DAMAI SECONDARY SCHOOL
End-of-Year Examination 2019

CANDIDATE NAME

CLASS | | | | INDEX NUMBER | | |

SCIENCE (PHYSICS) 5076/01

Paper 1 **14 October 2019**

Secondary 3 Express **30 minutes**

Setter: Mr Lau Hui Cheng **20 Marks**

Additional Materials: Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the Answer Sheet Provided using a 2B-pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
The use of an approved scientific calculator is expected, where appropriate.

There are **twenty** 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 **2B-pencil** on the Answer sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

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1 The length of an object is 6.0 μm.

Which of the following prefixes is used in this measurement?

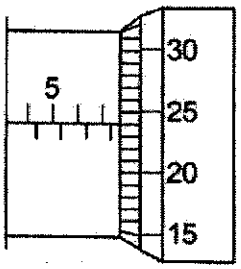
A deci

B micro

C milli

D nano

2 In the diagram below, a micrometer screw gauge is used to measure the thickness of a metal plate.



What is the measurement recorded?

A 5.24 mm

B 5.27 mm

C 7.24 mm

D 7.74 mm

3 The period of a simple pendulum increases when

A the length of the pendulum is doubled.

B the length of the pendulum is halved.

C the mass of the bob attached to the pendulum is doubled.

D the mass of the bob attached to the pendulum is halved.

4 A truck accelerated uniformly for a time *t* along a straight road from rest and reached the speed of 18 m/s. It continued to travel at this speed for 13 s before decelerating at a constant rate and came to a stop within 3.0 s at a traffic light. The total distance the truck travelled was 322 m.

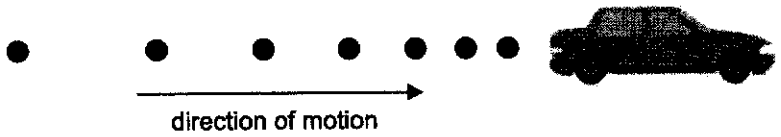
What would the value of *t* be?

A 1.9 s **B** 3.4 s **C** 3.8 s **D** 6.8 s

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5 A car is equipped with a device that sprays a drop of paint on the ground every second. The following diagram shows a trail of paint drops from the car that is moving in a straight line.



Which of the following statements about the car is correct?

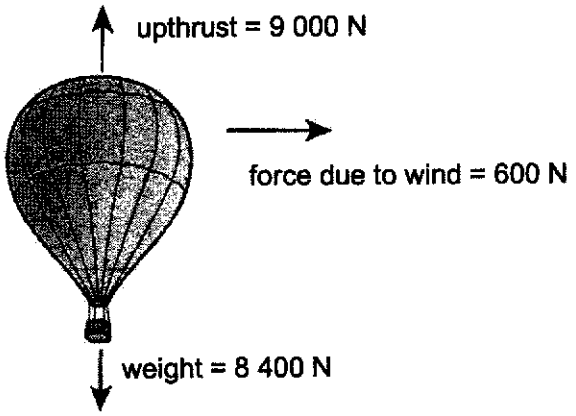
A The car is accelerating.

B The car's displacement is increasing at a constant rate.

C The car is slowing down.

D The car is travelling at a constant speed.

6 A hot-air balloon is acted upon by three forces as shown in the diagram. The three forces are its weight, the upthrust and the force due to the wind. The diagram is not drawn to scale.



What is the resultant force acting on the hot-air balloon?

A 346 N

B 600 N, vertically upward

C 849 N

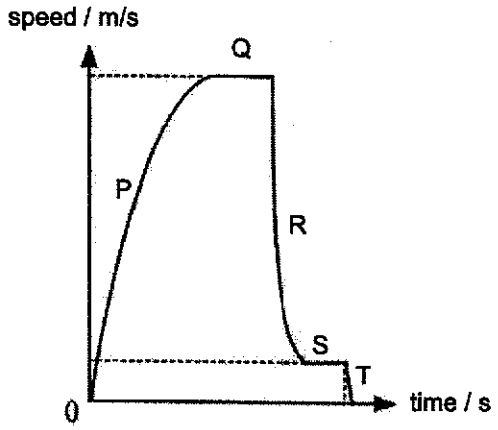
D 849 N, diagonally upward to the right

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7 The following shows the motion of a parachutist from the time she jumps out of an airplane to the time she lands.



