Class	Register No.

Candidate Name _____

PEIRCE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2021
SECONDARY 4 EXPRESS & 5 NORMAL (ACADEMIC)

SCIENCE (PHYSICS, CHEMISTRY) **5076 / 01**
Paper 1 Multiple Choice **1 September 2021**
1 hour

Additional materials:
Multiple Choice Answer Sheet

INSTRUCTIONS TO CANDIDATES
Write your name, class and register number in the spaces provided at the top of this page and on the separate Multiple Choice Answer Sheet.

There are forty questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate Multiple Choice Answer Sheet.

Read the instructions on the Multiple Choice Answer Sheet very carefully.

INFORMATION FOR CANDIDATES.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Data Sheet is printed on page 18.
A copy of the Periodic Table is printed on page 19.

This paper consists of **20** printed pages and 1 blank page.
Setters: Mr Ang Keng Kiat / Mr Brandon Sham

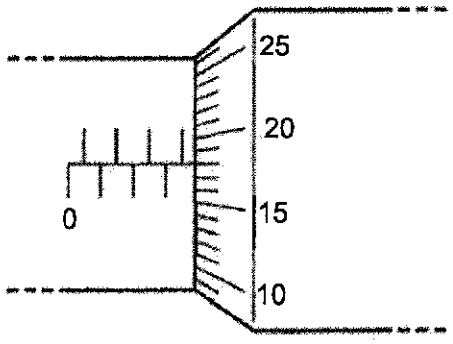
Paper 1: [40 marks]
Answer all the questions in the Multiple Choice Answer Sheet provided.

1 What is the order of magnitude of the diameter of an atom?

A 0.1 dm **B** 0.1 mm **C** 0.1 μm **D** 0.1 nm

2 A student measures the thickness of 10 sheets of paper with a micrometer.

The diagram shows the reading on the micrometer.



What is the average thickness of one sheet of paper?

A 0.368 mm **B** 0.418 mm **C** 3.68 mm **D** 4.18 mm

3 Each tyre of a bicycle exerts a pressure of 4.5 N/cm^2 on the ground.

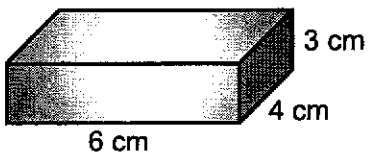
The area of each tyre in contact with the ground is 10 cm^2.

What is the weight of the bicycle?

A 0.9 N **B** 45 N **C** 90 N **D** 180 N

4 The diagram shows a box with dimensions 6 cm by 4 cm by 3 cm.

It has a mass of 800 g.



What is the density of the box?

A 0.09 g/cm^3 **B** 11.1 g/cm^3 **C** 33.3 g/cm^3 **D** 57600 g/cm^3

5 A spacecraft of mass 2000 kg has a weight of 7400 N on Mercury.

What is the gravitational field strength on Mercury?

A 0.27 N/kg **B** 0.37 N/kg **C** 3.7 N/kg **D** 10 N/kg

6 The braking distance of a loaded lorry is greater than an unloaded one.

Which of the following explains the above observation?

A The loaded lorry has a larger density.

B The loaded lorry has a larger mass.

C The loaded lorry has a larger volume.

D The loaded lorry has a larger weight.

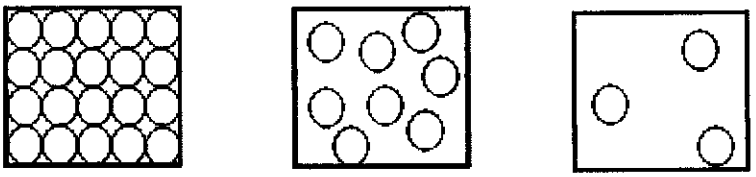
7 A lorry of mass 2500 kg is travelling at 12 m/s when the driver suddenly applies the emergency brake.

The constant braking force is 12000 N.

How far does the lorry travel before coming to rest?

A 1.25 m **B** 2.5 m **C** 15 m **D** 30 m

8 The diagram below shows the arrangement of particles in different states.



1 2 3

Which process represents freezing?

A 1 to 2 **B** 2 to 1 **C** 2 to 3 **D** 3 to 2

9 Cooling always accompanies evaporation because _____.

A the more energetic molecules leave the liquid

B there are fewer liquid molecules left in the liquid

C the escaped molecules return to the liquid

D the air molecules cool the liquid surface

10 What is meant by the melting point of a solid?

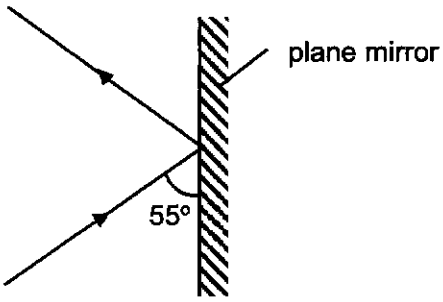
A the point where both solid and liquid exist together

B the point where it starts to turn into a liquid

C the temperature at which bubbles start to form

D the temperature at which it can exist as both solid and liquid

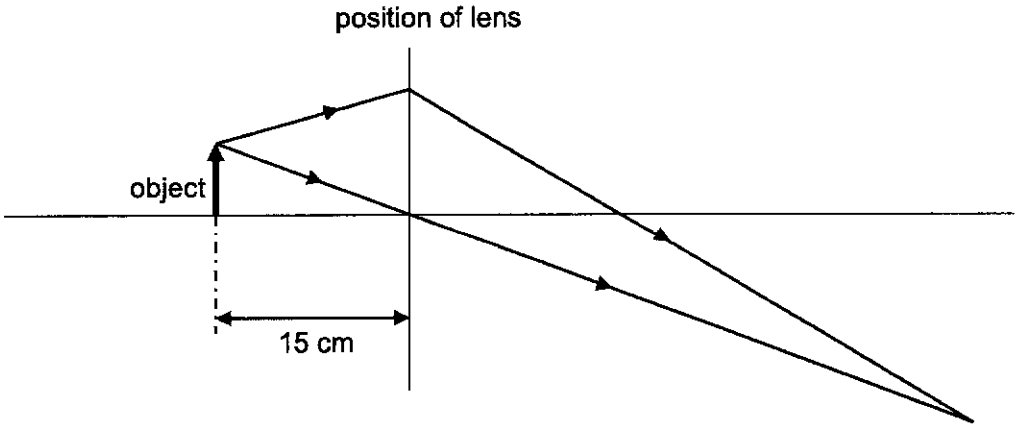
11 The diagram shows a ray of light reflected by a plane mirror. The diagram is not drawn to scale.



