BEDOK VIEW SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2022

CANDIDATE NAME

REGISTER NUMBER

CLASS

PHYSICS
Secondary 3 Express
Paper 1 Multiple Choice

6091/01
4 October 2022
1 hour

Additional Material(s): Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions in this section. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this paper.
The use of an approved scientific calculator is expected, where appropriate.

The maximum mark for this paper is 40 marks.

Setter: Mr Abdul Malek Osman

This document consists of **15** printed pages.

[Turn over

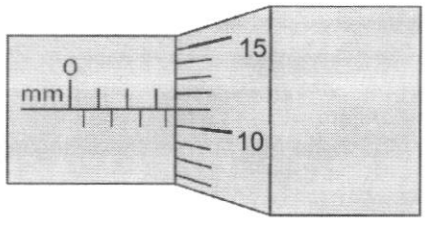
1 Which of the following is not an SI unit?

A Inch
B Kilogram
C Second
D Mole

2 Which of these quantities is a scalar quantity?

A Density
B Force
C Work done
D Acceleration

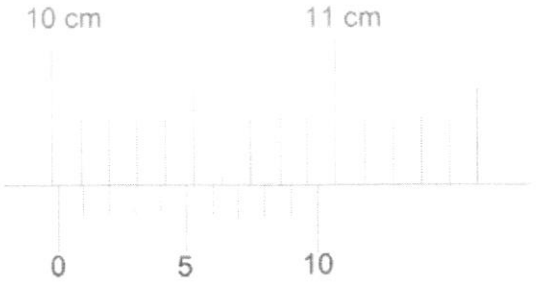
3 A micrometer screw gauge has a zero error of – 0.03 mm. It is being used to measure the thickness of a book. The figure below shows the recorded thickness of the book.



What is the actual thickness of the book?

A 3.11 mm
B 3.58 mm
C 3.61 mm
D 3.64 mm

4 A vernier caliper is used to measure the outer diameter of a water pipe. The figure below shows the recorded reading.



What is the diameter of the water pipe?

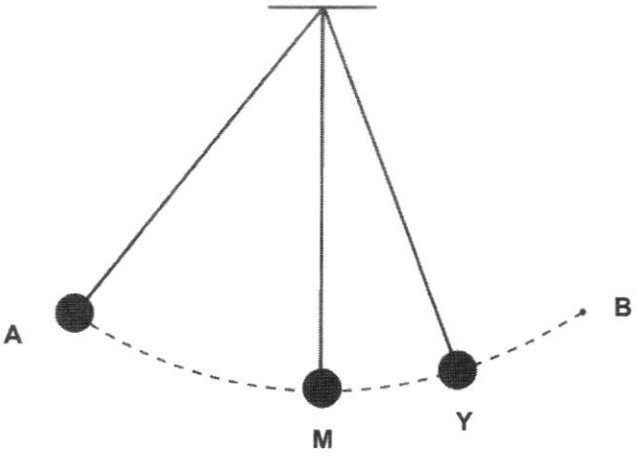
A 10.02 cm

B 10.12 cm

C 10.20 cm

D 10.90 cm

5 The bob of the pendulum shown below was pulled to position A. The period of the pendulum is 1.6 s. Position Y is at the mid-point of the swinging position M and position B.



What is the time for the pendulum to travel from position M to position Y?

A 0.1 s

B 0.2 s

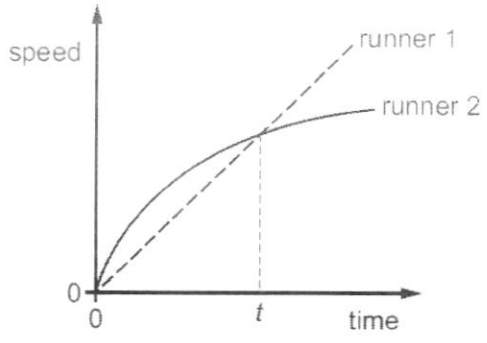
C 0.4 s

D 0.8 s

[Turn over

6 Two runners take part in a race.

The graph below shows how the speed of each runner changes with time.



What does the graph show about the runners at time *t*?

A Runner 1 has zero acceleration.

B Runner 1 runs ahead of runner 2.

C Runner 2 is slowing down.

D Both runners are moving at the same speed.

7 A car travels 50 km in an hour, and then it travels another 10 km in an unspecified amount of time. If the car's average speed for the entire journey is 10 m/s, calculate the time it takes to travel the final 10 km.

A 9 min

B 12 min

C 15 min

D 40 min

8 A lorry accelerates at 5 m/s^2 from rest for 10 s. It then maintains the velocity attained for another 30 s. Determine the total distance travelled by the lorry.

A 50 m

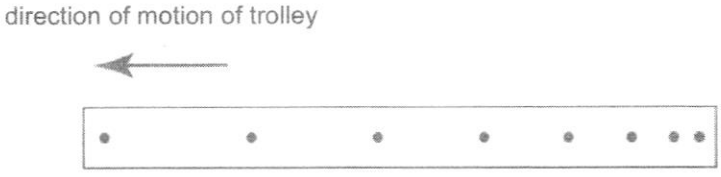
B 250 m

C 1500 m

D 1750 m

9 A student performs an experiment to investigate the motion of a trolley down an inclined runway.

A diagram of a section of the ticker-tape produced in an experiment is shown below.



What conclusion can be made about the motion of this trolley?

A accelerating

B decelerating

C constant velocity

D stationary

10 What is *terminal velocity*?

A It is the maximum velocity reached by a falling object subjected to air resistance.

B It is the minimum velocity reached by a falling object subjected to air resistance.

C It is the initial velocity of a falling object subjected to air resistance.

D It is the average velocity of a falling object subjected to air resistance.

11 Which of the following statements is correct?

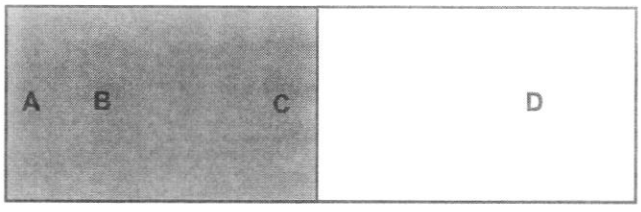
A Pressure of the surrounding air affects the mass of an object.

B Temperature of an object affects its mass.

