

Visit
FREETESTPAPER.com
for more papers



Website: freetestpaper.com



[Facebook.com/freetestpaper](https://www.facebook.com/freetestpaper)



[Twitter.com/freetestpaper](https://www.twitter.com/freetestpaper)



SERANGOON SECONDARY SCHOOL
END-OF-YEAR EXAMINATION
SECONDARY 3 EXPRESS

CANDIDATE
NAME

 ()

INDEX
NUMBER

CLASS

SCIENCE (PHYSICS, CHEMISTRY)

Paper 1 Multiple Choice

5076/01

12 Oct 2022
1 hour

Additional Materials: Multiple Choice Answer Sheet

Setter(s):

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your Centre number, index number and name on the Multiple Choice Answer Sheet.

DO **NOT** WRITE IN ANY BARCODES.

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

Choose the one you consider correct and record your 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 booklet.

A copy of the Data Sheet is printed on page X.

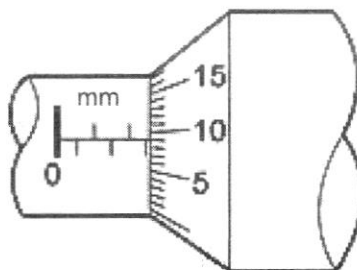
A copy of the Periodic Table is printed on page X.

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

This document consists of **8** printed pages, including this **cover** page.

2

- 1 The diagram shows part of a micrometer screw gauge.



Which is the correct reading shown on the micrometer screw gauge?

- A 2.90 mm B 2.09 mm
C 2.59 mm D 5.90 mm
- 2 Which list contains only vector quantities?
- A length, mass, speed
B distance, time, speed
C mass, length, time
D acceleration, displacement, velocity
- 3 In an experiment, the time taken by a simple pendulum to complete 50 oscillations was measured and recorded as shown in the table.

trial number	time for 50 oscillations / s
1	70.7
2	70.1
3	69.2

What is the period of the pendulum?

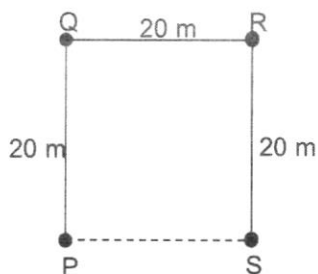
- A 1.40 s B 2.80 s
C 70.0 s D 140 s
- 4 The Singapore Airlines offers a flight from Singapore to Hokkaido. During the flight from Singapore to Tokyo, the plane travelled at an average speed of 970 km/h for 5.5 hours. The flight then continues for 1.5 hours from Tokyo to Hokkaido, which are 1200 km apart.

What is the average speed of the plane for the entire journey from Singapore to Hokkaido?

- A 140 km/h B 772 km/h
C 891 km/h D 933 km/h

3

- 5 A boy takes 10.0 s to walk from P to Q, 10.0 s to walk from Q to R and then another 10.0 s to walk from R to S as shown below.

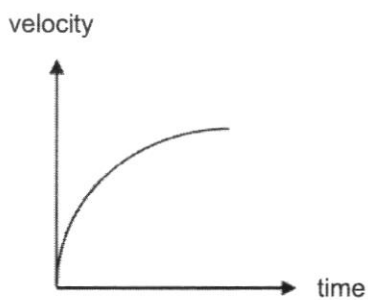
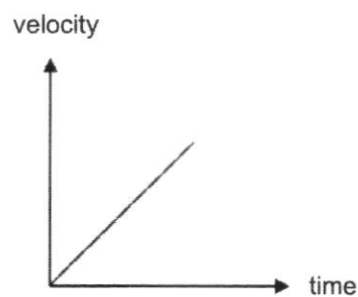
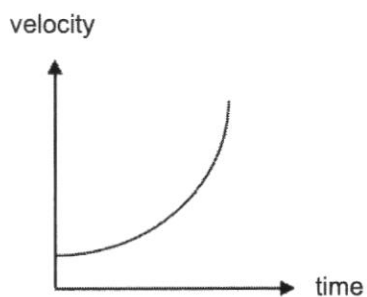
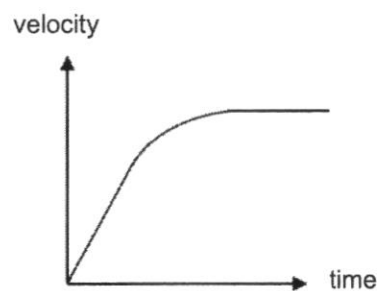


PQRS is a square with side 20 m.

What are his average speed and velocity from P to S?

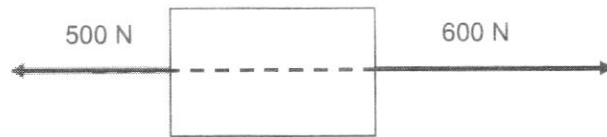
	average speed / m/s	average velocity / m/s
A	2.0	0.50
B	2.0	0.67
C	2.0	2.0
D	6.0	0.67

- 6 A ball is being released from the top of a building. Assuming that there is no air resistance, which diagram shows the speed-time graph of the ball?

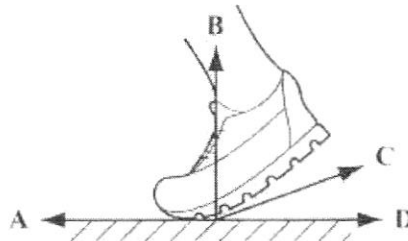
**A****B****C****D**

4

- 7 A block experiences a 600 N force to the right and a 500 N force to the left.