What is the angle of reflection?

A 25° **B** 35° **C** 55° **D** 70°

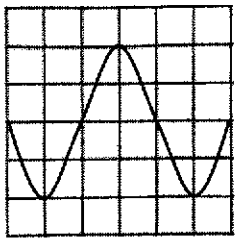
12 The diagram shows two rays of light reflected from an object. The object is placed 15 cm in front of a thin converging lens.



Which of the following describes the focal length and the type of image formed?

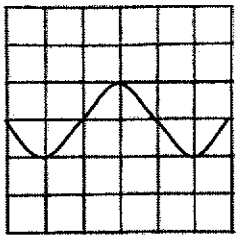
	focal length	type of image
A	less than 15 cm	diminished
B	less than 15 cm	magnified
C	greater than 15 cm	diminished
D	greater than 15 cm	magnified

13 The diagram shows the trace of a sound wave on a cathode-ray oscilloscope.

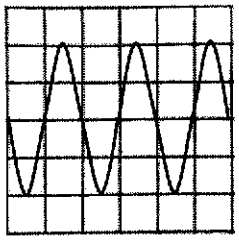


Which trace is obtained when the sound wave is changed to one of a lower pitch but same loudness?

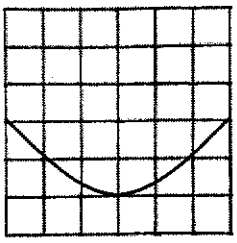
A



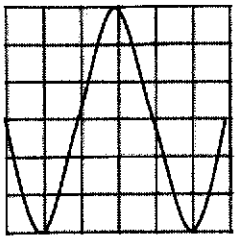
B



C



D

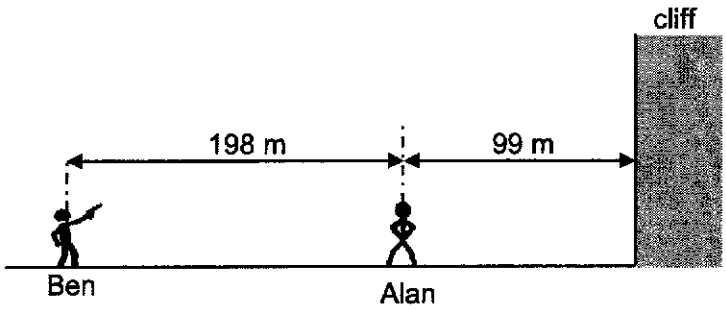


14 A professional subwoofer can produce a sound of 30 Hz while a special whistle can produce a sound of 30 kHz.

Are the sounds produced by the subwoofer and the whistle audible to a young adult?

	subwoofer	whistle
A	No	No
B	No	Yes
C	Yes	No
D	Yes	Yes

15 Alan stands at 99 m in front of a cliff. Ben stands at 198 m from Alan as shown in the diagram.



Ben fires a shot and Alan hears a shot and an echo. Assuming that the velocity of sound in air is 330 m/s, what is the time interval between the two sounds heard by Alan?

A 0.3 s **B** 0.6 s **C** 1.2 s **D** 1.5 s

16 Which copper wire has the largest resistance?

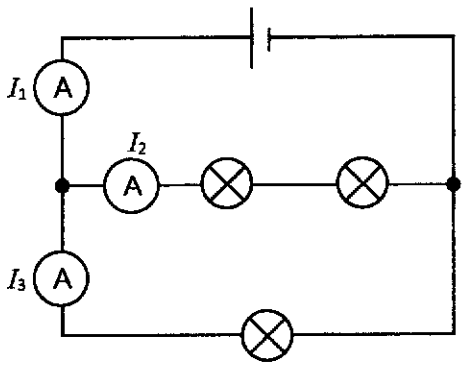
A a long, thick wire

B a long, thin wire

C a short, thick wire

D a short, thin wire

17 Three identical lamps and three identical ammeters are connected as shown.



The readings on the ammeters are I_1, I_2 and I_3. How are the readings related?

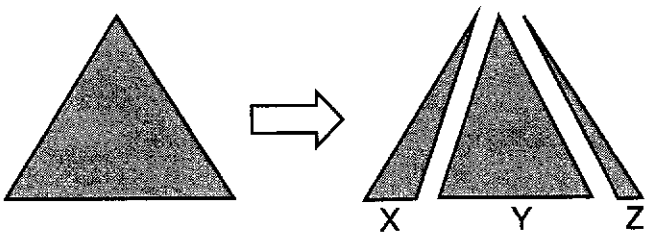
A $I_1 = I_2 = I_3$

B $I_1 > I_2$ and $I_2 = I_3$

C $I_1 > I_2 > I_3$

D $I_1 > I_3 > I_2$

18 A triangular lamina made of aluminium is cut into 3 pieces, X, Y and Z.



Which has the greatest density?

A all three pieces have the same density

B piece X

C piece Y

D piece Z

19 During condensation, what happens to the kinetic and potential energy of the molecules?

	kinetic energy	potential energy
A	decreases	decreases
B	decreases	no change
C	no change	decreases
D	no change	no change

20 Which statement describes the speed of microwaves in a vacuum?

A The speed of microwaves is zero.

B Microwaves travel faster than radio waves.

C Microwaves travel at the same speed as X-rays.

D Microwaves travel slower than gamma waves.

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PEIRCE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2021
SECONDARY 4 EXPRESS & 5 NORMAL (ACADEMIC)

SCIENCE (PHYSICS, CHEMISTRY) **5076 / 02**
Paper 2 Physics **30 August 2021**
1 hour 15 minutes

Candidates answer on the Question Paper.
No additional materials are required.

INSTRUCTIONS TO CANDIDATES
Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams and graphs.
Do not use paper clips, highlighter, glue or correction fluid.