In which part of the motion are the forces acting on her balanced?

A P and Q

B Q and R

C Q and S

D R and T

8 Aluminium is less dense than iron.

Which of the following statements is true about aluminium and iron?

A 1.0 kg of aluminium has a greater volume than 1.0 kg of iron.

B 1.0 kg of aluminium has a smaller volume than 1.0 kg of iron.

C 1.0 kg of aluminium has the same volume as 1.0 kg of iron.

D 1.0 kg of aluminium weighs more than 1.0 kg of iron.

9 Which of the following affects the inertia of a body?

A mass

B speed

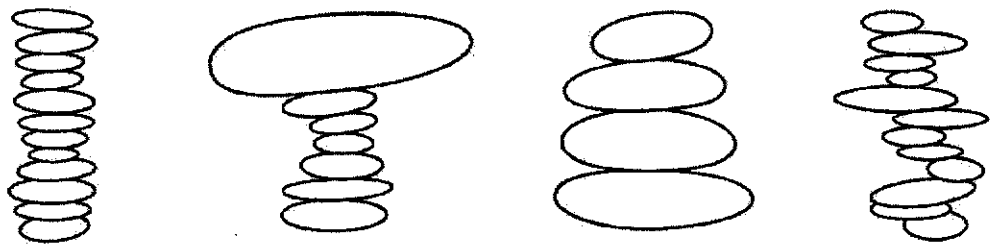
C volume

D weight

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10 Which of the following arrangements of stones is the most stable?



A B C D

11 One watt is

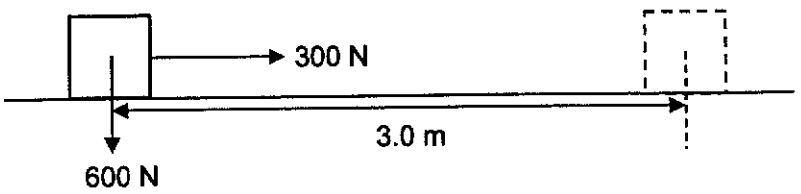
A the rate of converting 1 J of energy.

B the rate of converting 1 W of energy.

C doing 1 W of work.

D doing 1 J of work.

12 When a 300 N force is applied to a box weighing 600 N, the box moves 3.0 m horizontally in 20 s.



What is the average power?

A 45 W

B 90 W

C 900 W

D 1800 W

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13 A sealed container with a fixed volume contains carbon dioxide gas.

What will happen to the carbon dioxide molecules when the gas is heated?

A They will become denser.

B They will expand.

C They will move further apart.

D They will move more quickly.

14 When a metal block is heated, which of the following does not change?

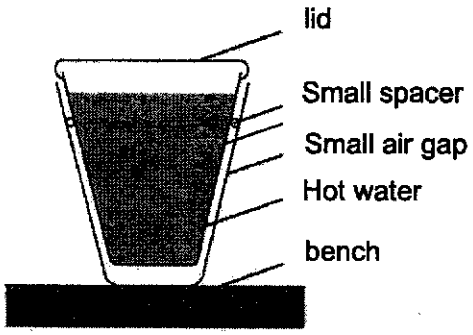
A density

B mass

C volume

D surface area

15 Two Styrofoam cups are stacked together. Hot water is poured into the inner cup and a lid is placed on top as shown in the diagram.



Which of the following statements is correct?

A Heat loss by radiation is prevented by the small air gap.

B No heat passes through the sides of either cup.

C The bench is heated by convection from the bottom of the outer cup.

D The lid reduces heat loss by convection.

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16 During a marathon race, the temperature of a runner's body increases and he perspires. At the end of the race, he covers himself with a shiny foil blanket to prevent himself from cooling too quickly.