- A It does not move.
 B It moves at a constant acceleration to the left.
 C It moves at a constant acceleration to the right.
 D It moves at a constant velocity to the right.
- 8 The diagram shows a runner's shoe at the start of a race. Which arrow indicates the direction of the frictional force acting on the runner's shoe when the runner is moving forward?

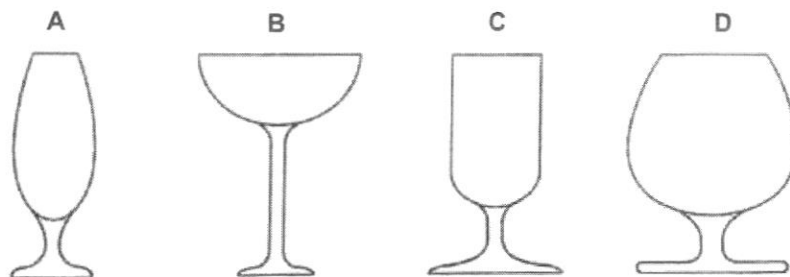


- 9 A 10.0 kg block of iron is brought from Earth to the surface of a planet.

Given that the gravitational field strength of the planet is 3.90 N/kg and the gravitational field strength of Earth is 10 N/kg, how will the mass and weight of the iron block change?

	mass	weight
A	unchanged	decreases
B	unchanged	increases
C	decreases	decreases
D	increases	increases

- 10 The diagrams show the cross-sections of different glasses.

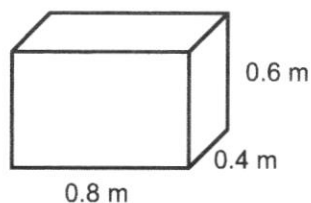


Which is the most stable when filled with liquid?

- 11 An electric motor lifts a load of mass 500 kg to a vertical height of 4.8 m in 8.0 seconds at constant speed.

What is the power developed by the motor? [Take $g = 10 \text{ N/kg}$]

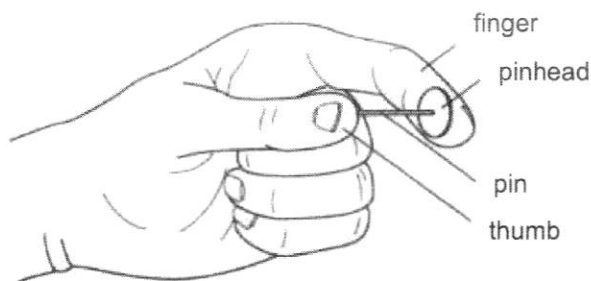
- | | |
|-----------------|-----------------|
| A 0.30 W | B 3.0 W |
| C 192 W | D 3000 W |
- 12 A block of dimension $0.4 \text{ m} \times 0.6 \text{ m} \times 0.8 \text{ m}$ rests on the floor as shown. Given that the block has a weight of 19 200 N, what is the highest pressure the block can exert on the floor?



- | | |
|--------------------|---------------------|
| A 40 000 Pa | B 60 000 Pa |
| C 80 000 Pa | D 100 000 Pa |

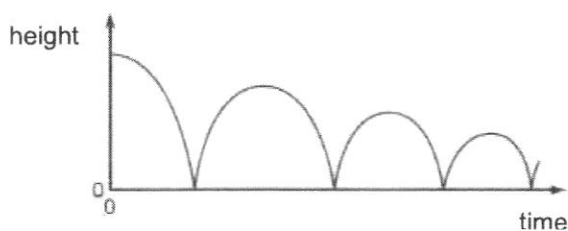
6

- 13 A pin is squeezed between finger and thumb as shown in the diagram.



Which statement is correct?

- A The force of the pin is larger on the finger than on the thumb.
 - B The force of the pin is larger on the thumb than on the finger.
 - C The pressure of the pin is larger on the finger than on the thumb.
 - D The pressure of the pin is larger on the thumb than on the finger.
- 14 The graph shows how the height above the ground of a bouncing ball changes with time.



Which statement explains why the height of each peak decreases with time?

- A The ball is wearing out.
 - B The ball gains energy on impact with the floor.
 - C All kinetic energy is converted to potential energy at each bounce.
 - D Some kinetic energy is converted to thermal energy at each bounce.
- 15 In a Brownian motion experiment involving smoke particles in air, large smoke particles settle quickly but small smoke particles remain suspended for long periods of time.

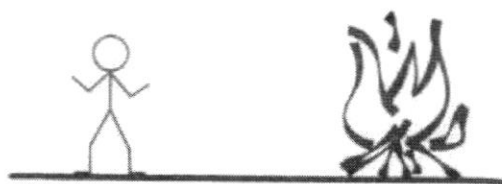
Which statement explains why small smoke particles do not settle quickly?

- A Air pressure has a greater effect on smaller particles.
- B The small smoke particles have the same density as air.
- C There are random collisions between the air molecules.
- D Random bombardments by air molecules keep the small smoke particles suspended.

- 16 Which row best describes the behaviour of particles in the gaseous state?

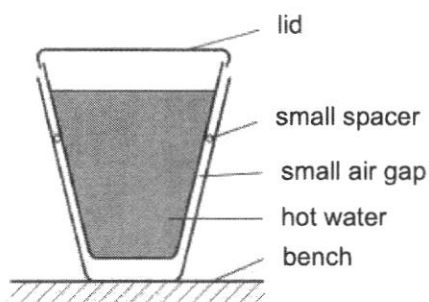
	forces between particles	arrangement of particles
A	weak	closely packed but in a disorderly manner
B	weak	far apart in a disorderly manner
C	strong	closely packed but in a disorderly manner
D	strong	far apart in a disorderly manner

- 17 Eric stands beside a campfire as shown below and starts to perspire.



