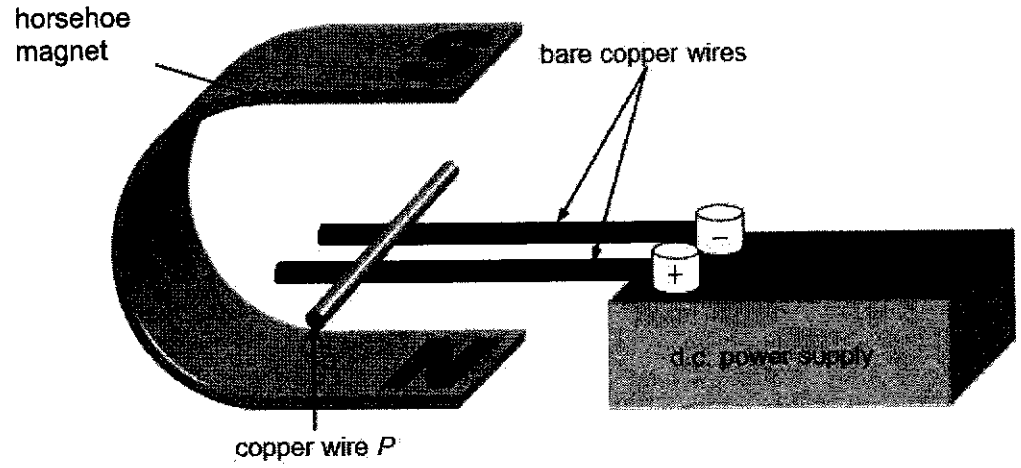

Fig. 1.1

(a) State the direction that the copper wire *P* would roll when the d.c. power supply is switched on.

..... [1]

(b) Explain the observation made in **(a)**.

.....

.....

..... [2]

(c) What difference would you notice if the following changes are made:

(i) the current is reversed,

..... [1]

(ii) the current is decreased,

..... [1]

[Turn over

2 Fig. 2.1 shows a ball falling a distance of 1.1 m when Kevin drops it. The mass of the ball is 0.5 kg. Ignore air resistance. The gravitational field strength is 10 N/kg.

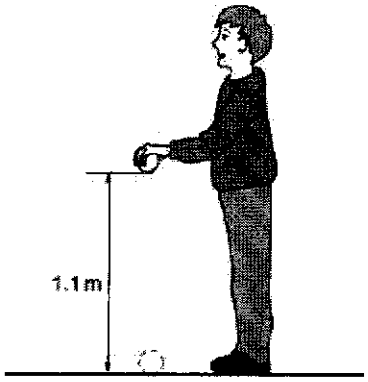

Fig. 2.1

(a) Calculate the loss in gravitational potential energy of the ball as it falls through the 1.1 m.

loss in gravitational potential energy = ... J [2]

(b) The ball bounces and only rises to a height of 0.8 m.

(i) Calculate the energy lost during the bounce.

energy lost = ... J [2]

(ii) Suggest what has happened to the energy lost during the bounce.

..... [1]

[Turn over

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(iii) Calculate the speed of the ball right after it bounced off the ground.

speed = ... m/s [2]

3 Fig. 3.1 shows three resistors X, Y and Z connected in a circuit. The current flowing through X is 1.5 A and X has a resistance of 3.0 Ω.

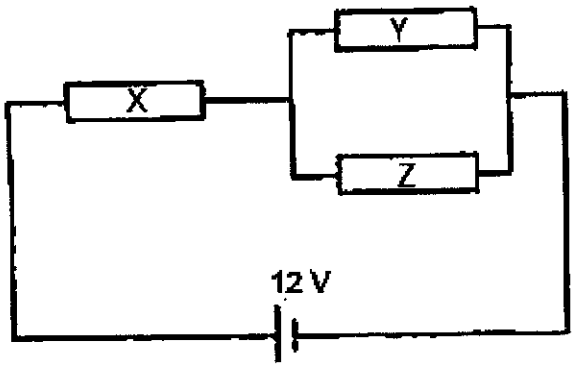

Fig. 3.1

(a) Calculate the potential difference across X.

potential difference = ... V [2]

(b) The resistance of Z is 6.0 Ω.

Calculate the current flowing through Z.

current = ... A [2]

[Turn over

(c) Calculate the resistance of Y.

resistance = ... Ω [2]

4 Fig. 4.1 shows a fireman standing next to his fire engine. The fireman is wearing a mesh T-shirt and holding his fire-protective jacket.