Section A [45 marks]
Answer **all** questions.

Section B [20 marks]
Answer any **two** questions.

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.

PARENT'S SIGNATURE

For Examiner's Use	
Section A	
Section B	
Total	

This paper consists of **16** printed pages and **0** blank page.
Setter: Mr Ang Keng Kiat

Section A

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

1 A basketball of mass 0.6 kg is moving in mid-air.

Fig. 1 shows the horizontal velocity and the vertical velocity of the basketball at this instance, drawn to a scale where 1.0 cm represents a speed of 2.5 m/s.

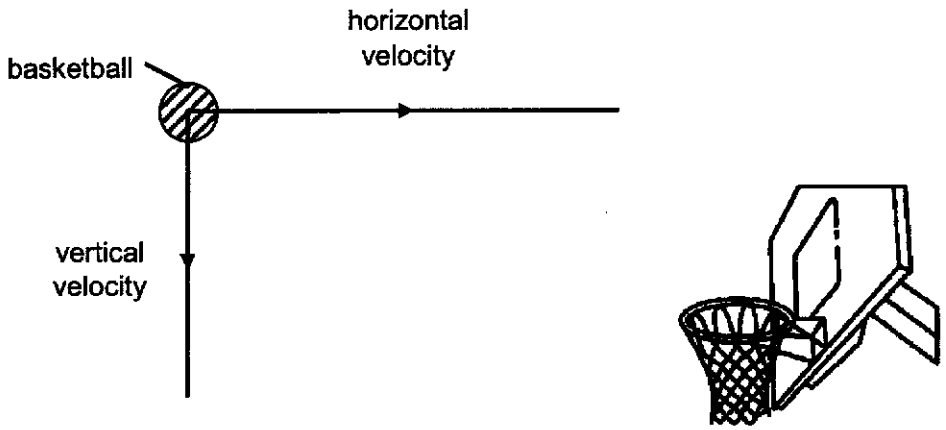


Fig. 1 (to scale)

(a) On Fig. 1, draw and label, with the letter **V**, the resultant velocity of the ball. Determine the size of the resultant velocity, giving your answer in one decimal place.

resultant velocity = ... m/s [3]

(b) The basketball is 3.5 m above the ground.

Using your answer in part **(a)**, calculate the **total energy** of the basketball at this particular instance. Take g = 10 m/s^2.

total energy = ... J [3]

2 A girl pulls a box of mass 2 kg along a table with a force ***F***, as shown in Fig. 2.1.

When the box is moving, there is a frictional force of 8.0 N acting on the box.

Fig. 2.1

Fig. 2.2 shows the speed-time graph of the box for the first 4 seconds.

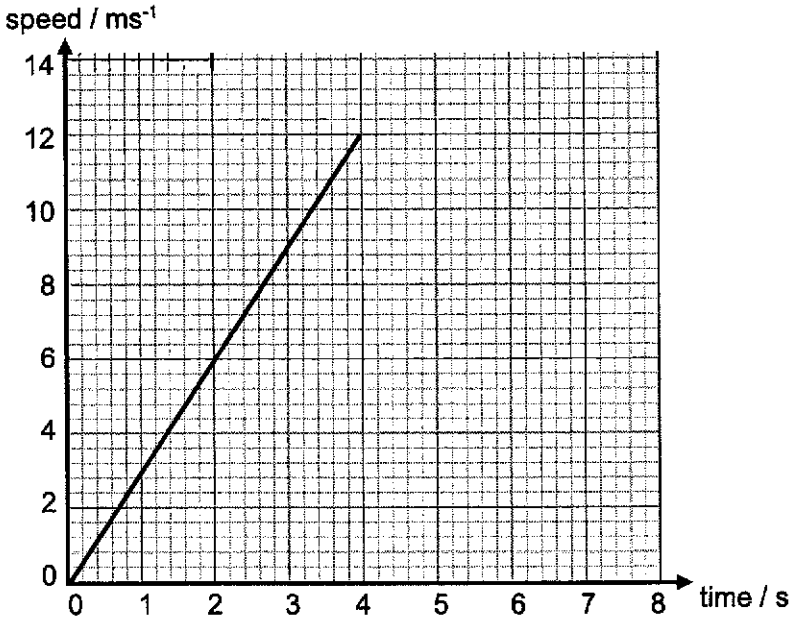


Fig. 2.2

(a) **(i)** From Fig. 2.2, calculate the acceleration of the box for the first 4 seconds.

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

(ii) Hence or otherwise, calculate the magnitude of the applied force ***F***.

F = ... N [2]

After 4 seconds, the girl stops applying the force. The frictional force causes the box to come to a stop after some time.

(b) **(i)** Calculate the deceleration of the box after the girl stops applying the force.

deceleration = ... m/s^2 [1]

(ii) On Fig. 2.2, continue the speed-time graph of the box after 4 seconds. [1]

(c) From your graph, calculate the total distance travelled by the box for the whole duration.

total distance = ... m [2]

3 A uniform metre rule is pivoted at the 42.0 cm mark, as shown in Fig. 3.
T is the tension in the string that is used to hold the ruler.

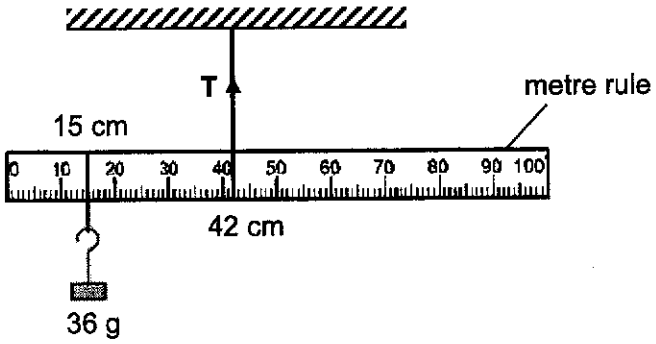


Fig. 3

The metre rule is balanced when a 36 g mass is hung from the 15 cm mark.

(a) Calculate the mass of the metre rule.

mass = ... g [3]

(b) Explain why tension **T** is not included in the calculation in part **(a)**.

.....