What is the main process by which heat from the campfire reach Eric?

- A** radiation
 - B** convection
 - C** conduction and radiation
 - D** conduction and convection
- 18 Two plastic cups are placed one inside the other as shown in the diagram. Hot water is poured into the inner cup and a lid is put on top as shown.



Which statement is correct?

- A** No heat passes through the sides of either cup.
- B** Heat loss by radiation is prevented by the small air gap.
- C** The lid is used to reduce heat loss by convection and evaporation.
- D** The bench is heated by convection from the bottom of the outer cup.

- 19 During evaporation, the temperature of the liquid decreases.

Which of the following shows the changes in the average kinetic and potential energy of the liquid molecules in the liquid during evaporation?

	average kinetic energy of molecules	average potential energy of molecules
A	decreases	unchanged
B	increases	decreases
C	unchanged	increases
D	unchanged	unchanged

- 20 Three substances with their respective boiling and freezing points are shown in the table.

	substance X	substance Y	substance Z
freezing point / °C	-39	-112	-180
boiling point / °C	357	78	36.5

Which substance(s) is/are in gaseous state at 150 °C and solid state at -150 °C?

- A** X only
- B** Y only
- C** Z only
- D** Y and Z only

END OF PAPER



SERANGOON SECONDARY SCHOOL
END-OF-YEAR EXAMINATION
SECONDARY 3 EXPRESS

CANDIDATE
NAME

CLASS

--	--	--

INDEX
NUMBER

--	--

SCIENCE PHYSICS

Paper 2 (Section A)

5076/02

7 October 2022

1 hour 15 minutes

Candidates answer on the Question Paper.

Setter(s):

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

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

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

You may lose marks if you do not show your working or if you do not use appropriate units.

Section A

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

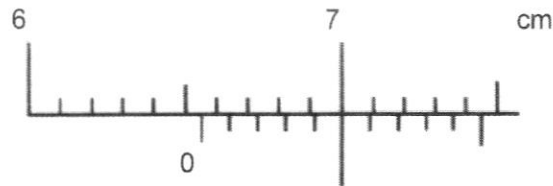
The number of marks is given in brackets [] at the end of each question or part question.

For examiner's use	
Section A	45

This question paper consists of **11** printed pages, including this cover page.

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

- 1 (a) Fig. 1.1 shows the reading on a pair of vernier calipers used to measure a ream of 500 pieces of paper.

**Fig. 1.1**

- (i) State the reading on the vernier scale.

reading = cm [1]

- (ii) Hence, determine the thickness of single piece of paper.

thickness = cm [1]

- (b) Describe briefly how a more accurate measurement of the thickness of the ream of papers can be obtained.

..... [1]

- (c) Explain why the micrometer screw gauge is not a suitable instrument to measure the thickness of the stack of papers.

..... [1]

- (d) Explain why a pair of vernier calipers is not a suitable instrument to measure the thickness of a **single** piece of paper.

..... [1]

(e) Complete the following sentences.

(i) 400 nm is equal to km. [1]

(ii) 90 km/h is equal to m/s. [1]

- 2 A skydiver jumps off from an aeroplane. He falls freely for 5 s and reaches a speed of 50 m/s. Then he falls with decreasing acceleration and reaches a speed of 80 m/s in the next 10 s and continues to fall at that speed for another 30 s. The skydiver then pulls the rip cord to open his parachute. He decelerates uniformly for 25 s and reaches a speed of 10 m/s.

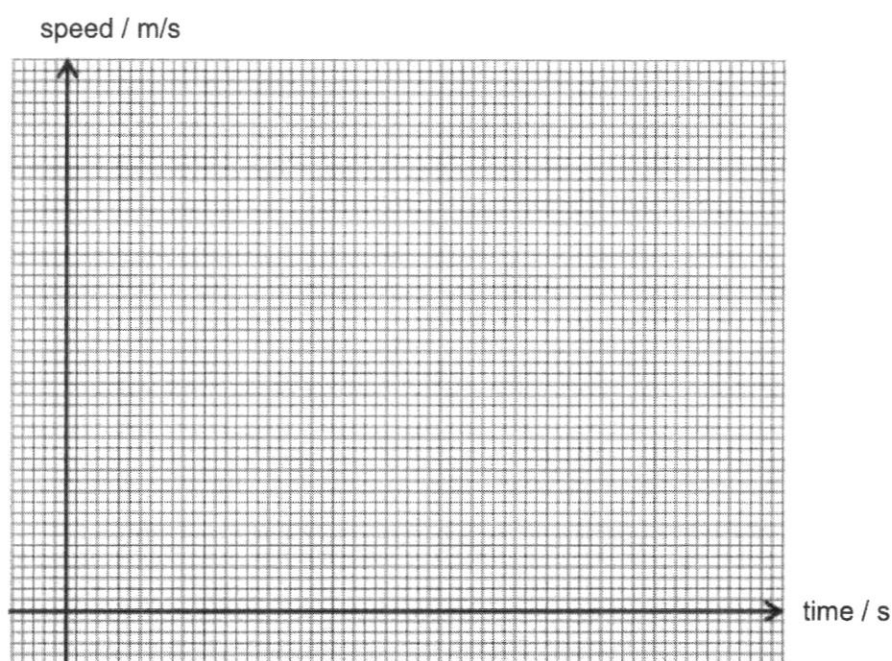


Fig. 2.1

- (a) On Fig. 2.1, draw a speed-time graph to show how the speed of the skydiver changes with time. [3]
- (b) Use the graph to calculate
- (i) the acceleration of the skydiver in the first 5 s,

acceleration = m/s² [1]

4

- (ii) the distance travelled by the skydiver from 45 s to 65 s, and

distance = m [1]

- (iii) average speed of the skydiver from 45 s to 60 s.

average speed = m/s [1]

- (c) Explain, in terms of forces,

- (i) why the acceleration of the skydiver decreases from 5 s to 15 s,

.....