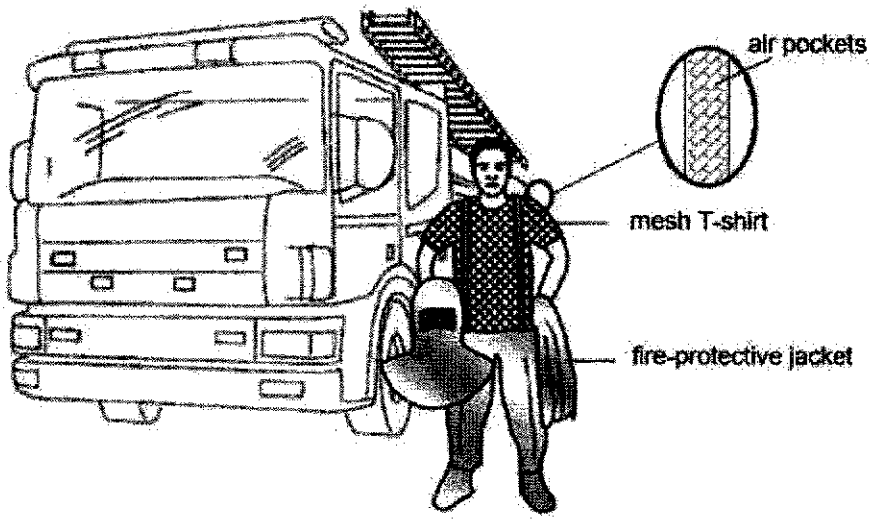

Fig. 4.1

(a) Describe and explain how the loosely woven mesh T-shirt helps to keep the fireman cool when he is close to the fire.

.....

.....

.....

.....

..... [2]

[Turn over

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(b) State the choice of colour for the fire-protective jacket to reduce transfer of thermal energy to the fireman. Explain your answer.

.....

.....

.....

.....

..... [2]

5 A vertical uniform cylinder contains some liquid as shown in Fig. 5.1.

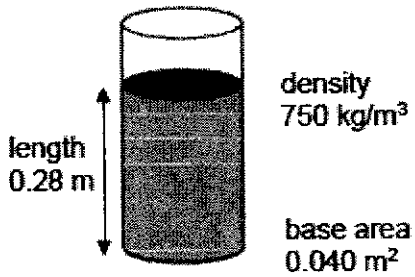

Fig. 5.1

The base area of the cylinder is 0.040 m^2.
The vertical length of the liquid is 0.28 m.
The density of the liquid is 750 kg/m^3.
The gravitational field strength on Earth is 10 N/kg.

(a) Calculate the mass of the liquid in the cylinder.

mass = ... kg [2]

[Turn over

(b) Determine the weight of the liquid in the cylinder.

weight = ... N [1]

(c) Calculate the pressure exerted by the liquid on the base of the cylinder.

pressure = ... Pa [2]

6 Fig. 6.1 shows regions of the electromagnetic spectrum in order of decreasing wavelength. Some regions are identified by letters.

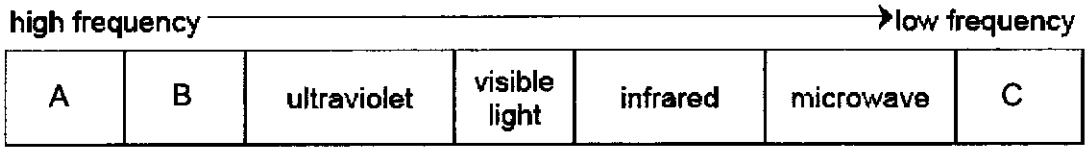

Fig. 6.1

(a) State two properties of waves in regions B and C that are different from properties of sound waves.

1. .....

2. ..... [2]

(b) For region A,

(i) name this region, and

..... [1]

(ii) state one use of waves in this region.

..... [1]

[Turn over

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7 Fig. 7.1 shows a ray of light incident on a triangular glass prism ABC.
The critical angle of light in the glass prism is 43°.

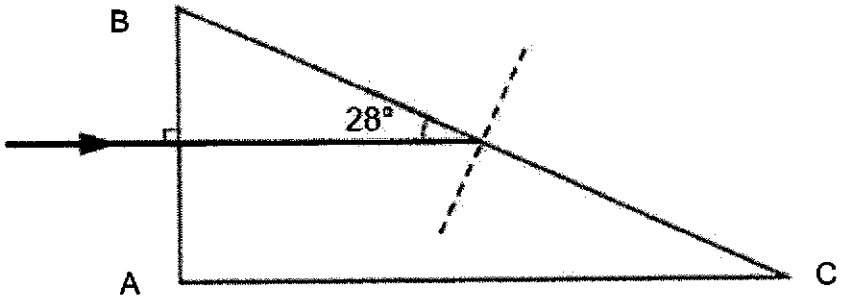

Fig. 7.1 (not drawn to scale)

(a) State whether the light ray will emerge from the face BC. Explain your answer.