How does the perspiration and blanket help the runner to regulate his body temperature?

	sweat	shiny surface of blanket
A	gains heat from his skin to evaporate	reflects heat back to the runner's body
B	gains heat from his skin to evaporate	absorbs heat from the surrounding
C	loses heat to his skin to condense	reflects heat back to the runner's body
D	loses heat to his skin to condense	absorbs heat from the surrounding

17 When a metal spoon and a plastic spoon are placed on a table in a room, the metal spoon feels colder when touched.

Which of the following is most likely the reason?

A Metal spoon is a good reflector of heat.

B Metal spoon is a good emitter of heat.

C Metal spoon is a good conductor of heat.

D Metal spoon is a good insulator of heat.

18 Water vapour loses thermal energy when it condenses into liquid.

Which of the following is true about the water molecules during condensation?

A The speed of the molecules decreases.

B The distance between the molecules decreases.

C The intermolecular forces decrease.

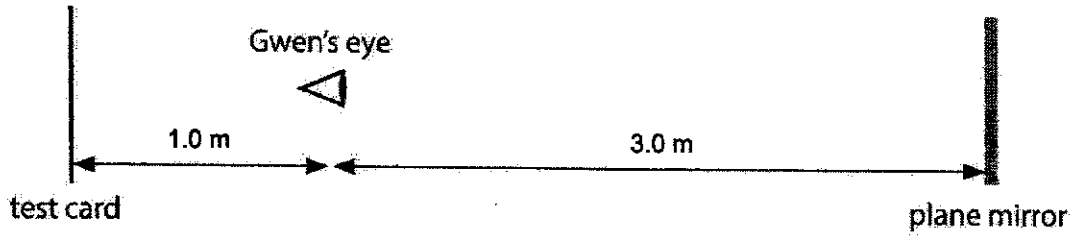
D The kinetic energy of the molecules decreases.

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19 The diagram shows Gwen having her eyes tested. A test card with letters on it is placed behind her and she sees the image of the card in a plane mirror.



The distance from Gwen's eyes to the image of the card is

A 3.0 m

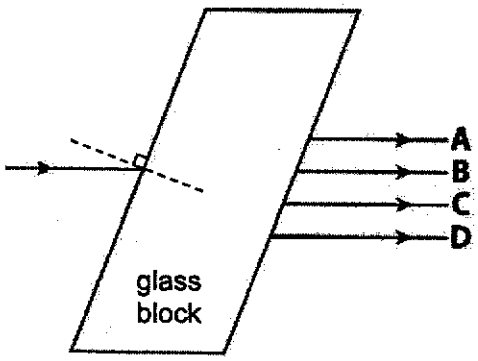
B 6.0 m

C 7.0 m

D 8.0 m

20 A monochromatic light ray travels from air and strikes a parallelogrammical glass block as shown in the diagram.

Which ray, **A**, **B**, **C** or **D**, can possibly be the emergent ray?



END OF PAPER

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SCIENCE (PHYSICS) 5076/02

Paper 2 **10 October 2019**

Secondary 3 Express **1 hour 15 minutes**

Setter: Mr Lau Hui Cheng **65 Marks**

Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagram, graphs or rough working.
Do not use staples, paper clips, highlighters, 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.

Section B
Answer only **two** questions.

For Examiner's Use	
Section A	45
Section B	20
Total	65

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

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Section A (45 marks)

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

1 Fig. 1.1 illustrates the arrangement of the molecules of a substance in its solid, liquid and gaseous states.

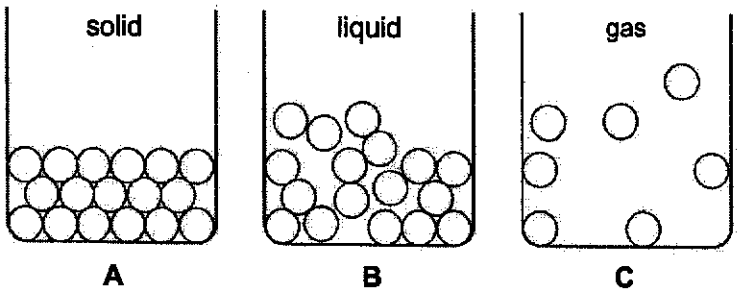


Fig. 1.1

(a) State which arrangement **A**, **B** or **C** contains molecules with the most kinetic energy.