C Density of an object affects its mass.

D Amount of matter in an object affects its mass.

12 One half of the block shown below is made of lead, the other half from foam. Which letter is closest to the centre of gravity of the block?



13 A ship is to be loaded with containers with various weights. Which of the following will make the ship most stable?

A Placing the heavier containers on top of the lighter containers.

B Placing the lighter containers on top of the heavier containers.

C Placing the lighter containers on one side of the ship and the heavier containers on the other side of the ship.

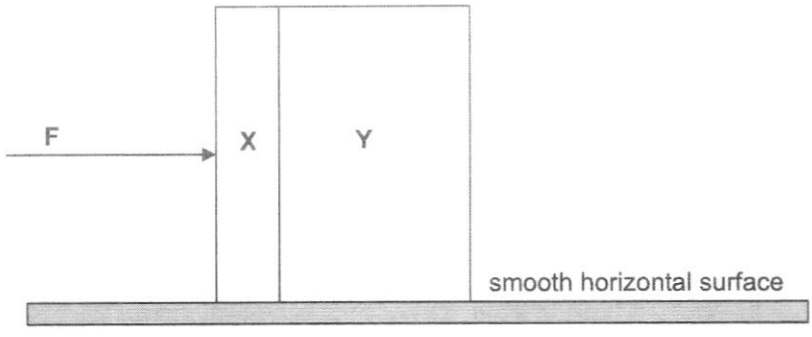
D Placing the heavier containers at the back of the ship and lighter containers at the front of the ship.

14 Two objects P and Q are placed in a beaker containing a liquid. Object P suspends in the liquid and object Q sinks.

Which of the following rows shows the possible densities of object P, object Q and the liquid?

	density of object P (g/cm^3)	density of object Q (g/cm^3)	density of liquid (g/cm^3)
A	1.0	0.6	0.8
B	1.0	1.4	1.0
C	11.3	8.9	13.6
D	11.3	19.5	13.6

15 Two blocks X and Y, of masses m and 4m respectively, are accelerated along a smooth horizontal surface by a force F applied to the block X as shown.



What is the magnitude of the force exerted by block X on block Y during this acceleration?

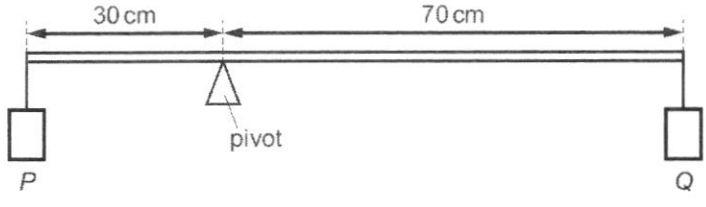
A 0.20 F

B 0.50 F

C 0.80 F

D 1.25 F

16 A beam on a pivot supports a load *P* at one end and a load *Q* at the other end. The weight of the beam can be ignored.



The beam is balanced.

Which row gives possible values for *P* and for *Q*?

	P / N	*Q* / N
A	21	9
B	30	10
C	21	90
D	30	70

[Turn over

17 A box is being lifted by a fork-lift truck.

The weight of the box is 3000 N. The force exerted by the fork-lift truck on the box is 3500 N vertically upwards.

What is the vertical acceleration of the box?

A 1.67 m/s^2 downwards

B 1.67 m/s^2 upwards

C 21.67 m/s^2 downwards

D 21.67 m/s^2 upwards

18 A ball is thrown straight upwards in the air. The initial velocity of the ball is 10 m/s.

What is the maximum height reached by the ball?

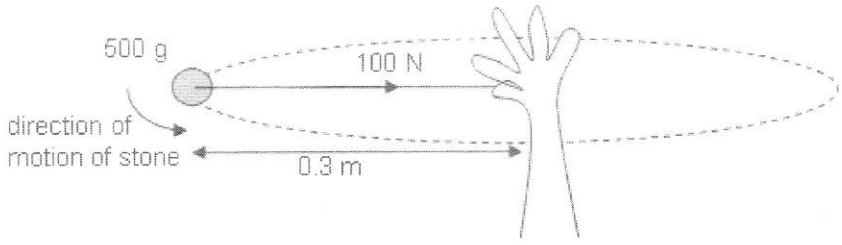
A 5 m

B 8 m

C 10 m

D 20 m

19 A 500 g stone tied to a 0.3 m long string is twirled in a horizontal circle, as shown. The only horizontal force acting on the stone is the 100 N tension by the string.



What is the work done by this tension? Assume that there is negligible air resistance.

A 0 J

B 30 J

C 50 J

D 188 J

20 Two identical boxes are placed at a height of 50 m. Box A is dropped vertically to the ground, while box B is allowed to slide down a frictionless slope to the ground.

Which box will have higher kinetic energy just before hitting the ground? Assume that there is negligible air resistance.

A Both boxes have zero kinetic energy.

B Box A will have higher kinetic energy.

C Box B will have higher kinetic energy.

D Both boxes will have the same kinetic energy.

21 A force of 5.0 N exerted on an object causes it to accelerate from stationary to 8.0 m/s in 10 s.

What is the power of this force?

A 0.4 W

B 2 W

C 20 W

D 40 W

[Turn over

22 A rectangular block has dimensions of 5 cm by 10 cm by 8 cm. It weighs 40 N.

What is the least pressure exerted by the block when it is resting on the table?

A 0.5 Pa

B 1.0 Pa

C 5 kPa

D 8 kPa

23 Which of the following does not change the height of the liquid column of a simple mercury barometer?

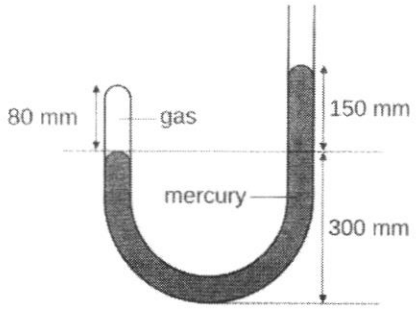
A Heating up the mercury in the simple barometer

B Moving the simple barometer to the top of a mountain.

C Leaving the simple barometer for a period of time so that some of the mercury evaporates to the atmosphere.

D Replacing the mercury in the simple barometer with oil.

24 The diagram shows a gas trapped in the left arm of a manometer containing mercury.



If the atmospheric pressure is 740 mm Hg, what is the pressure of the trapped gas?