..... [1]

(c) State what will be observed if the 36 g mass is adjusted to the 20 cm mark on the metre rule.

.....

..... [1]

4 Fig. 4 shows an electric kettle with its heating element at the base of the kettle.

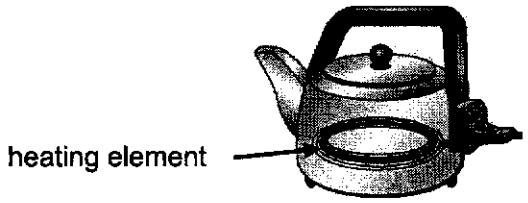


Fig. 4

Describe how the heating element heats up water in the kettle.

.....

.....

.....

.....

..... [3]

5 Ultraviolet (UV) radiation in Singapore hit extreme levels during a three-hour period on 6 March 2021.

An ultraviolet ray on that day has a wavelength of 290 nm.

(a) Calculate the frequency of this ray in vacuum, stating clearly the value of any constant used in the calculation.

frequency = ... Hz [3]

(b) State one component of the electromagnetic spectrum that has a higher frequency than the frequency of an ultraviolet ray and state a use of this component.

Component: .....

Use: ..... [2]

6 An ebonite rod is rubbed with a dry woollen cloth, as shown in Fig. 6.1.

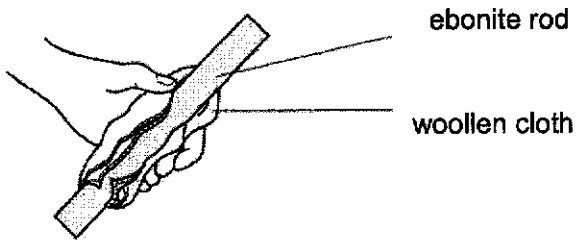


Fig. 6.1

The charged rod is then held close to a positively charged sphere. The sphere moves as shown in Fig. 6.2.

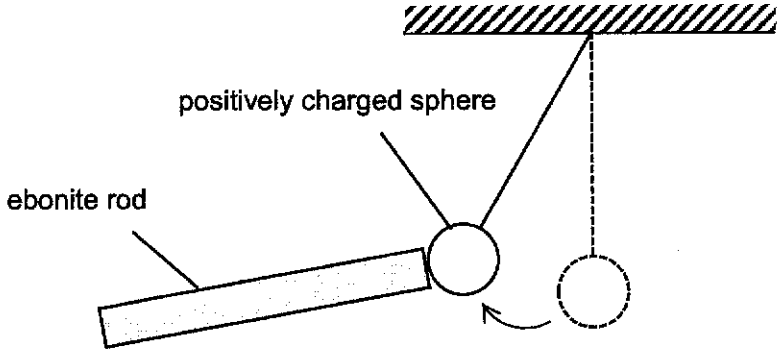


Fig. 6.2

(a) Explain what happened to the charges in the rod when it was rubbed with the dry woollen cloth and why the positively charged sphere moved in the direction shown in Fig. 6.2.

.....

.....

.....

..... [3]

(b) Fig. 6.3 shows eight electric field lines to represent the electric field around the positively charged sphere.

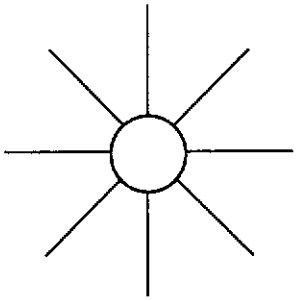


Fig. 6.3

(i) Draw an arrow on each field line to show the direction of the electric field. [1]

(ii) State how the representation of the electric field changes when the sphere becomes less positively charged.

.....

..... [1]

7 Fig. 7 shows a circuit with a battery, a switch and three resistors, **A**, **B** and **C**. The battery has an e.m.f. of 9 V.

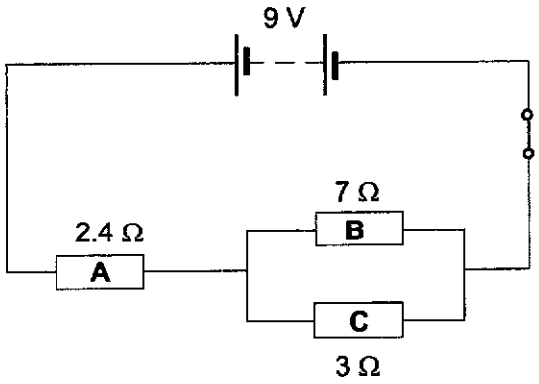


Fig. 7

(a) Explain what is meant by an e.m.f. of 9 V.

.....

..... [1]

(b) Calculate

(i) the effective resistance of resistors **B** and **C**.

effective resistance = ... Ω [2]

(ii) the current through resistor **A**.

current through resistor **A** = ... A [2]

(c) The circuit is switched on for 5 minutes. Calculate the total amount of charge that flow through resistor **A**.

amount of charge = ... C [2]

8 Fig. 8 shows an electric iron.

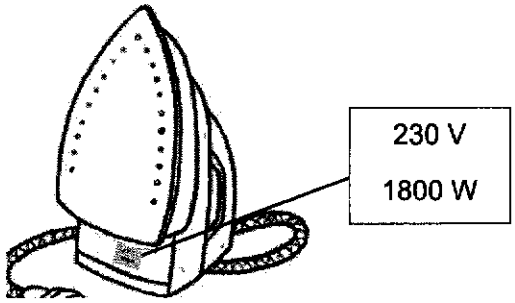


Fig. 8

(a) Determine a suitable fuse rating for the electric iron.

fuse rating = ... A [2]

(b) The metal case of the electric iron is earthed. Explain how this protects the user.

.....

.....

.....

..... [2]

(c) The electric iron was used for 30 minutes a day, 5 days a week.
The cost of 1 kWh of electrical energy is 24 cents.
Calculate the cost of using the electric iron for 1 week.

cost = $ ..... [2]

Section B

Answer any **two** questions in the spaces provided.

9 Fig. 9.1 shows the apparatus used to investigate what happens to a solid substance **X** as it is heated. The solid is contained in a copper can. A temperature probe is used to measure the temperature of substance **X** while an immersion heater supplies heat constantly.