 [2]

- (ii) why the skydiver moves at constant speed from 15 s to 45 s.

.....

 [2]

- 3 Fig. 3.1 shows a boat of weight 2000 N is being pulled by a fisherman with a 400 N force across the water. It can be assumed that there is no friction between the boat and the water.

(Take gravitational field strength, $g = 10 \text{ N/kg}$)

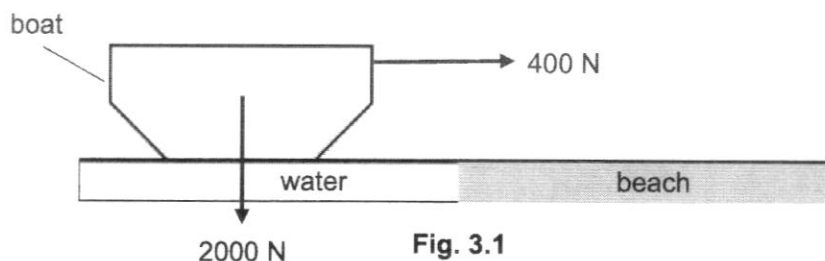


Fig. 3.1

- (a) Calculate the acceleration of the boat on the water.

acceleration = m/s^2 [2]

- (b) As the boat moves onto the beach, the 400 N force continues to act on the boat.

State the frictional force acting on the boat if it moves at a constant speed on the beach. Explain your answer.

.....

.....

[2]

- (c) Fig 3.2 shows another fisherman helping to pull the boat. Each fisherman pulls with a force of 400 N at an angle of 30° to each other.

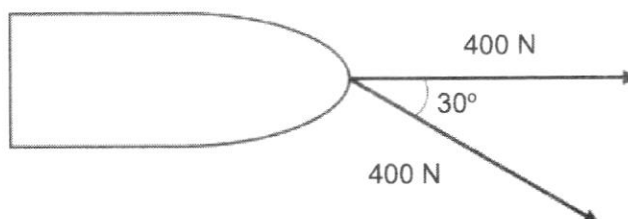


Fig. 3.2

By using a suitable scale, determine the magnitude and the direction of the resultant force acting on the boat. State the scale used.

scale =

magnitude = N

direction = [4]

7

- 4 Fig 4.1 shows a tank full of a liquid. The tank has length 240 cm, width 150 cm and height 224 cm.

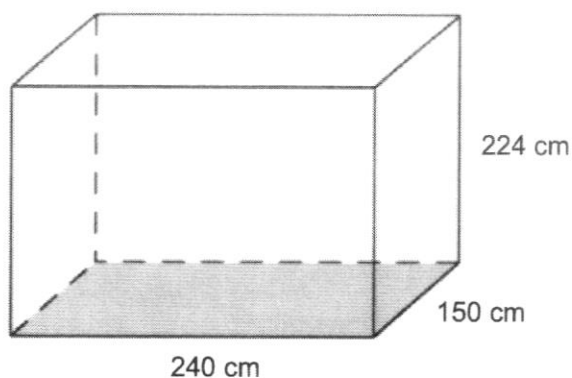


Fig. 4.1

The density of the liquid is 0.08 g/cm^3 .

- (a) Explain the difference between mass and weight.

.....
 [2]

- (b) Calculate

- (i) the mass of the liquid in the tank,

mass = g [2]

- (ii) the weight of the liquid in the tank ($g = 10 \text{ N/kg}$),

weight = N [1]

- 5 A hydraulic press is used at a recycling centre to compress waste materials. Fig. 5.1 is a side view of the press.

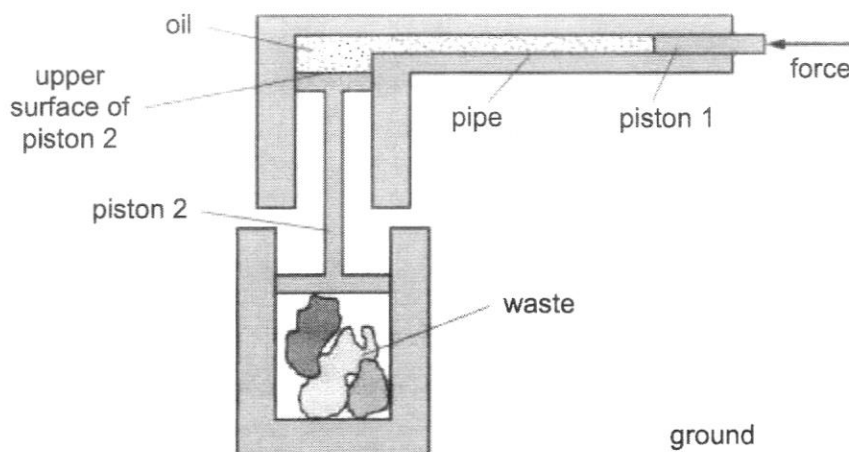


Fig. 5.1

A force to the left is exerted on piston 1. Oil is pushed along the pipe and this moves piston 2 downwards. Piston 2 compresses the waste.

- (a) Oil is a liquid.

- (i) State the property of a liquid that makes it suitable for use in a hydraulic system.

..... [1]

- (ii) Explain, in terms of kinetic theory, why oil has this property.

.....
 [1]

- (b) The cross-sectional area of piston 1 is 0.018 m^2 .

Piston 1 exerts a force of 4.5 kN on the oil.

- (i) State what is meant by pressure.