..... [1]

(b) Explain, using kinetic model of matter, why gases are easier to compress than liquids.

.....

..... [1]

(c) Fig. 1.2 shows the heating curve (Region **A** to **E**) of a substance.

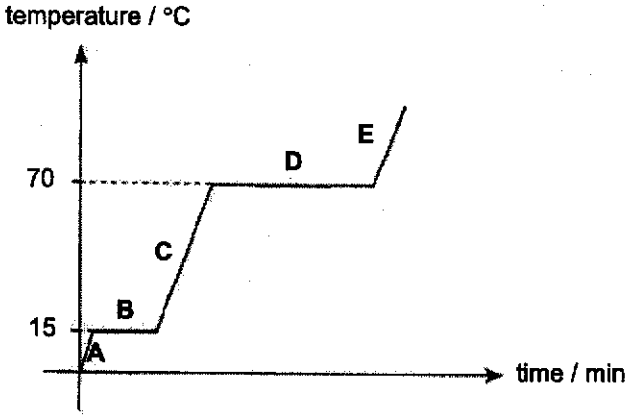


Fig. 1.2

(i) State the region at which the substance is boiling.

..... [1]

(ii) State the regions that show an increase in kinetic energy.

..... [1]

(iii) State one difference between boiling and evaporation.

..... [1]

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2 Ships entering the Anchorage (Port water of Singapore) must switch off their engine and be towed by tugboats using tow ropes.

Fig. 2.1 shows a container ship being towed by two tugboats using tow ropes. The tension on the tow ropes are 1.5×10^5 N respectively.

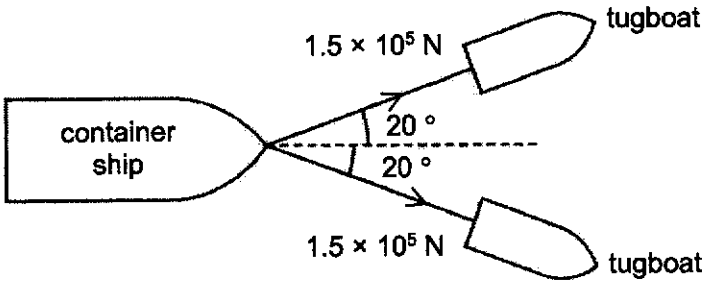


Fig. 2.1

(a) By drawing a scale diagram, find the resultant of the two forces exerted by the two tugboats. State the scale that you use.

scale = ... [1]

resultant force = ... N [3]

(b) The engine of the two tugboats are subsequently switched off and the tow ropes are released. However, the ship continues to move a distance before stopping.

Explain why the ship continues to move over a distance.

.....

.....

..... [2]

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3 A falling metal hammer is used to drive a hollow steel post into the ground, as shown in Fig. 3.1. The hammer is lifted by an electric motor and then falls freely to hit the base plate. The metal hammer has a mass of 2500 kg and it hits the base plate with a speed of 9.6 m/s. The gravitational field strength of Earth is 10 N/kg.

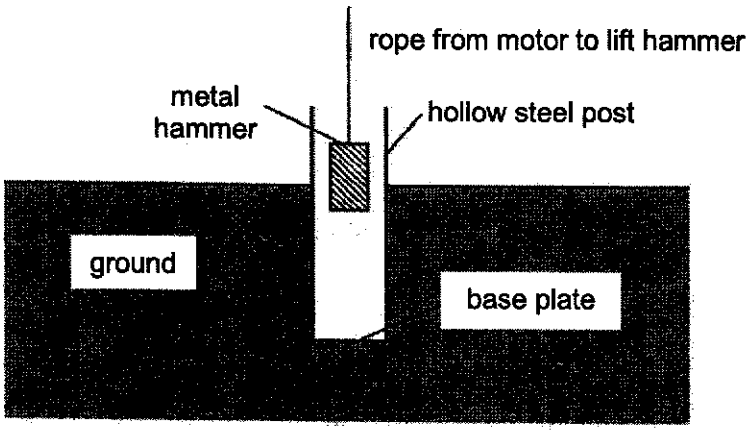


Fig. 3.1

(a) State the principle of conservation of energy.