.....

.....

.....

..... [2]

(b) Calculate the refractive index of the glass prism.

refractive index = ... [2]

[Turn over

8 Fig. 8.1 shows a stone supported by the 2 strings. The tensions in the two strings are 3.0 N and 4.0 N respectively.

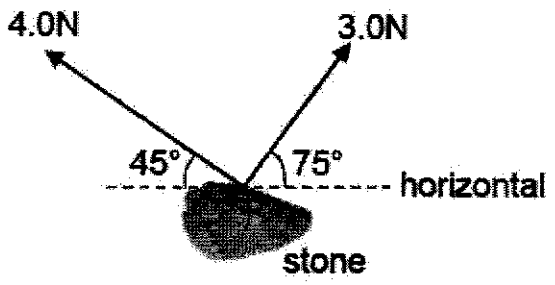

Fig. 8.1 (not drawn to scale)

By means of a scale diagram, determine the magnitude and direction of the resultant force due to the tensions in the two strings.

resultant force = ... N

direction of resultant force = ... [4]

[Turn over

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9 A car was travelling along Bendemeer Road and was about to pass a traffic crossing when a boy suddenly jay-walked across the road. The graph in Fig. 9.1 shows how the speed of the car changed from the moment the driver saw the boy until the car stopped.

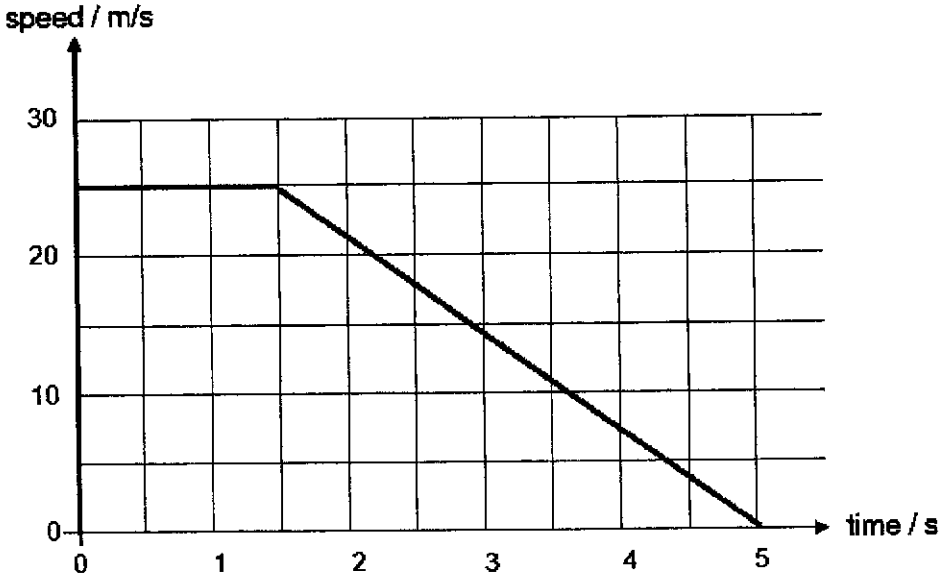

Fig. 9.1

(a) Suggest why the car continued at a constant speed for the first 1.5 s, even though the driver had seen the boy.

.....

..... [1]

(b) Determine how far the car travelled before the car started to decelerate from the moment the driver saw the boy.

distance = ... m [1]

(c) Calculate the deceleration of the car.

deceleration = ... m/s^2 [2]

[Turn over

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(d) The boy is standing 50 m in front of the car.

Using the graph, determine if the boy will be knocked down by the car. Show your workings clearly.

.....

.....

..... [2]

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Section B [20 marks]
Answer any **two** questions in the spaces provided.