.....
 [1]

- (ii) The pressure of the oil is uniform throughout the pipe.

The area of the upper surface of piston 2 that is in contact with the oil is 1.4 m^2 .

Calculate the force exerted on piston 2 due to the pressure calculated in (b)(i).

force = N [1]

- (iii) Suggest one advantage of using a hydraulic press.

.....
 [1]

- 6 (a) Fig. 6.1 shows a living room.

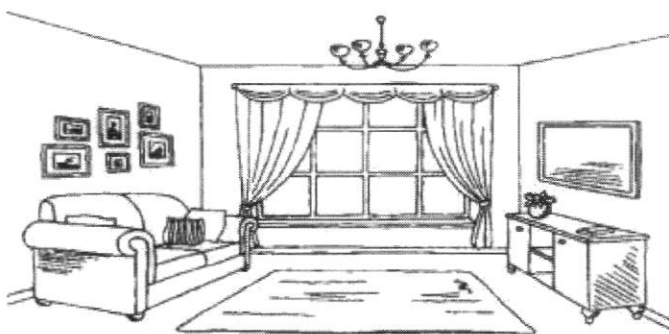


Fig. 6.1

- (i) Mark an X on Fig. 6.1 to indicate a possible spot where an air-conditioner can be installed to cool the room efficiently. [1]

- (ii) Explain your answer to (a).

.....

 [2]

- (b) An experiment is carried out as shown in Fig. 6.2.

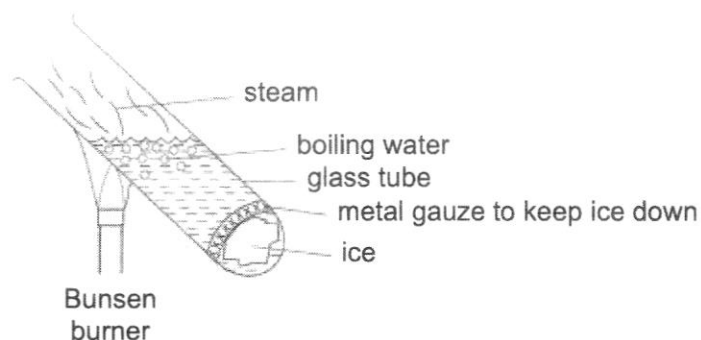


Fig. 6.2

- (i) Explain why the ice takes a long time to melt, even though the water at the top of the boiling tube is boiling.

..... [1]

- (ii) Describe the process by which thermal energy is transferred from the water on top to the ice.

..... [2]

- (c) Electrical components in our laptops can get hot easily when the laptops are used for long hours. To prevent damage to them due to overheating, these electrical components are mounted onto a heat sink. The heat sink is made of aluminium and consists of a flat base with many cooling fins protruding out as shown in Fig. 6.3.

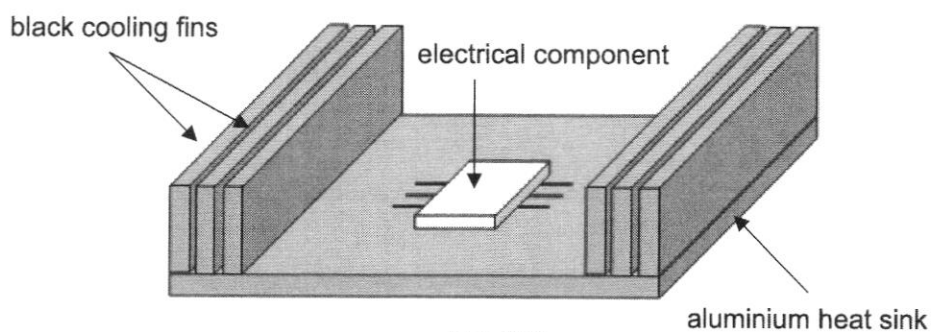


Fig. 6.3

- (i) Explain why the heat sink has many cooling fins.

..... [2]

- (ii) Explain why the cooling fins are painted black in colour.

.....

.....

.....

[2]

END OF PAPER



SERANGOON SECONDARY SCHOOL
END-OF-YEAR EXAMINATION
SECONDARY 3 EXPRESS

CANDIDATE
NAME

CLASS

--	--	--

INDEX
NUMBER

--	--

SCIENCE PHYSICS

Paper 2 (Section B)

5076/02

7 October 2022

1 hour 15 minutes

Candidates answer on the Question Paper.

Setter(s):

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

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

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

You may lose marks if you do not show your working or if you do not use appropriate units.

Section B

Answer any **two** questions.

Write your answers in the spaces provided on the question paper.

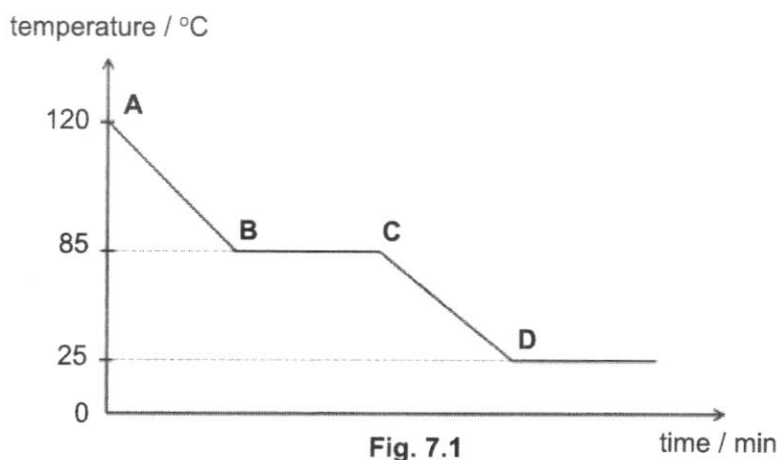
The number of marks is given in brackets [] at the end of each question or part question.