.....

.....

..... [2]

(b) Calculate the kinetic energy of the hammer as it hits the base plate.

kinetic energy = ... J [2]

(c) Hence, calculate the height of the hammer above the base plate from which it is dropped.

height = ... m [2]

(d) State the assumption you have made to obtain your answer in part **(c)**.

.....

.....

..... [1]

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(e) The base plate penetrated 5.0 cm into the ground after it was hit by the hammer. If we assume that the frictional force *F* is constant (between the ground and the base plate) and that total energy lost is 10000 J, calculate the value of *F*.

frictional force *F* = ... N [2]

4 Fig. 4.1 shows a stool that is unstable with point P in contact with the ground. Point C is the centre of gravity of the stool.

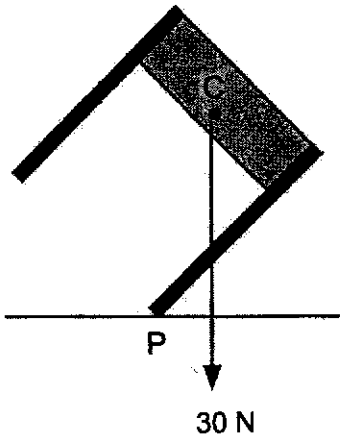


Fig. 4.1

(a) Define centre of gravity.

.....

..... [1]

(b) Explain why the stool in Fig. 4.1 is unstable.

.....

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(c) The stool is now balanced by a horizontal force *F* as shown in Fig. 4.2.

Calculate the force *F*.

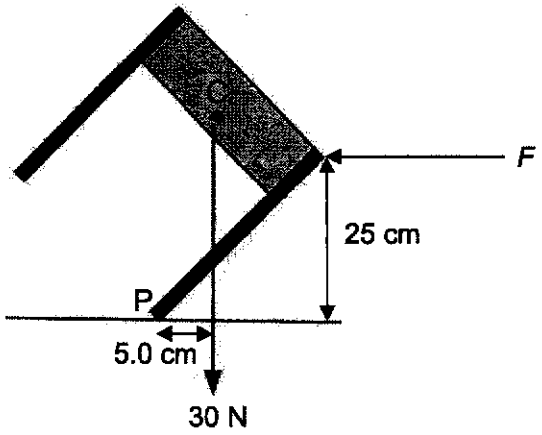


Fig. 4.2

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

5 Fig. 5.1 shows an experiment where a block of stone is measured using a spring balance and a beam balance on Earth. The Earth's gravitational field strength is 10 N/kg.

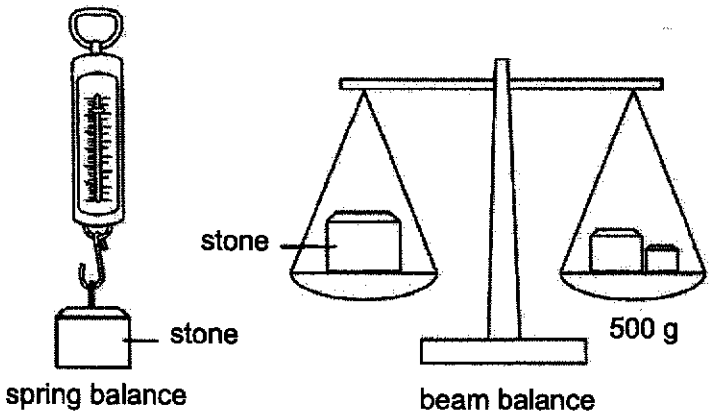


Fig. 5.1

(a) State the readings on the spring balance and the beam balance.

reading on spring balance = ... N [1]

reading on beam balance = ... kg [1]

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(b) This experiment is repeated on the Moon where g = 1.6 N/kg.