A 440 mm Hg

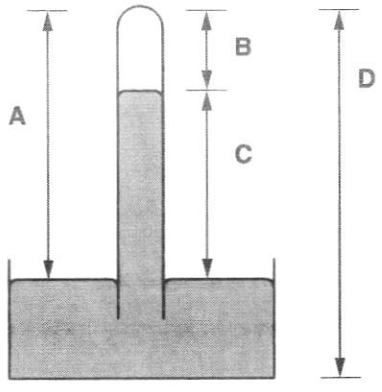
B 590 mm Hg

C 660 mm Hg

D 890 mm Hg

25 The diagram shows a simple mercury barometer.

Which height is a measure of the atmospheric pressure?



26 Which of the following statements about temperature is **incorrect**?

A Temperature is a base quantity.

B A hot object has a higher temperature than a cold object.

C The temperature of an object decreases when it loses thermal energy.

D Temperature has no lower and upper magnitude limits.

27 Which of these is a good characteristic of a liquid-in-glass thermometer?

A colourless liquid

B thick bulb wall

C small bulb volume

D high boiling point of liquid

28 Smoke is introduced in an enclosed glass container filled with air. The glass container is illuminated strongly and observed under a microscope. Bright sparks are seen to be moving randomly.

What is the reason for this?

A convection currents occur in the air

B air molecules are colliding with each other

C air molecules are colliding with the smoke particles

D smoke particles are colliding with each other

[Turn over

29 A fixed mass of gas is heated in a cylinder with a moveable piston. The piston is pushed outward by the gas to maintain a constant pressure in the piston.

Which of the following rows describe the change correctly?

	average distance apart	average speed
A	increase	increase
B	decrease	no change
C	increase	no change
D	no change	increase

30 Objects X and Y are at thermal equilibrium.

Which of the following statements describes object X and Y correctly?

A Both have the same temperature.

B Both emit thermal energy at the same rate.

C Both conduct thermal energy at the same rate.

D Both contain the same amount of thermal energy.

31 Which of the following statement(s) regarding radiation is/are **false**?

(1) Radiation cannot pass through solid
(2) Radiation can pass through vacuum
(3) Thermal energy can be transferred by infra-red radiation

A 1 only

B 1 & 2 only

C 1 & 3 only

D 2 only

32 What is the use of the vacuum in the vacuum flask?

A To minimise heat transfer via convection.

B To prevent radiation from taking place.

C To minimise heat transfer via conduction and convection.

D To prevent heat transfer via conduction and convection.

For Questions 33 and 34, refer to the following description.

A 300 g block of lead, with a specific heat capacity of 130 J/kgK, is heated to a temperature of 50 °C. It is then dropped into a well-insulated beaker of water at 30 °C. Take the heat capacity of the water and beaker to be 300 J/K and assume that there is no heat loss to the surroundings.

33 What is the heat capacity of the block of lead?

A 39 J/K

B 130 J/K

C 1170 J/K

D 1950 J/K

34 The block of lead is dropped into the water. Its temperature decreases while the temperature of water (and the beaker) increases until they are at the same temperature.

What is the final temperature of the block of lead and the water?

A 32 °C

B 35 °C

C 40 °C

D 42 °C

35 A beaker of water is continuously heated. Bubbles are seen forming rapidly in the water and the temperature of the water remains constant.

Which of the following statements is correct?

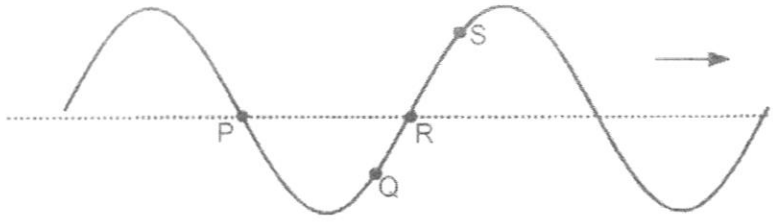
A The water particles are moving further apart.

B The water particles are moving faster.

C The water particles are moving faster and further apart.

D The water particles are moving faster and closer together.

36 The diagram below shows the side view of a wave moving from left to right on a piece of string. P, Q, R and S represents various points along the piece of string.



Which of the following statements regarding the points is true?

A R is moving right at this instance.

B S is moving upwards at this instance.

C Q is moving downwards at this instance.

D P and R are moving in the same direction.

37 In a ripple tank experiment, a dipper is connected to a motor to generate water waves. If the water is replaced with a liquid X such that the speed of the waves becomes slower, what is the effect on the frequency and wavelength of the wave?

	frequency	wavelength
A	no change	increases
B	no change	decreases
C	change	increases
D	change	decreases

38 A series of circular wavefronts are created in a ripple tank. The distance between 3 consecutive wavefronts is 1.6 cm. The speed of the wave is 6.0 cm/s.

What is the frequency of the wave?

A 0.13 Hz

B 4.8 Hz

C 6.8 Hz

D 7.5 Hz

39 Which of the following uses gamma rays?

(1) killing cancer cells
(2) detecting flaws in thick concrete blocks
(3) sterilising surgical instruments

A 1 & 2 only
B 1 & 3 only
C 2 & 3 only
D 1, 2 & 3

40 What is the speed of X-ray in a vacuum?

A 300 m/s
B 1500 m/s
C 3300 m/s
D 3×10^8 m/s

End of Paper

BEDOK VIEW SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2022

CANDIDATE NAME

REGISTER NUMBER

CLASS

PHYSICS
Secondary 3 Express
Paper 2 Theory

6091/02
3 October 2022
Paper 2: 1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

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

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

Section B
Answer all **three** questions, the last question has a choice of parts to answer, in the form either/or.
Write your answers in the spaces provided.

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

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 concepts than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Setter(s): Abdul Malek Osman

Parent's / Guardian's Signature: .....

This document consists of **18** printed pages.

[Turn over

Section A
Answer **all** the questions in this section.

For Examiner's Use

1 **(a)** State the SI unit for measurement of mass.

..... [1]

(b) Jack conducted an experiment to calculate the gravitational acceleration using the formula

$$T = 2\pi \sqrt{\frac{l}{g}}$$

where T is the period of oscillation, l length of the pendulum and g is the Earth's gravitational field strength.