For examiner's use	
Section B	
Q no.	
Q no.	
Total	20

This question paper consists of **8** printed pages, including this cover page.

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

- 7 (a) Fig. 7.1 shows how the temperature of liquid X changes over time when left in a room.



- (i) State the freezing point of liquid X.
 [1]
- (ii) Explain why the temperature remains constant after point D.
 [1]
- (iii) Explain why the temperature of substance X remains unchanged in section BC.

 [2]
- (iv) Sketch a new graph on Fig. 7.1 showing how the temperature of substance X changes over time if thermal energy is removed at a lower rate. Label the new graph with the letter Y. [1]

- (b) Boiling and evaporation involve the change in state of a substance from the liquid state to the gaseous state. Boiling, however, is a relatively quicker process as compared to evaporation.

State one other difference between boiling and evaporation.

.....
 [1]

- (c) Fig 7.2 shows the process by which molecules near the surface of water escape.

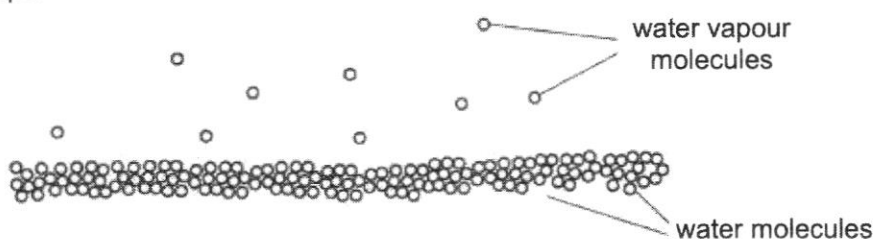


Fig. 7.2

- (i) State the name of the process shown in Fig. 7.2

..... [1]

- (ii) Explain why a swimmer feels cold when he steps out of the swimming pool.

.....

 [2]

- (iii) Describe the difference between the movement of the molecules in the liquid and gaseous state.

.....

 [1]

- 8 Fig. 8.1 shows the Great Xingdong Tourist World's vertical roller coaster in China with a maximum vertical drop of 60 m. The vertical roller coaster integrates vertical fall, inverted dives and high-speed swings, subjecting the riders to large changes in speed.



Fig. 8.1

Fig 8.2 shows the simplified diagram of the vertical drop.

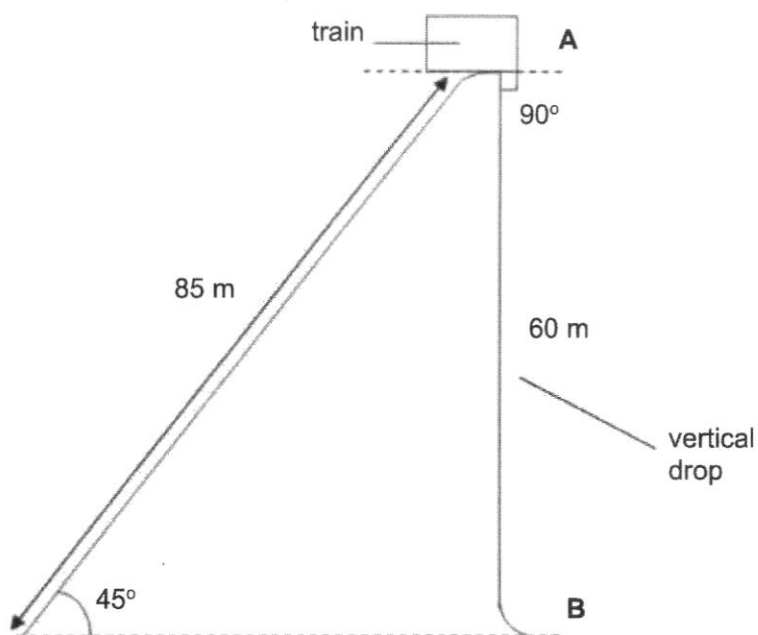


Fig. 8.2

At the start of the ride, the train of mass 3000 kg climbs a 45° hill at a constant speed of 3.0 m/s. The train is momentarily at rest at the top of the hill before dropping 60 m at 90° hitting a maximum speed of 31.7 m/s at the bottom of the hill.

- (a) State the principle of conservation of energy.

.....

 [2]

- (b) Calculate the time taken for the train to move up the hill.

time = [1]

- (c) (i) Calculate the gain in gravitational potential energy of the train when it is at the top of the hill. (Take gravitational field strength, $g = 10 \text{ N/kg}$)

gravitational potential energy = [1]

- (ii) Calculate the kinetic energy of the train at the bottom of the hill.

kinetic energy = [1]

- (iii) Hence, determine the average frictional force between the tracks and the train at the vertical drop.

average frictional force = [2]

6

- (d) Using your answers in part (b) and (c)(i), calculate the minimum power of the train when it moves up the hill. Assume that the frictional force is constant as the train moves up the hill. Leave your answer in kW.

power = [2]

- (e) The work done in pulling the train up the hill is transferred to different forms of energy. State the energy conversions from point A to point B.

.....

..... [1]

- 9 A worker carries a ladder on his shoulder. His shoulder acts as a pivot. Fig. 9.1 shows that the ladder is horizontal.