State the readings on the spring balance and the beam balance.

reading on spring balance = ... N [1]

reading on beam balance = ... kg [1]

6 A student conducts an experiment to find the density of a small wooden cube. He does so by placing one such cube into a measuring cylinder containing water and taking several measurements. The data he obtains is summarised in the Fig. 6.1 below.
(Density of water = 1.0 g/cm^3)

mass of cylinder with water	125 g
mass of cylinder with water and a cube	135 g
volume of water	50.0 cm^3
volume of water and a cube	65.0 cm^3

Fig. 6.1

(a) Based on the data in Fig. 6.1, calculate the density of a wooden cube in g/cm^3.

density = ... g/cm^3 [2]

(b) Explain why the result in **(a)** does not show the correct density of the wooden cube.

.....

.....

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.....

..... [2]

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7 **(a)** A small table of mass 4.0 kg stands on four legs.
The base of each leg is a square of side 3.2 cm.

Calculate the pressure, in Pa, exerted by the table on the floor.

pressure = ... Pa [2]

(b) A U-tube is first filled with liquid **A** and then with liquid **B** in the right side of the tube as shown in Fig. 7.1.

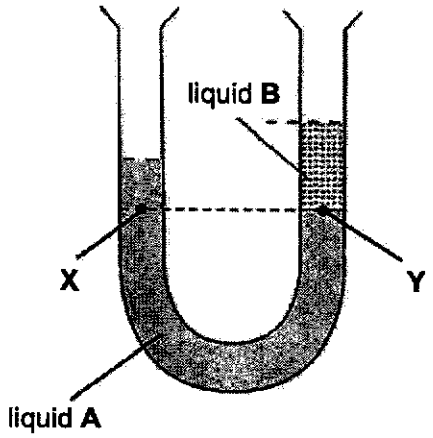


Fig. 7.1

The cross-sectional area of the U-tube is 3.0 cm^2. Point **X** and **Y** are at the same horizontal level. The pressure at point **X** and point **Y** are the same.

Explain whether liquid **A** has a larger or smaller density than liquid **B**. You may support your explanation with working.

.....

.....

.....

.....

..... [3]

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8 Fig. 8.1 shows the path of a light ray through part of an optical fibre. The core has a refractive index of 1.8.

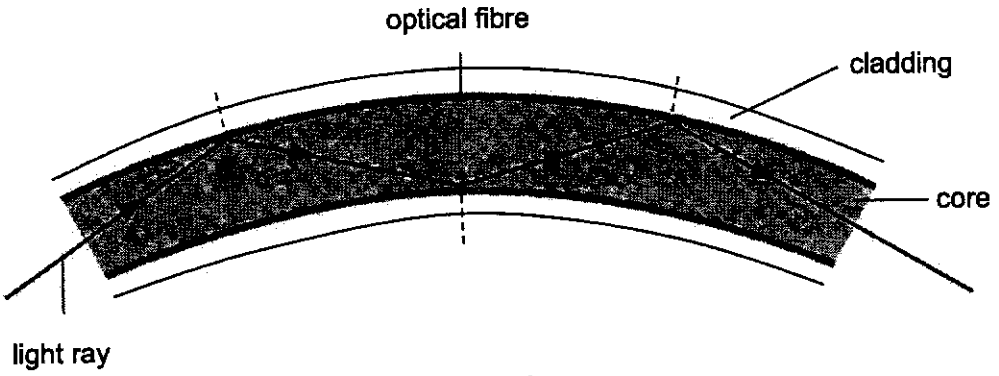


Fig. 8.1

(a) Determine the critical angle of the core.

critical angle = ... ° [2]

(b) Determine the speed of light ray inside the optical fibre.

speed of light = ... m/s [2]

(c) Name the phenomenon as shown by the path of the light ray in Fig. 8.1.

..... [1]

(d) What can you deduce about the material used for the cladding and the angle α, β and γ in order for the phenomenon in **(c)** to occur?

.....

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..... [2]

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Section B (20 marks)

Answer any **two** questions in this section.

Write your answers in the spaces provided.

9 A loaded lorry has a mass of 9000 kg. The graph in Fig. 9.1 shows how the speed of the lorry varied with time during part of a journey.