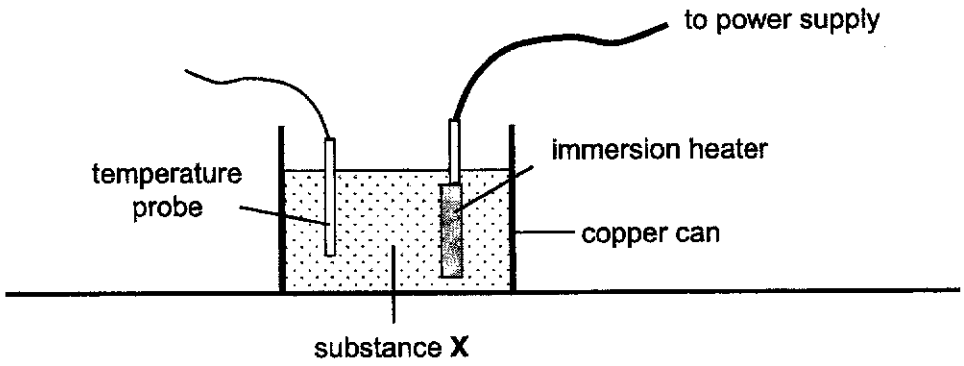


Fig 9.1

Fig. 9.2 shows the temperature-time graph during the 80 minutes of heating.

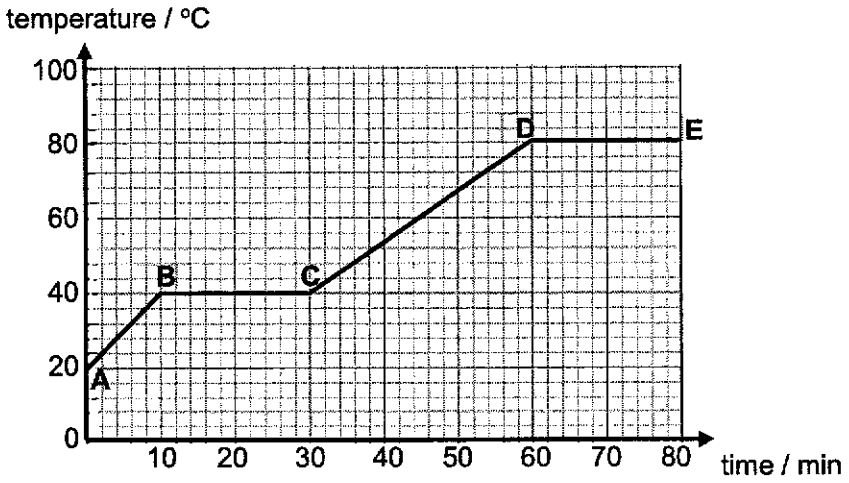


Fig. 9.2

(a) Explain why there is no increase in temperature between points **B** and **C** even though heat is supplied constantly.

.....

.....

..... [2]

(b) Calculate the thermal energy required to melt the solid completely, given that the immersion heater has a power rating of 65 W and it takes 30 minutes to melt the solid.

thermal energy = ... J [2]

(c) **(i)** Explain why the energy gained by substance **X** between points **B** and **C** is less than that calculated in **(b)**.

.....

..... [1]

(ii) Suggest a way to reduce this difference.

.....

..... [1]

(d) Describe the **changes** in arrangement and movement of molecules in the substance **X**, as it is being heated at sections **BC** and **DE**.

BC: .....

.....

.....

.....

DE: .....

.....

.....

..... [4]

10 Fig. 10.1 shows two parallel light rays, ray 1 and ray 2, being refracted as they pass from air into the liquid in a water tank. The angle of incidence and angle of refraction of ray 1 are 42° and 30° respectively.

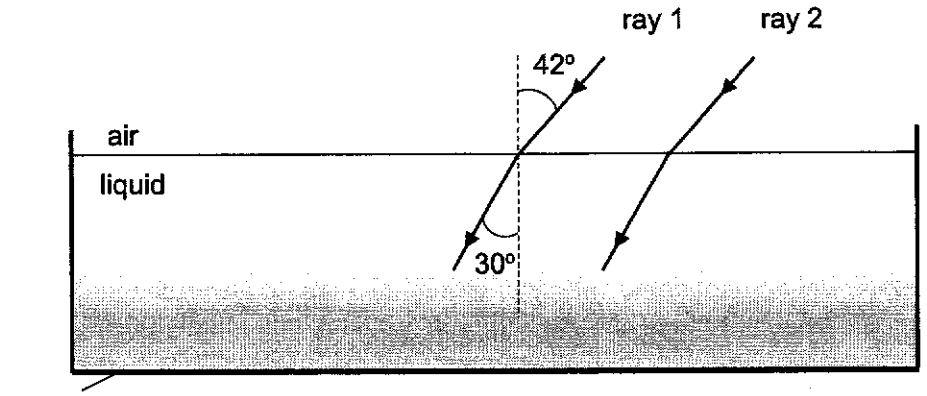


Fig. 10.1

(a) Calculate the critical angle of the liquid.

critical angle = ... ° [3]

After passing through the liquid, the two rays hit an air bubble as shown in Fig. 10.2.

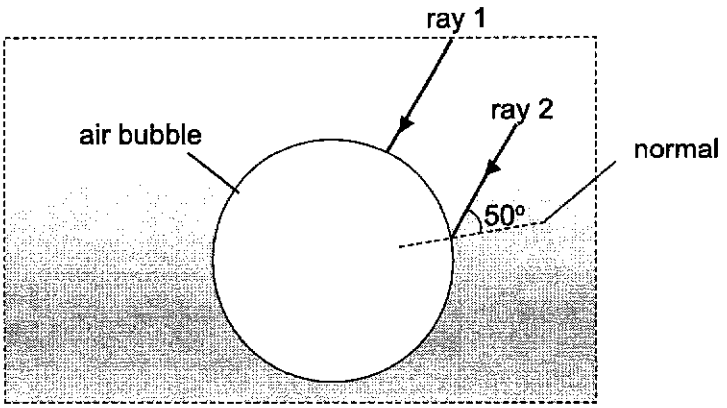


Fig. 10.2

Ray 1 is perpendicular to the surface of the air bubble.