He sets a 1 m long pendulum shown in Fig. 1.1 into small amplitude oscillation. Jack recorded 40 s for 20 complete oscillations.

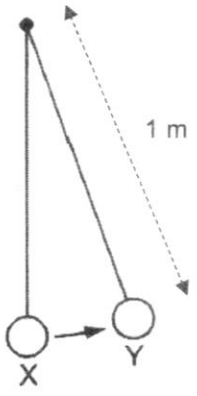


Fig. 1.1

(i) Calculate the period of this pendulum.

period = ... [1]

(ii) Determine how many complete oscillations are there in 1 minute.

oscillations = ... [1]

(iii) Calculate the Earth's gravitational field strength.

For Examiner's Use

gravitational field strength = ... [2]

[Total: 5]

2 A vase is placed on a table. Forces X and Y act on the vase, as shown in Fig. 2.1. The mass of the vase is 0.25 kg. The vase is not moving and the gravitational field strength g is 10 N/kg.

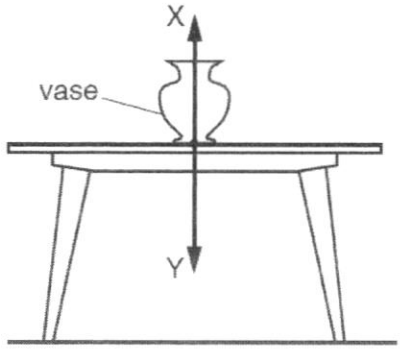


Fig. 2.1

(a) Calculate the value of force X and force Y. Explain your answer.

.....

.....

.....

..... [2]

(b) The vase was accidentally pushed off the table. It took 0.5 s to hit the floor.

(i) Determine the initial acceleration of the vase.

acceleration = ... [1]

(ii) Calculate the velocity at which it hits the floor.

velocity = ... [2]

(iii) Calculate the height of the table.

For Examiner's Use

height = ... [2]

[Total: 7]

3 A small ball of weight 5.0 N is suspended by a light thread. When a strong wind blows horizontally exerting a constant force of 12.0 N on the ball, the thread makes an angle, θ to the vertical as shown in Fig. 3.1.

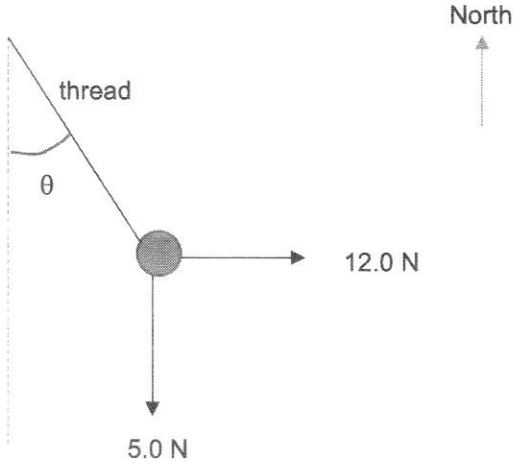


Fig. 3.1

(a) Determine the tension in the thread using the graphical method.

tension = ... [4]

(b) The string suddenly breaks and the small ball drops to the ground. Calculate the initial acceleration of the ball and determine the initial direction at which the ball moves.

For Examiner's Use

acceleration = ...

initial direction = ... [3]

[Total: 7]

4 **(a)** Fig. 4.1 shows a man pushing down on a lever with a force of 400 N to lift one end of a heavy log.

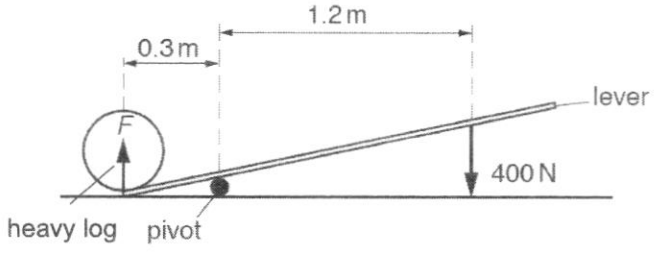


Fig. 4.1

(i) Calculate the force *F*, exerted by the lever on the heavy log.

force, *F* = ... [2]

(ii) Describe and explain how the man can use a lesser force than 400 N to lift the heavy log.

.....

.....

.....

..... [2]

For Examiner's Use

(b) The man is standing on a muddy ground. The contact surface area of one of his shoes is 85 cm^2 and he has a mass of 75 kg. The gravitational field strength g is 10 N/kg.

(i) Calculate the total pressure exerted on the muddy ground by the man.

pressure = ... [2]

(ii) Describe and explain how he can stand on the muddy ground better without sinking.

.....

.....

.....

..... [2]

[Total: 8]

5 Fig. 5.1 shows a conveyor belt transporting a luggage to a raised platform. The belt is driven by a motor.

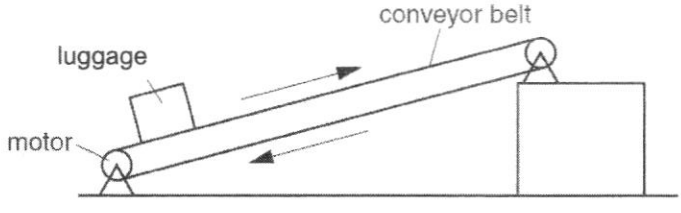


Fig. 5.1

(a) The mass of the luggage is 25 kg.

Calculate the increase in the gravitational potential energy (gpe) of the package when it is raised through a vertical height of 3.0 m. The gravitational field strength g is 10 N/kg.

increase in gpe = ... [2]

(b) The package is raised through the vertical height of 3.0 m in 4.0 s.

Calculate the power needed to raise the luggage.

For Examiner's Use

power = ... [2]

(c) The electrical power supplied to the motor is much greater than the answer to **(b)**.

Explain how the principle of conservation of energy applies to this system.

.....

.....

.....

..... [2]

(d) The motor has an efficiency of 12.5 %.

Calculate the actual power of the motor.

actual power = ... [2]

(e) Assume that the power available to raise the luggage is constant. A luggage of mass greater than 25 kg is raised through the same height.

Suggest and explain the effect of this mass on the timing of the conveyor belt movement.

.....

.....

.....

.....