10 Fig. 10.1 shows a man standing in a queue with his wheeled bag. The mass of the bag is 50 kg.

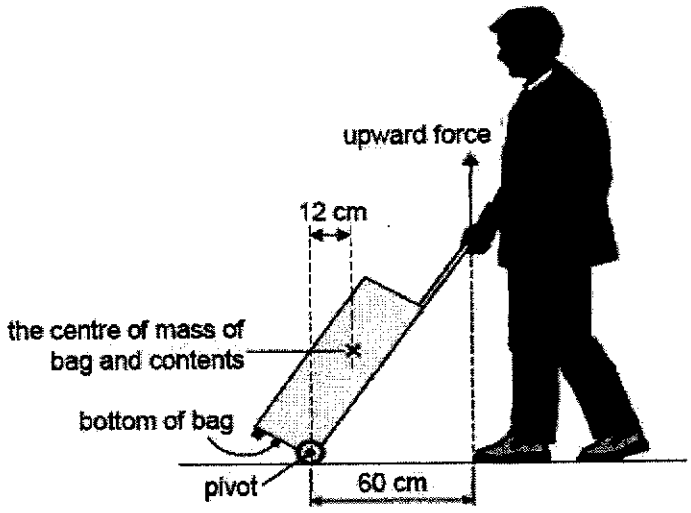

Fig. 10.1

(a) On Fig. 10.1, draw an arrow to indicate the weight of the bag. [1]

(b) The man applies an upward force to the handle of his bag to stop the bag from falling.

Calculate the upward force.

upward force = ... N [2]

(c) Explain why the bag falls and hits the floor when the man lets go of the handle.

.....

.....

..... [2]

[Turn over

(d) The man bought a souvenir and put it into his bag. He now needs an upward force of 120 N to support the bag in the same position shown in Fig. 10.1.

Assuming the centre of mass of the bag and its contents remains in the same position, calculate the mass of the souvenir.

mass = ... kg [3]

(e) Suggest how the man should rearrange the contents in his bag to make it more stable when the bag is in the upright position.

.....

.....

..... [1]

(f) The man thinks that if he shortens the length of the handle, he will require a smaller upward force.

Do you think the man's assumption is correct? Explain your answer.

.....

.....

..... [1]

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11 An electric kettle with a power rating of 2.5 kW is connected to a 240 V mains supply by a flexible cable to a 3-pin plug.

(a) Complete Fig. 11.1 with the names of the three wires found in the 3-pin plug and their respective colours.

name of wire	colour

Fig. 11.1

[3]

(b) Calculate the current flowing in the circuit when the electric kettle is operating under normal condition.

current = ... A [2]

(c) Suggest a suitable fuse rating for this circuit. Explain your answer.

.....

.....

..... [2]

[Turn over

(d) If the cost of electricity is $0.25 per kWh, calculate the total cost of using the electric kettle for 2 hours a day for 1 week.

cost = $..... [2]

(e) Suggest where a heating element should be placed in the electric kettle so that the water can be heated efficiently.

.....

..... [1]

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12 Fig. 12.1 shows the surface of the water in a swimming pool, 1.5 seconds after the wave-making machine was turned on.

Fig. 12.1

(a) State the number of wavelengths between points X and Y.

..... [1]

(b) Calculate the frequency of the waves.

frequency = ... Hz [2]

(c) Fig. 12.2 shows the surface of the pool several minutes after the machine was turned on. Three toy ducks are placed at different positions in the pool. The line LL represents the original water level before the wave-making machine was turned on.

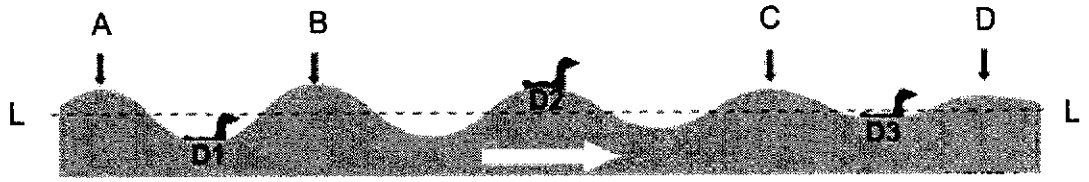

Fig. 12.2

(i) If the wavelength of the wave is 35 cm, calculate the speed of the wave in section AB.

speed = ... m/s [2]

[Turn over

(ii) The three ducks are set in motion as the wave-making machine is turned on. Explain whether the duck at D1 would hit the other two ducks after some time.

.....

..... [1]

(iii) The swimming pool operator wants to reduce the speed of the waves. He decides to reduce the frequency of the wave-making machine.
Explain why he will be unsuccessful in his attempt.

.....

..... [1]

(d) A string on a guitar is plucked. Fig. 12.3 shows the variation with time of the pressure of the air near the guitar string.