Ray 2 incident on the surface of the air bubble at an angle as shown in Fig. 10.2.

(b) Complete Fig. 10.2 to show how ray 1 and ray 2 continue after they meet the air bubble. [2]

A vertical vibrator is placed on the surface of the liquid to create waves in the water tank, as shown in Fig. 10.3.

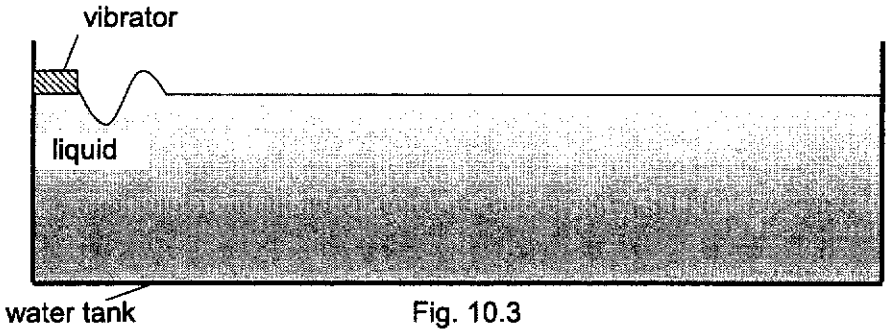


Fig. 10.3

The wavefronts of the waves produced are shown in Fig 10.4.

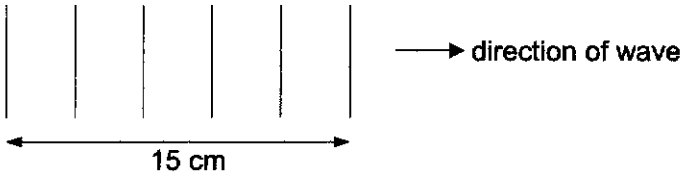


Fig. 10.4

The vibrator operates at a frequency of 10 Hz and an amplitude of 2 cm.

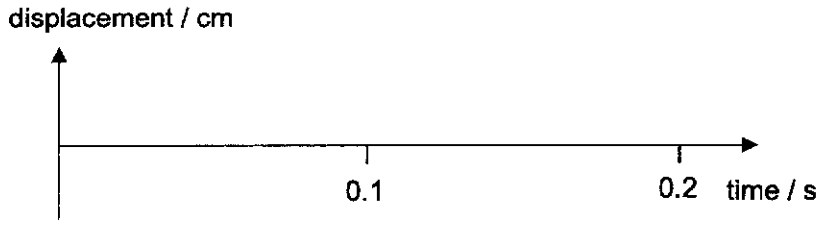
(c) **(i)** State the period and wavelength of the waves produced. [2]

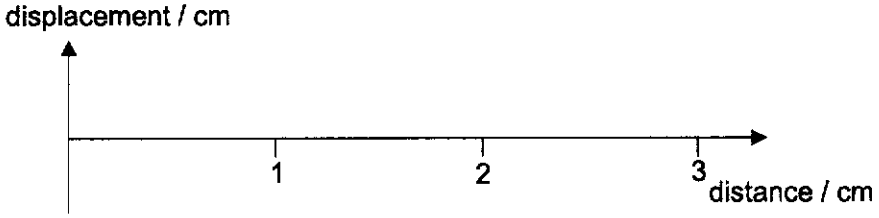
Period = ...

Wavelength = ...

(ii) On the axes below, sketch the displacement-time and displacement-distance graphs that represent the waves. [3]

Mark suitable values on the vertical axes of the graphs.





11 Fig. 11.1 shows a gymnast on a trampoline.

At point A in Fig. 11.1a, the gymnast starts to rise. He passes through B in Fig. 11.1b and reaches his maximum height at C in Fig. 11.1c.

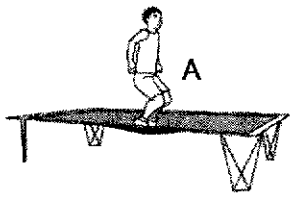


Fig. 11.1a

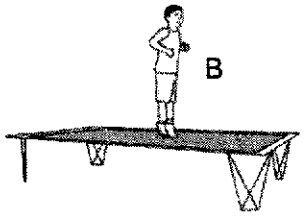


Fig. 11.1b

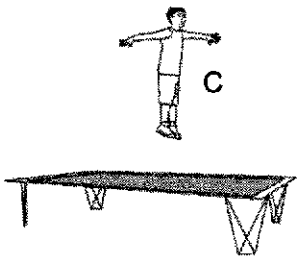


Fig. 11.1c

(a) **(i)** State the form of energy stored in the trampoline shown in Fig. 11.1a.

..... [1]

(ii) State the form of energy gained by the gymnast between B and C.

..... [1]

(b) When the gymnast is at B, his kinetic energy is 1920 J, its maximum value. The mass of the gymnast is 60 kg.

(i) Calculate his maximum speed at B.

maximum speed = ... m / s [2]

(ii) Calculate the gain in height of the gymnast, as he moves from B to C. Ignore air resistance and take g = 10 N / kg.

gain in height = ... m [2]

(c) The energy stored in the stretched trampoline shown in Fig. 11.1a is greater than 1920 J. State one possible reason for this.

.....

.....

..... [1]

(d) The spectators in the same room hear a bouncing sound each time the gymnast bounces on the trampoline.

Explain how sound from the trampoline reaches all parts of the room.

.....

.....

.....

.....