[2]

[Total: 10]

For Examiner's Use

6 A solar panel is mounted on the roof of a building. Fig. 6.1 shows a section through part of the solar panel.

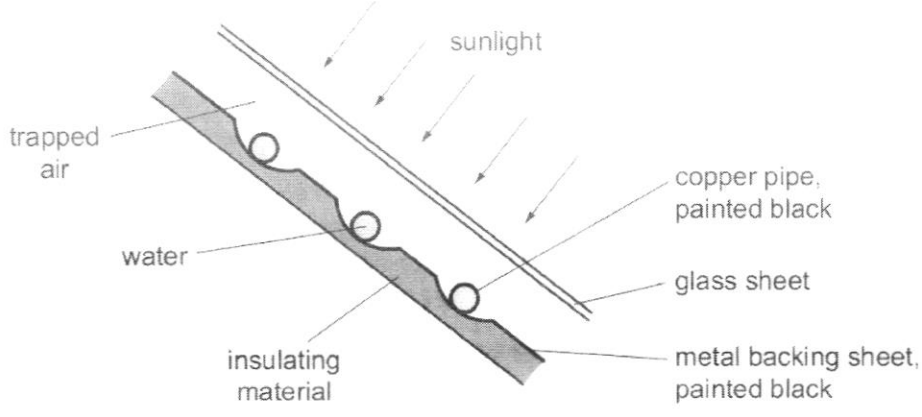


Fig. 6.1

A pump makes water flow through the copper pipes. The water is then heated by passing through the solar panel.

(a) Explain **three** features of the solar panel that allows the water to be heated effectively to reach its maximum temperature.

.....

.....

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.....

.....

..... [3]

(b) 250 kg of water is pumped through the solar panel daily. The temperature of the water rises from 28 °C to 40 °C. The water absorbs 25 % of the energy incident on the solar panel. The specific heat capacity of water is 4200 J / (kg °C).

For Examiner's Use

Calculate the energy incident on the solar panel during each day.

energy = ... [3]

(c) Sally is deciding whether to install solar panels on her house.

State **two** disadvantages of solar panel that she must consider before making her decision.

.....

.....

.....

.....

..... [2]

[Total: 8]

7 Fig. 7.1 shows a sound wave in air where the lines represent layers of air.

For Examiner's Use

Fig. 7.1

(a) On Fig. 7.1, label the region of rarefactions with X. [1]

(b) Fig. 7.1 is drown to scale.

Determine the wavelength of the sound wave.

wavelength = ... [1]

(c) Sketch the pressure–distance graph for the above sound wave and label the positions of A, B, C and D on the graph.

[3]
[Total: 5]

Section B

Answer **all** the questions in this section.

Answer only one of the two alternative questions in **Question 10**.

For Examiner's Use

8 **(a)** Explain what is *thermometric property* of a substance.

.....

.....

.....

..... [1]

(b) You are given an uncalibrated thermometer.

Describe the experiment(s) on how you can calibrate the thermometer to be used to measure the melting point of naphthalene at 80 °C. You may provide diagram(s) in your description.

.....

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.....

..... [5]

(c) Thermocouple is often used as a thermometer.

For Examiner's Use

(i) Describe a thermocouple thermometer and how it works.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) State one advantage of thermocouple thermometer compared to a alcohol-in-glass thermometer.

.....

.....

.....

..... [1]

[Total: 10]

For Examiner's Use

9 A paper ball is dropped from the top of a building. The speed of the paper ball is recorded every second.

time / s	0	1	2	3	4	5	6	7
speed / (m/s)	0	3.0	4.0	4.8	5.0	5.0	5.0	5.0

(a) Using the grid on page 14, plot a graph of speed against time of the paper ball dropped from the top of the building. [5]

(b) From the graph, find the instantaneous acceleration at t = 1.5 s.

instantaneous acceleration = ... [2]

(c) Describe the motion of the paper ball from t = 0 s to t = 7s.

.....

.....

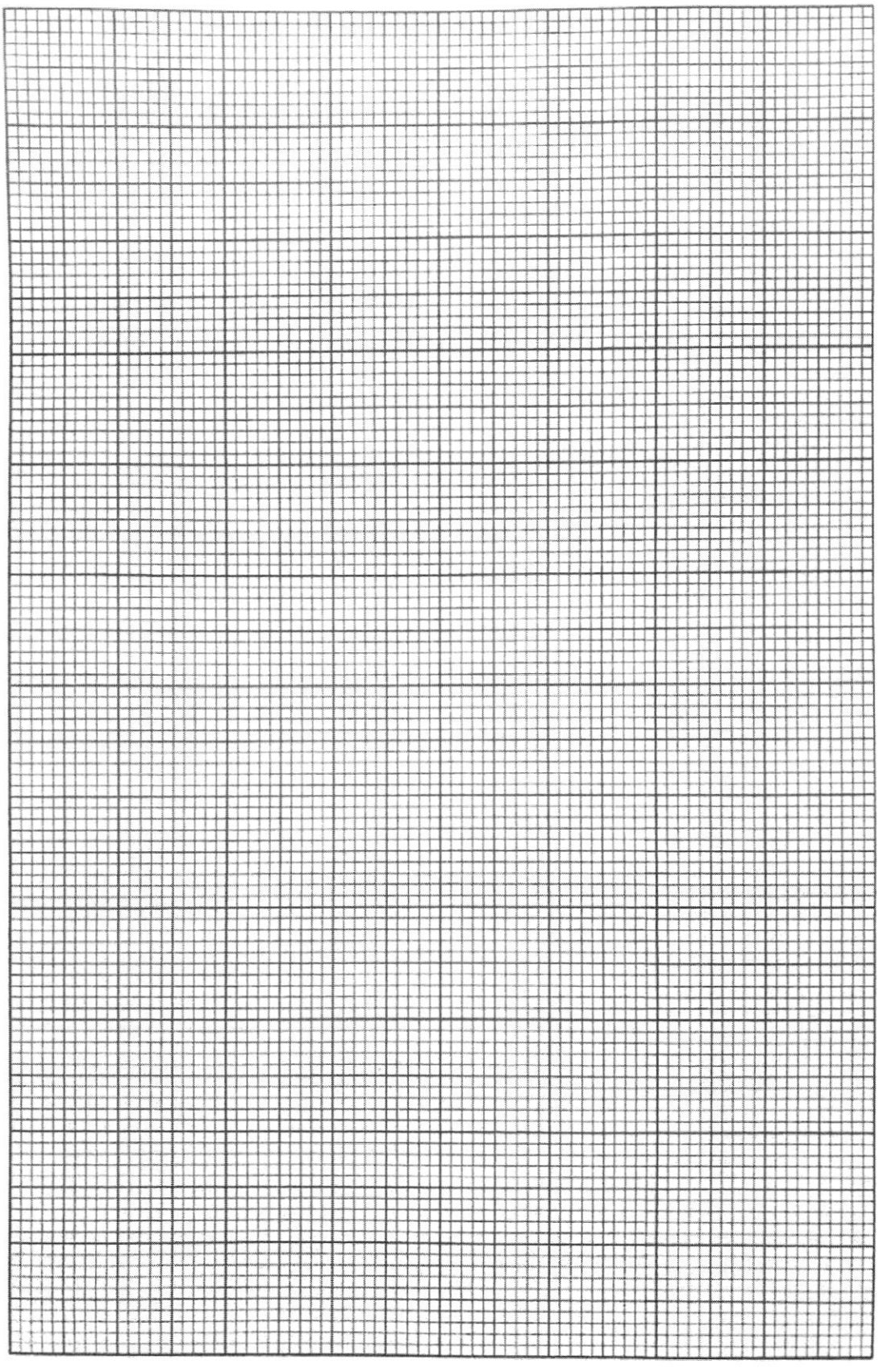
.....