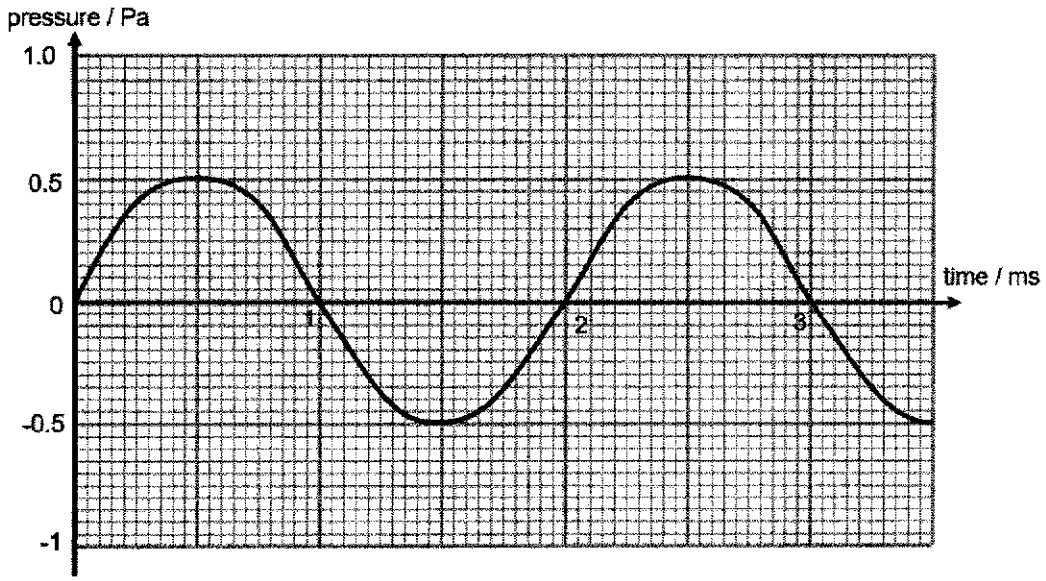

Fig. 12.3

(i) The string is plucked again to produce a louder note with the same pitch.
On Fig. 12.3, draw a line to show the waveform of this louder note. [2]

(ii) The string is tightened and plucked again to produce a note of higher pitch.
Describe how the graph would be different as a result of playing this new note.

.....

..... [1]

End of paper

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Bendemeer Secondary School
2021 Preliminary Examination
Secondary Four Express / Five Normal (Academic)

Science (Physics)
Paper 1 [20 marks]

Mark Scheme

1	D	**11**	C
2	B	**12**	D
3	C	**13**	B
4	D	**14**	A
5	D	**15**	D
6	D	**16**	A
7	C	**17**	A
8	C	**18**	C
9	B	**19**	C
10	C	**20**	A

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Bendemeer Secondary School
2021 Preliminary Examination
Paper 2
Section A [45 marks]

		Section A	Marks
1	(a)	Roll to the right (towards the d.c. power supply)	1
	(b)	When the power supply is switched on, current flows through wire P in a direction that is into the plane of the page which is perpendicular to the magnetic field direction (upward). By Fleming's Left Hand Rule, a force to the right acts on wire P.	1 1
	(c) (i)	P rolls to the left	1
	(c) (ii)	P rolls more slowly	1
2	(a)	Loss in GPE = 0.5 x 10 x 1.1 = 5.5 J	1 1
	(b) (i)	5.5 – 0.5 x 10 x 0.8 = 1.5 J	1 1
	(b) (ii)	Energy lost as thermal / sound energy	1
	(b) (iii)	½ x m x v^2 = mgh v^2 = 2gh v^2 = 2 x 10 x 0.8 v = 4 m/s	 1 1
3	(a)	V = 1.5 x 3 = 4.5 V	1 1
	(b)	V = 12 - 4.5 = 7.5V I = 7.5 / 6 = 1.25 A	1 1

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		Section A	Marks
	(c)	V = 7.5 V I = 1.5 – 1.25 = 0.25 A R = 7.5 / 0.25 = 30 Ω	 1 1
4	(a)	The loosely woven mesh T-shirt traps air which is a bad thermal conductor. This reduces the transfer of thermal energy by conduction from the fire to the fireman's body and thus keeping him cool.	1 1
	(b)	The fireman's jacket should be silver as silver is a bad absorber of radiant heat and thus reduces the rate of transfer of thermal energy by radiation.	1 1
5	(a)	Mass = volume x density = (0.04 x 0.28) x 750 = 8.4 kg	 1 1
	(b)	W = mg = 8.4 x 10 = 84 N	 1
	(c)	P = F/A = 84 / 0.04 = 2100 Pa	 1 1
6	(a)	1. They are transverse waves 2. They travel at a speed of 3 x 10^8 m/s in vacuum.	1 1
	(b) (i)	Gamma rays	1
	(b) (ii)	Cancer treatment	1
7	(a)	The light ray will not emerge from BC as it undergoes total internal reflection at face BC. The angle of incidence of 62° is larger than the critical angle and the light ray is going from an optically denser medium to an optically less dense medium.	1 1