..... [3]

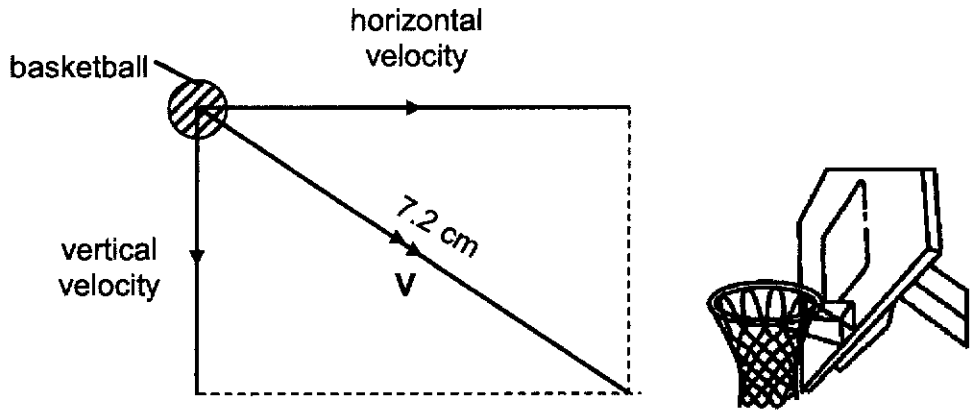
End of Paper 2

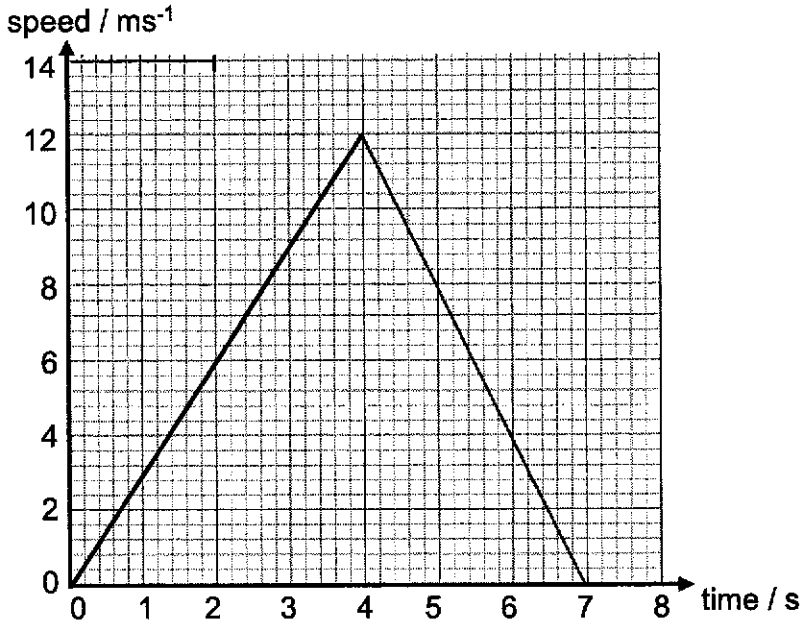
4E5A Science Physics Prelim 2021 Marking Scheme

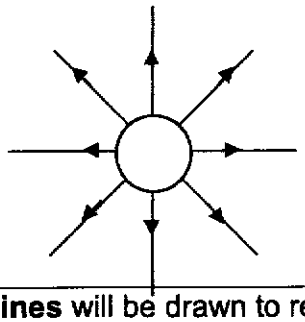
Paper 1: Multiple Choice Questions [20 marks]

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

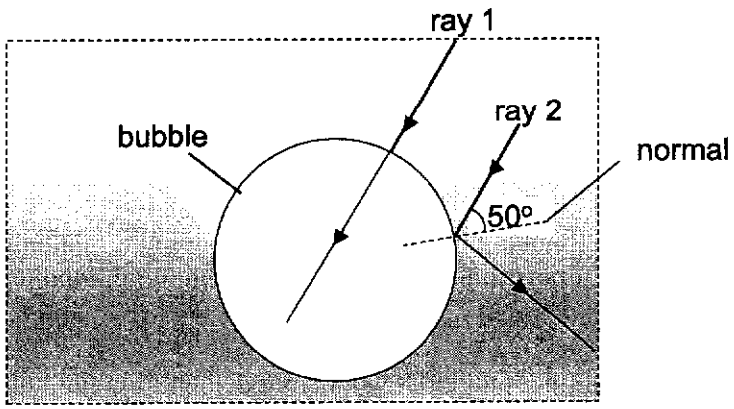
Paper 2
Section A: Structured Questions [45 marks]

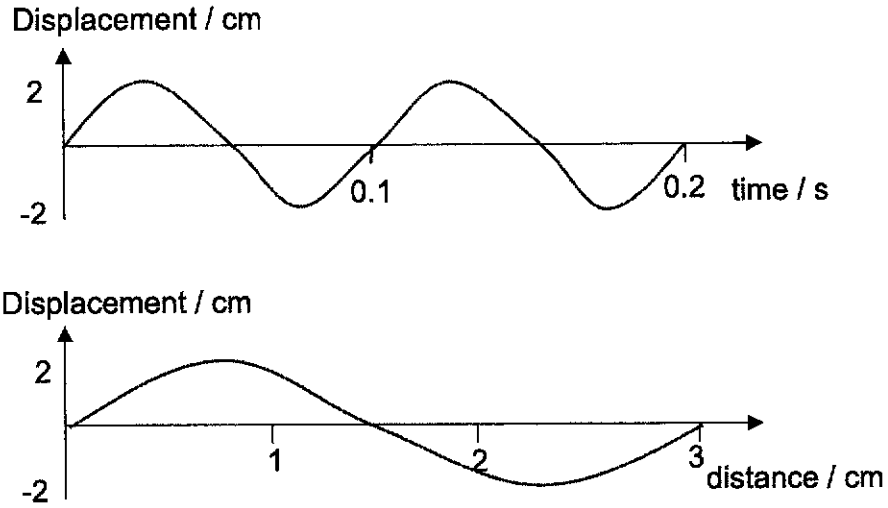
No.	Answer	Marks
1(a)	 Fig. 1.1 (to scale)	B1 – construct rectangle **and** draw correct diagonal B1 – indicate direction with double arrow **and** label V.
	Resultant velocity = 18.0 m/s (acceptable range: 17.5 to 18.5)	B1
(b)	GPE = 0.6 × 10 × 3.5 (= 21J)	M1
	KE = 0.5 × 0.6 × 18^2 [accept error carried forward] (= 97.2 J)	M1
	Total energy = *118* J (accept error carried forward)	A1
2(a)(i)	$a = \frac{12 - 0}{4}$	M1
	= 3 m/s^2	A1
(a)(ii)	Resultant force = 2 × *3* (accept error carried forward) (= 6N)	M1
	Applied force, F = 8 + *6* (accept error carried forward)	
	= *14* N (accept error carried forward)	A1
(b)(i)	deceleration $= \frac{8}{2}$ = 4 m/s^2	B1