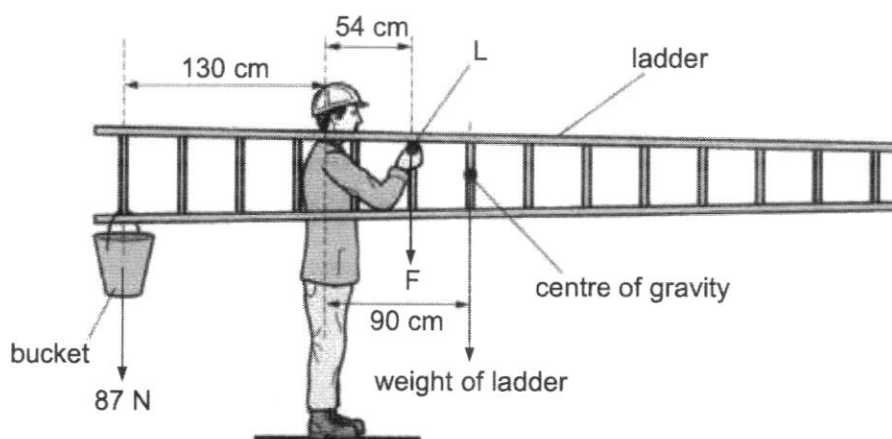


Fig. 9.1

The ladder is wider at one end than at the other end. The weight of the ladder is 80 N.

- (a) The centre of gravity of the ladder is not halfway along its length.

Explain what this shows about the ladder.

..... [1]

7

- (b) The centre of gravity of the ladder is a horizontal distance of 90 cm from the worker's shoulder.

Calculate the moment about the worker's shoulder of the weight of the ladder.

moment = [1]

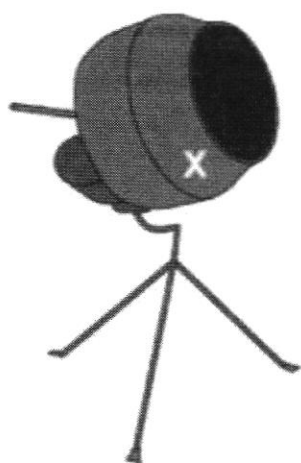
- (c) A bucket of mass 87 N is suspended from the ladder at a horizontal distance of 130 cm from the worker's shoulder.

The worker keeps the ladder horizontal by exerting a downward force F at point L. L is a horizontal distance of 54 cm from his shoulder.

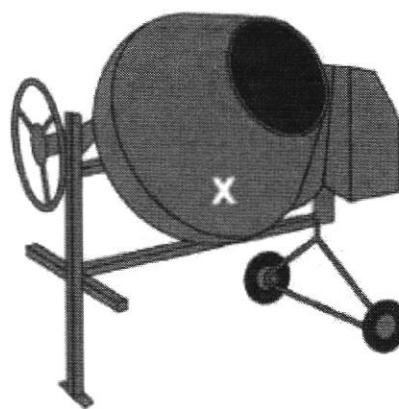
Determine the magnitude of the force F exerted at L.

magnitude = [2]

Fig. 9.2 shows two concrete mixers.



concrete mixer A



concrete mixer B

Fig. 9.2

On each diagram, the X marks the *centre of gravity* of the concrete mixer and its contents.

- (d) State what is meant by *centre of gravity*.

.....
 [1]

- (e) The diagrams are drawn to the same scale.

State which concrete mixer is more stable and state two features which make it the more stable concrete mixer.

.....

 [3]

- (f) A stable concrete mixer does not fall over when it is given a small push.

Explain why the concrete mixer is stable.

.....

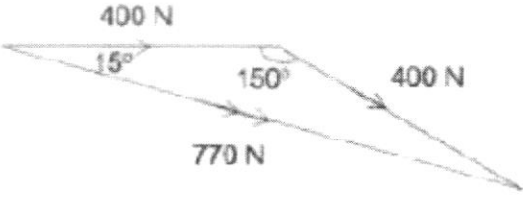
 [2]

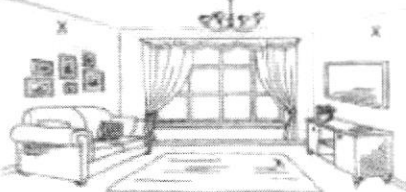
END OF PAPER

2022 3E Sci Physics EYE Paper 2 Mark Scheme [65 marks]

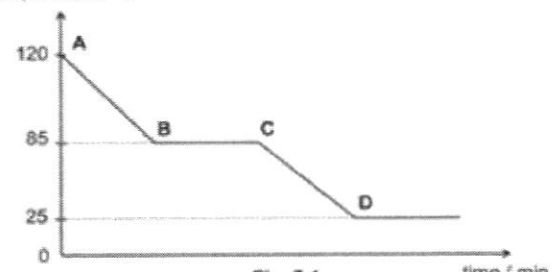
Section A (45 marks)

1ai)	6.55	[1]
1a ii)	0.0131	[1]
1b)	Measure the thickness of the ream of papers at different positions and take average of the readings	[1]
1c)	The thickness of 500 pieces of paper is beyond the limit of measurement for micrometer screw gauge / micromemter screw gauge is used to measure smaller readings	[1]
1d)	Precision of vernier caliper is 0.01 cm, not precise enough to measure thickness of 1 piece of paper. OR a single piece of paper is too thin to be measured to be measured by the VC . Do NOT accept accurate	[1]
1ei)	4×10^{-10}	[1]
1eii)	25	[1]
[Total: 7]		
2a)	Correct shape Correct key values on axes Consistent scale	[1] [1] [1]
2bi)	$a = \frac{50-0}{5-0} = 10 \text{ m/s}^2$ Working must be clearly shown	[1]
2bii)	$d = \frac{1}{2}(80 + 24)(20) = 1040 \text{ m}$ Working must be clearly shown	[1]
2biii)	Average speed = $\frac{1}{2}(80 + 38) = 59 \text{ m/s}$ Working must be clearly shown	[1]
2ci)	upwards air resistance increases due to increasing speed resultant force decreases Direction of the forces must be explicitly mentioned.	[1] [1]
2cii)	upwards air resistance is equal to his downward weight and no resultant force acts on the skydiver Direction of the forces must be explicitly mentioned.	[1] [1]
[Total: 10]		