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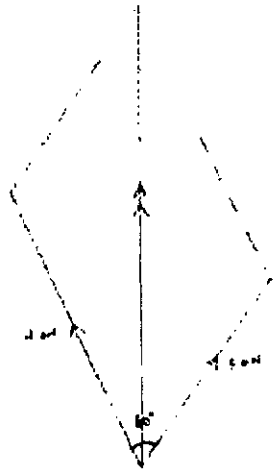
		Section A	Marks
	(b)	Refractive index = 1/ sin 43 = 1.47	1 1
8		Scale 1 cm : 0.5 N  Diagram drawn correctly with correct angle and forces labelled. Resultant force has double arrowheads. Resultant force between 5.9 N to 6.2 N Direction: 25° from 4.0 N or 35° from 3.0 N (+/- 2°)	1 1 1
9	(a)	The driver took 1.5 s to react	1
	(b)	Distance = 25 x 1.5 = 37.5 m	1
	(c)	Deceleration = 25/(5-1.5) = 7.14 m/s^2	1 1
	(d)	Braking distance = 0.5 x 25 x 3.5 = 43.75 m Total distance = 37.5 + 43.75 = 81.25 m Car did not manage to stop in time, boy will be knocked down by the car.	1 1

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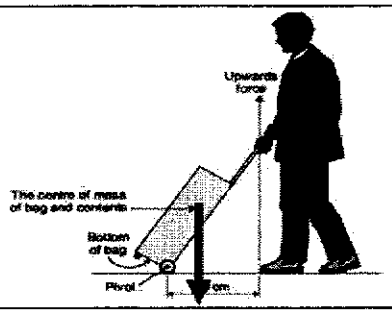
		Section B	Marks
10	(a)		1
	(b)	ACM = CM F x 60 = 500 x 12 F = 6000/60 = 100 N	1 1
	(c)	The line of action of weight of the bag lies outside the base area (bottom of bag), which produces a clockwise moment about the pivot, hence the bag will fall and hit the floor.	1 1
	(d)	ACM = CM 120 x 60 = W x 12 W = 7200/12 = 600 N Mass of bag and contents = 600/10 = 60 kg Mass of souvenir = 60 – 50 = 10 kg	 1 1 1
	(e)	Place the heavier items near the bottom of the bag to lower the centre of gravity.	1
	(f)	No, turning effect of force is dependent on the force and the perpendicular distance of force from pivot. Shortening the handle will reduce the turning effect of force. (No marks awarded if no explanation is given)	1
11	(a)	Live wire – brown Neutral wire – blue Earth wire – green and yellow	1 1 1
	(b)	current = 2500 / 240 = 10.4 A	1 1
	(c)	Suitable fuse rating = 13 A The fuse rating should be slightly higher than the current flowing in the circuit for the fuse to work under normal working conditions of the electric kettle.	1 1

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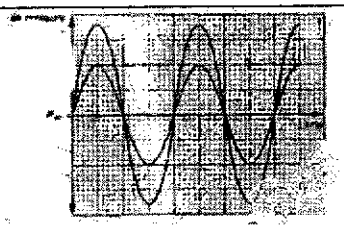
		Section B	Marks
	(d)	Total cost = 0.25 x 2.5 x 2 x 7 = $8.75	1 1
	(e)	It should be placed near the bottom of the electric kettle	1
12	(a)	3	1
	(b)	f = 3/1.5 = 2 Hz	1 1
	(c) (i)	Speed = 2 x 0.35 = 0.7 m/s	1 1
	(c) (ii)	Duck at D1 would never hit the other two ducks because waves transfer energy without transferring matter. The duck will only move up and down and not forward.	1
	(c) (iii)	Wave speed depends upon the medium through which the wave is moving in.	1
	(d) (i)	 Larger amplitude -1m Same frequency -1m	2
	(d) (ii)	A note of higher pitch has a higher frequency. This means that more complete waves would be seen displayed on the screen in the same period of time.	1

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