(b)(ii)	 Fig. 2.2	B1 (cuts time-axis at 7s)
(c)	Distance = $\frac{1}{2} \times 7 \times 12$ (accept error carried forward)	M1
	= 42 m (accept error carried forward)	A1
3(a)	W × (50 – 42) = 0.36 × (42 – 15) OR m × (50 – 42) = 36 × (42 – 15)	M2 – 1 for each side of POM equation
	m = 121.5 = 122 g (3 sig fig) [Do not penalize if students leave their answers as 121.5 g]	A1
(b)	**There is no moments about the pivot due to T.** (since it passes through the pivot)	B1
(c)	The metre rule will **tilt to the right** OR The metre rule will **rotate clockwise** [Must state direction]	B1
4	The heating element transfer thermal energy to the water in contact with it by **conduction**. [For this question, 1 mark is allocated for description of conduction and 2 marks for description of convection]	B1
	As the water is heated, it expands, **becomes less dense** and **rises**.	B1
	Cooler, **denser** water **sinks** and gets heated by the heating element.	B1
	This sets up a convection current. [For students who do not mention describe density changes but states clearly that the water is heated by forming of convection current (or hot water rises or cold water sinks), award overall 1 mark for the process of convection]	
5(a)	c = 3×10^8 m/s [can appear anywhere in the working]	B1
	$f = \frac{3 \times 10^8}{290 \times 10^{-9}}$ [Still award mark if students did not write nm in m]	M1
	= 1.03×10^{15} Hz	A1
(b)	Component: X-ray or Gamma ray	B1

	Use: any correct use X-ray (e.g. radiography, engineering, airport security) Gamma (e.g. cancer treatment; sterilization of medical equipment)	B1
6(a)	Ebonite rod **gains electrons** from woollen cloth; OR Woollen cloth **loses electrons** to ebonite rod [To gain this mark, the transfer of electrons between the two objects must be explicitly stated]	B1
	Ebonite rod becomes negatively charged.	B1
	Unlike charges attract. [Hence, positively charged sphere is attracted to ebonite rod]	A1
(b)(i)	Direction of ALL field lines shown correctly 	B1
(ii)	**Fewer field lines** will be drawn to represent the electric field. [Accept: the lines shown will be further apart or more spread out]	B1
7(a)	The battery does **9J of work** by driving **a unit charge** across the **whole/ complete circuit** (or equivalent; must have correct unit for work done)	B1
(b)(i)	$R = \frac{3 \times 7}{3+7}$ OR $\frac{1}{R} = \frac{1}{7} + \frac{1}{3}$	M1
	R = 2.1 Ω	A1
(ii)	Total resistance = *2.1* + 2.4 [accept error carried forward] = 4.5 Ω	M1
	$I = \frac{9}{4.5}$ [accept error carried forward] $= 2A$	A1
(c)	Q = 2 × 5 × 60 [accept error carried forward; award one mark even if a candidate does not convert minutes to seconds]	M1
	= 600 C (accept error carried forward)	A1
8(a)	$I = \frac{1800}{230}$ (=7.83 A)	M1
	Fuse rating = 10A [Accept 8 A to 10 A]	A1
(b)	**When there is a fault and the metal case becomes live**, a large current will flow through the earth (and live) wire.	B1
	This **breaks/melts the fuse**, isolating the user from high voltage/potential.	B1
(c)	Energy used per week = 1.8 kW x 2.5 h = 4.5 kWh	M1
	Cost = 4.5 × 24 cents = $1.08	A1

Section B: Free Response Questions [20 marks]

No.	Answer	Marks
9(a)	Heat supplied is used to • weaken the intermolecular bond between the molecules; or • change substance X from solid to liquid state; or • increase potential energy of the molecules	B1
	There is no change in kinetic energy of the molecules	B1
(b)	E = 65 × 30 × 60 [award 1 mark for 65 x 30]	M1
	= 117 000 J	A1
(c)(i)	Some energy supplied by the heater is lost to the surrounding.	B1
(ii)	Any reasonable method to reduce heat loss to the surrounding, e.g. • cover the copper can • insulate the copper can • paint the copper can silver	B1
(d)	Students must show changes or comparison before marks can be awarded.	
	At section BC, the molecules change from **vibrating at fixed positions to sliding past each other**.	B1
	The arrangement of the molecules changes from **regular / orderly arrangement to irregular random arrangement**.	B1
	At section DE, the molecules changes from **sliding past each other to moving randomly at high speed**.	B1
	The molecules change from being **closely packed to far apart**.	B1
10(a)	$n = \frac{\sin 42}{\sin 30}$ (= 1.338)	M1
	$c = \sin^{-1}\frac{1}{1.338}$ [*accept error carried forward*]	M1
	= 48.35 = 48.4° (3 sf)	A1
(b)	 Fig. 10.2	B1 for ray 1 (un-deviated) B1 for ray 2 (Total internal reflection; do not penalize for inaccurate angle of reflection)
(c)(i)	Period = 1/10 = 0.1 s Wavelength = 15/5 = 3 cm [No marks awarded for missing or wrong units]	B1 for period B1 for wavelength

(ii)		B1 – correct period for d-time graph B1 – correct wavelength for d-distance graph B1 – indication of amplitude (2 cm) in both graphs
11(a)(i)	elastic potential energy	B1
(ii)	gravitational potential energy	B1
(b)(i)	$\frac{1}{2} \times 60 \times v^2 = 1920$	M1
	$v = 8$ m / s	A1
(ii)	$60 \times 10 \times h = 1920$	M1
	$h = 3.2$ m	A1
(c)	Some of the stored energy in the trampoline is **converted** to **thermal energy (or sound energy)**.	B1
(d)	Disturbance in the trampoline causes neighbouring **air particles to vibrate**.	B1
	Sound energy is transferred by air particles in the form of **a longitudinal wave** to all parts of the room. [*description of what a longitudinal wave is not necessary, but do not penalize students for wrong descriptions*]	B1
	Some sound energy is **reflected by the walls and/or ceiling of the room.**	B1