.....

.....

..... [3]

[Total: 10]



10 EITHER

For Examiner's Use

In building bridges, civil engineers need to choose strong and cost-effective materials. Fig. 10.1 shows a bridge that is supported by five circular pillars. The weight of the bridge is 4×10^6 N. The gravitational field strength g is 10 N/kg.

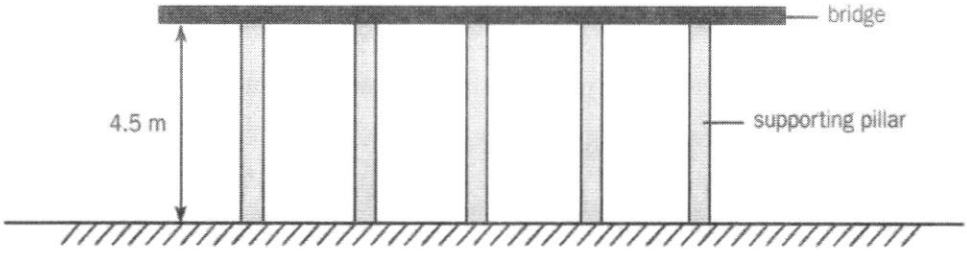


Fig. 10.1

Table 10.1 shows two types of materials that could be used to construct the supporting pillars.

Table 10.1

Material	Maximum pressure that the material can support (N/m^2)	Material cost ($/m^3$)
high-grade concrete	500 000	350
reinforced steel	5 000 000	600

(a) The pillars are evenly spaced. Calculate the weight that each pillar supports.

weight = ... [2]

(b) Calculate the minimum cross-sectional area of each pillar needed to support the bridge when using

(i) high-grade concrete;

area = ... [2]

For Examiner's Use

(ii) reinforced steel.

area = ... [1]

(c) Calculate the total volume of material needed to make all five pillars if

(i) high-grade concrete is used;

volume = ... [2]

(ii) reinforced steel is used.

volume = ... [1]

(d) Based on your findings in part (b) and (c), recommend the material that you would use to build the pillars. Explain why.

.....

.....

.....

..... [2]

[Total: 10]

10 OR

For Examiner's Use

The Electronic Road Pricing (ERP) system is the primary method of regulating traffic in Singapore. ERP gantries erected at key positions charge motorists for utilising certain roads at times when these roads are more prone to congestion.

The ERP system leverages on technology to allow for a more effective and flexible method of congestion charging. An automated collection of a congestion fee from any vehicle passing under a ERP gantry during its operating hours was implemented. The gantry points use the ERP units that are placed at the windscreen of vehicles to charge a toll.

Fig. 10.2 shows an ERP unit that is commonly seen at the windscreen of the vehicle.

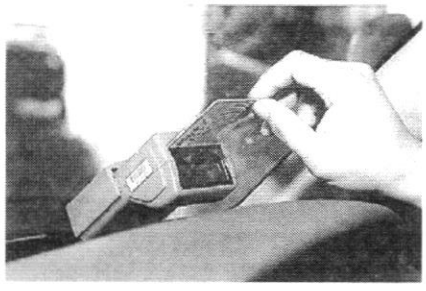


Fig. 10.2

The gantry points send an electromagnetic signal that activates the tag on the ERP unit and reflects the wave back to the gantry points with its tag identification.

(a) (i) State what type of wave are electromagnetic waves.

..... [1]

(ii) Name the type of electromagnetic wave that is used in the ERP system.

..... [1]

(b) The electromagnetic wave in the ERP system has a frequency of 900 MHz. The speed of the electromagnetic wave in air is 3.0×10^8 m/s.

(i) Calculate the wavelength of this electromagnetic wave.

wavelength = ... [2]

For Examiner's Use

(ii) The gantry points send an electromagnetic signal that activates the tag on the ERP unit and reflects the wave back to the gantry points with its tag identification. The time taken for the gantry point to send the signal and receiving it back is 2×10^{-6} s.

Calculate the distance of the gantry point to the ERP unit.

distance = ... [2]

(c) Fig. 10.3 shows the displacement–distance graph of a wave at time $t = 0$ s. The speed of the wave is 200 m/s.

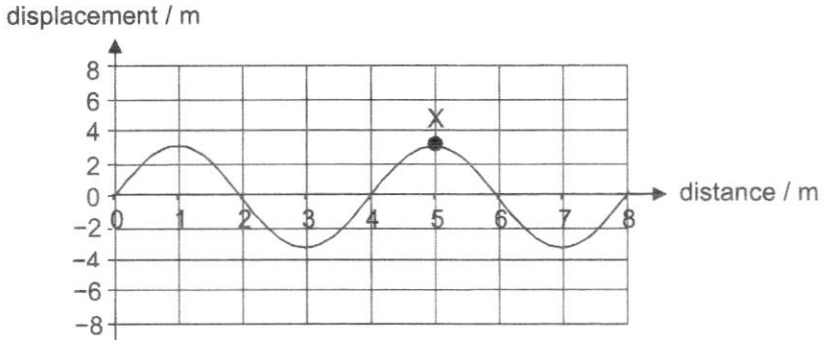


Fig. 10.3

(i) Calculate the period of the wave.

period = ... [2]

(ii) Describe the movement of particle X for one complete cycle with reference to the time taken.