3a)	$a = 400 \div \frac{2000}{10}$ $= 2.0 \text{ m/s}^2$ Working must be clearly shown	[1] [1]
3b)	Frictional force is 400 N Since not accelerating, no resultant force so equal to pulling force	[1] [1]
3c)	 scale = 1 cm : 100N magnitude = 750 N to 790 N direction = 14° to 15° south of 400 N force	[1] [1] [1]
		[Total: 8]
4a)	The weight is gravitational force acting on a body whereas the mass is the amount of matter in a body Comparative word must be used	[1] [1]
4bi)	mass = volume $\times$ density volume = $240 \times 150 \times 224 = 8,064,000 \text{ cm}^3$ mass = $8,064,000 \times 0.08 = 645,120 \approx 645,000 \text{ g}$	[1] [1]
4bii)	weight = mass $\times$ g - field strength weight = $\frac{645120}{1000} \times 10 = 6451.2 \text{ N} \approx 6450 \text{ N}$	[1]
		[Total: 5]
5ai)	Liquid is incompressible	[1]
5aii)	The particles are closely packed in a random manner.	[1]
5bi)	Forcing acting perpendicularly on per unit contact area	[1]
5bii)	Force = pressure $\times$ area Pressure on piston 1 = $4500 \div 0.018 = 250,000 \text{ Pa}$ F = $250000 \times 1.4 = 350,000 \text{ N}$	[1]
5biii)	A smaller force is needed to overcome a larger force	[1]
		[Total: 5]

6ai)		[1]
6aii)	Warmer air rises due to its lower density AND cooler air blown out will sink due to higher density Cycle repeats and the room is cooled by <u>convection current</u>	[1] [1]
6bi)	Water is poor conductor / insulator of thermal energy	[1]
6bii)	<u>Particles</u> near the heat source <u>gain thermal energy</u> and <u>move more vigorously</u> The particles <u>collide with neighbouring ones</u> and <u>energy is passed</u> on them	[1] [1]
6ci)	Increase exposed surface area Thermal energy is transferred to surrounding quickly by radiation	[1] [1]
6cii)	Black is a <u>good radiator</u> of thermal energy <u>Thermal energy is transferred</u> quickly to the surrounding keeping the component cool	[1] [1]
		[Total: 10]

Section B (20 marks)

7ai)	85°C	[1]
7aii)	Solid X <u>reached thermal equilibrium</u> with the surrounding / same temperature as the surrounding	[1]
7aiii)	Energy transferred out of substance X is <u>used to form intermolecular bonds</u> / attractive forces between the particles The <u>average kinetic energy</u> of the particles remains <u>constant</u>	[1] [1]
7aiv)	temperature / °C  Fig. 7.1 time / min Gradient for graph Y must be less than original graph AND Horizontal section must be longer than original graph	[1]
7b)	More vigorous in boiling / bubbling in boiling but not evaporation / fixed temp for boiling but a range of temp for evaporation	[1]
7ci)	Evaporation	[1]

7cii)	The more energetic water particles have sufficient energy to overcome the attractive forces between the particles to escape into the atmosphere Less energetic particles are left behind, resulting in lower average kinetic energy and the temperature decreases	[1] [1]
7ciii)	Particles in the liquid slide over each other , BUT the particles in the gas move at high speed in all directions . Comparative word must be used	[1]
		[Total: 10]
8a)	Energy cannot be created nor destroyed AND It can only transfer from one form to another The total energy in an isolated system is conserved	[1] [1]
8b)	time = distance ÷ speed = $85 \div 3.0 = 28.333 \approx 28 \text{ s (2 s.f.) or } 28.3 \text{ s (3 s.f.)}$	[1]
8ci)	GPE = $mgh = 3000 \times 10 \times 60 = 1,800,000 \text{ J}$	[1]
8cii)	KE = $\frac{1}{2}mv^2 = \frac{1}{2} \times 3000 \times 31.7^2 = 1,507,335 \approx 1,500,000 \text{ J (2 s.f.) or } 1,510,000 \text{ J (3 s.f.)}$	[1]
8ciii)	Energy loss due to friction = $1,800,000 - 1,507,335 = 292,665 \text{ J}$ average frictional force = $292,665 \div 60 = 4,877.75 \text{ N} \approx 4880 \text{ N}$	[1] [1]
8d)	Power = work done ÷ time = $1,800,000 \div 28.333 = 63,530 \text{ W}$ $63,530 \text{ W} = 63.5 \text{ kW}$	[1] [1]
8e)	From gravitational potential energy → kinetic energy + thermal energy	[1]
		[Total: 10]
9a)	It is not a uniform ladder / the weight is not uniformly distributed	[1]
9b)	moment = force × perpendicular distance $M = 80 \times \frac{90}{100} = 72 \text{ Nm or } 7200 \text{ Ncm}$	[1]
9c)	$87 \times 130 = 80 \times 90 + 54F$ $F = 76.1 \text{ N}$	[1] [1]
9d)	It is a point where the whole weight of the object seems to act on for any orientation	[1]
9e)	Concrete mixer: B Feature 1: larger base area Feature 2: lower centre of gravity	[1] [1] [1]
9f)	The line of action of its weight is within its base The weight will create a moment about the point of turning to restore it to original position	[1] [1]
		[Total: 10]