.....

.....

.....

..... [2]

[Total: 10]

End of Paper

6091 Physics Marking Scheme
Bedok View Secondary School
3E End-of-Year Examination 2022

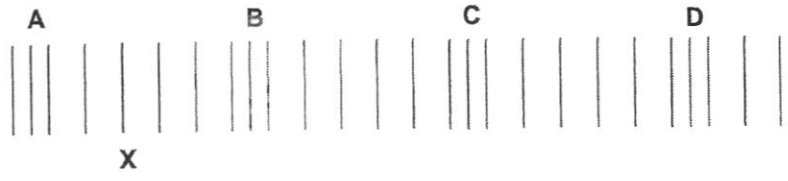
Paper 1

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

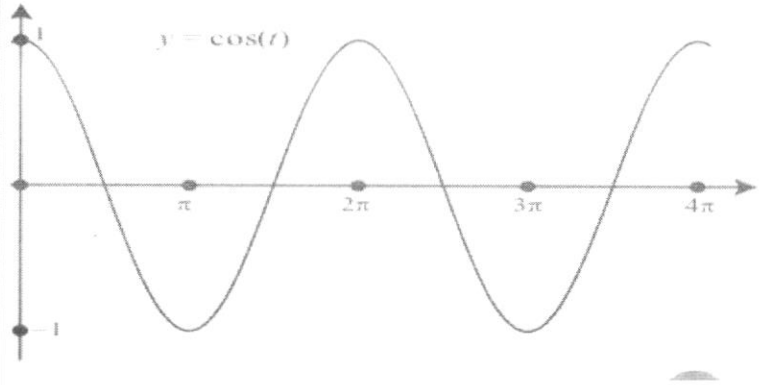
Paper 2 Section A

Qns	Answers	Marks
1a	Kilogram Accept "kg"	B1
1bi	40 / 20 = 2 s Note: Some candidates substituted into main equation.	B1
1bii	30 oscillations	B1
1biii	$g = 1 / (1 / \pi)^2$ = 9.87 N/kg	M1 A1
		Total 5m
2a	X & Y = 2.5 N P: Newton's 3rd Law R: **For every action, there is equal and opposite reaction.** O: Weight of vase (Y) will be equal to reaction force (X)	B1 B1
2bi	10 m/s^2	B1
2bii	velocity = 10 x 0.5 = 5 m/s Noted: ECF	M1 A1
2bii	Height = ½ x 0.5 x 5 = 1.25 m Note: Candidates did not draw the graph.	M1 A1
		Total 7m

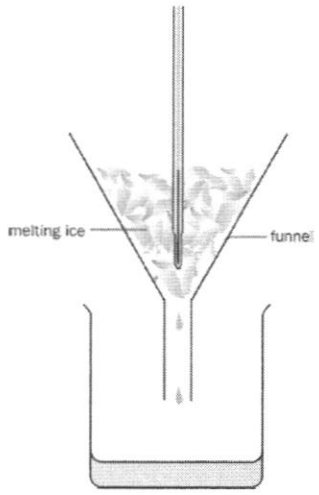
3a	Drawing of forces with acceptable scale Drawing of arrows for forces Labelling with units (13.0 ± 0.1) N	G1 G1 G1 B1
3b	a = 13.0 / 0.5 = 26.0 m/s^2 = 67.4 ° (from scaled diagram) direction = bearings 112.6 ° Remarks: Take note of ECF	M1 A1 B1
		Total 7m
4ai	400 x 1.2 = F x 0.3 F = 1600 N	M1 A1
4aii	P: Principle of Moments R: Total clockwise moments = Tota anti clockwise moments abort same pivot. O: 1) increase the distance of applied force from the pivot OR 2) decrease the distance of pivot to heavy log	 B1 B1
4bi	pressure = 750 / (0.0085 x 2) = 44117.65 Pa = 44100 Pa (3 s.f)	M1 A1
4bii	P: Pressure = Force / Contact Area R: To stand on muddy ground, the man will need to have a lower **pressure** acting on the muddy ground To decrease pressure, either decrease force or increase contact area. Since weight of man is constant, increase contact area. O: Use shoes with very large contact area with muddy ground.	 B1 B1
		Total 8m
5a	GPE = 25 x 10 x 3 =750 J	M1 A1
5b	power =750 / 4 = 187.5 Watts Note: Allow ECF	M1 A1
5c	P: Principle of Conservation of Energy R: **Energy supplied by motor = Increase in GPE + Heat Energy + Sound Energy** O: Since heat energy and sound energy are lost to surroundings, **energy supplied by motor (power) is greater than calculated value**	 B1 B1
5d	12.5 % = 187.5 Watts 100% = 1500 Watts actual power = 1500 Watts	 M1 A1
5e	P: Power = Work done / Time Taken	

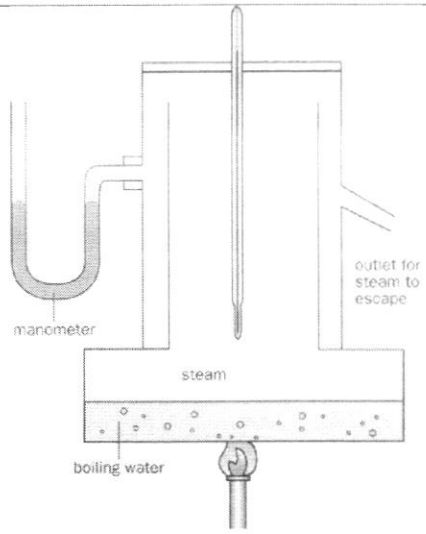
	R: Since the power is constant, **when work done to increase the luggages increases, the time taken will also increases** O: The **timing of the conveyor belt movement will also increase** Note: Candidates did not explain clearly using P = WD /Time Taken Candidate may use P = Force x Vel to explain.	B1 B1
		Total 10m
6a	Copper pipe – Metal is good conductor of heat Black copper pipe – Black surface is good absorber of heat Black metal backing sheet – Conducts heat well to the copper pipe Remarks: Accept any other possible reasons Glass sheet - does not allow heat generated from light to escape easily. Insulating material - does not allow heat from pipes to be conducted to surrounding easily Small amount of trapped air - minimises convection current	B1 B1 B1
6b	energy absorbed by water = 250 x 4200 x (40 – 28) = 12.6 x 10^6 J Energy incident on solar panel = (12.6 x 10^6 / 25) x 100 = 50.4 x 10^6 J Note: Candidates do not understand that 25% of the energy is transferred to water.	M1 M1 A1
6c	1. Cost of installing solar panels 2. Unable to heat the water during cloudy days Remarks: Accept any other possible reasons	B1 B1
		Total 8m
7a	 Remarks: Accept location of X at any rarefaction regions.	B1
7b	Wavelength = 3.8 cm (Value from scaled drawing)	B1
7c		

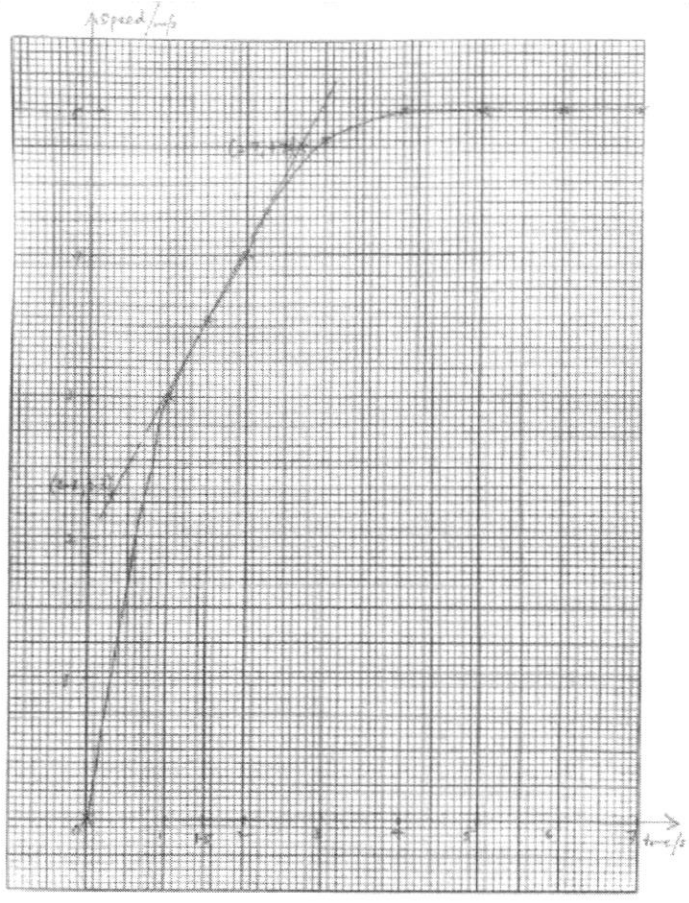
pressure / Pa

	 1. Correct axis drawn with label 2. Correct graph 3. Labelling of A, B, C & D	G1 G1 G1
		Total 5m

Paper 2 Section B

Qns	Answers	Remarks
8a	Thermometric substances have physical (thermometric) properties that vary **uniformly** and **continuously** with temperature.	B1
8b	1. Find the length of the mercury thread l_0 at 0°C.  2. Find the length of the mercury thread l_{100} at 100°C.	B1 D1 B1

	 3. Find the length of the mercury thread l_θ at the unknown temperature θ. 4. Temperature θ is calculated using the equation below: $$\theta = \frac{l_\theta - l_0}{l_{100} - l_0} \times 100^\circ C$$ Note: See Exemplar	D1 B1
8b	- Consists of **two wires made of different metals** such as iron and copper - The wires are joined to form two junctions, which produce a small electromotive force when there is a **temperature difference** between them. - Find the electromotive force for temperature difference between 0 °C and 100 °C. - Find the electromotive force for temperature difference between unknown temperature 0 °C and θ °C. - Temperature θ is calculated using the equation below: - $\theta = \frac{V_\theta - V_0}{V_{100} - V_0} \times 100^\circ C$	B1 B1 B1
8c	Able to measure temperature with high and low range OR Able to measure of matter at inaccessible places i.e. small exposed area Remarks: Accept any other possible reasons.	B1
		Total 10m
9a	1) correctly labelled axis 2) correctly plotted points 3) balanced curve 4) appropriate scaling Remarks: Please see graph.	G1 G2 G1 G1

		
9b	From graph; instantaneous acceleration = (4.75 – 2.3) / (2.7 -0.3) = 1.02 m/s^2 (3 s.f) Note: Accept +/- 0.1	 M1 A1
9c	0 – 1s : constant acceleration (may accept decreasing acceleration) 1 – 4s: decreasing acceleration 4 – 7s: constant velocity Note: Candidates did not provide 3 ranges of timing. The number of ranges will be dependent on the marks allocated.	B1 B1 B1
		Total 10m
EITHER		
10a	weight = 4 x 10^6 / 5 = 8 x 10^5 N	M1 A1
10bi	pressure = force / contact area contact area = 8 x 10^5 / 500 000 = 1.6 m^2	 M1 A1
10bii	pressure = force / contact area contact area = 8 x 10^5 / 5 000 000 = 0.16 m^2	 B1
10ci	volume = 5 x 1.6 x 4.5	M1

	= 36 m^3	A1
10cii	volume = 5 x 0.16 x 4.5 = 3.6 m^3	B1
10d	Total cost for high-grade concrete used = 36 x 350 = \$12 600 Total cost for reinforced steel used = 3.6 x 600 = \$2 160 Based on costings, material selected will be reinforced steel.	B1 B1
		Total 10m
OR		
10ai	Transverse wave	B1
10aii	Radiowaves	B1
10bi	3 x 10^8 = 900 x 10^6 x wavelength wavelength = 0.333 m	M1 A1
10bii	distance = ½ x (3 x 10^8 x 2 x 10^{-6}) = 300 m	M1 A1
10ci	frequency = 200 / 4 = 50 Hz period = 1/ 50 = 0.02 s	B1 B1
10cii	For one complete cycle: 0 – 0.01s : particle X will move vertically downwards to x = -3 0.01 – 0.02s : particle X will move vertically upwards to x = +3	B1 B1
		Total 10m