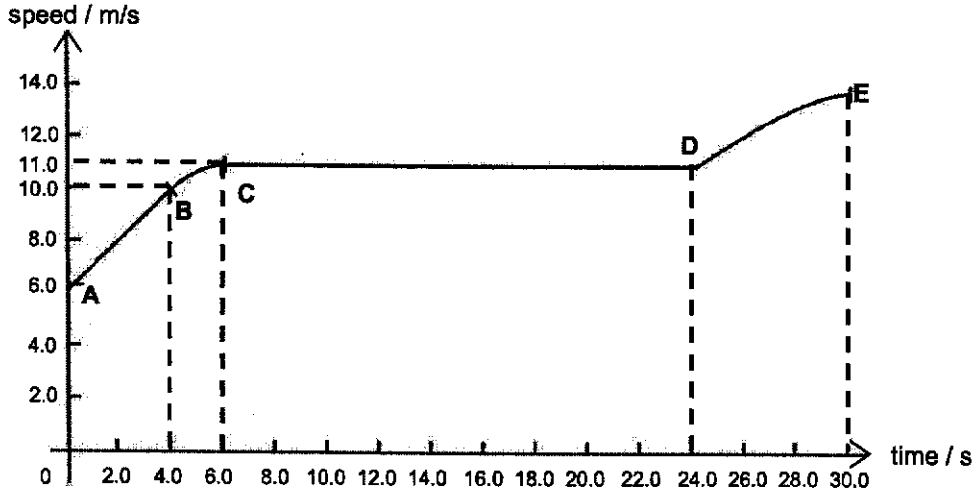


Fig. 9.1

(a) From **A** to **B**, the lorry was accelerating along a straight road. Use the graph to calculate

(i) the acceleration during the first 4.0 s,

acceleration = ... [2]

(ii) the resultant force acting on the lorry during the first 4.0 s.

resultant force = ... [2]

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(iii) the distance travelled during the first 4.0 s.

distance = ... [2]

(iv) the average velocity of the lorry during the first 4.0 s.

average velocity = ... [2]

(b) Describe the motion of the lorry for the following sections of the graph in Fig. 9.1:

(i) section **C** to **D**,

.....

..... [1]

(ii) section **D** to **E**.

.....

..... [1]

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10 (a) There are two common types of thermal flasks. One makes use of foam as the insulating material (Fig. 10.1) and the other uses vacuum (Fig. 10.2).

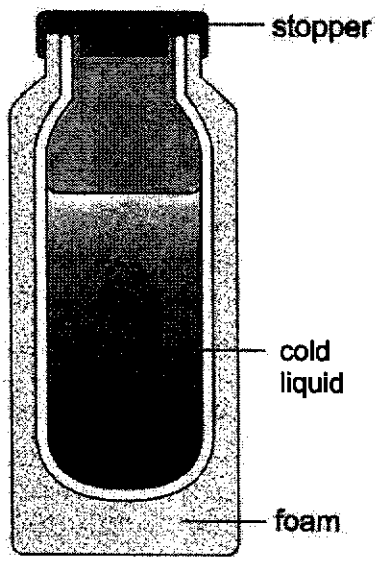


Fig. 10.1

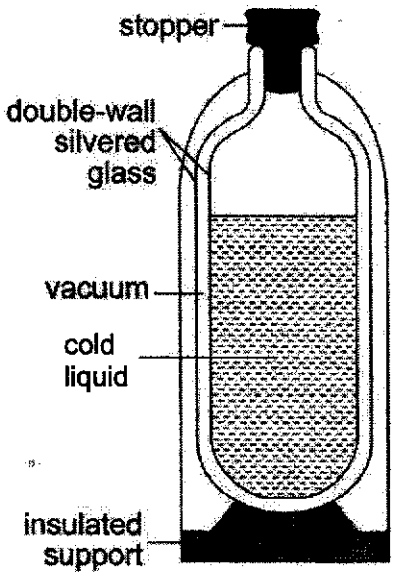


Fig 10.2

(i) Explain how the foam keeps the liquid cold in the thermal flask shown in Fig. 10.1.

.....

.....

.....

..... [2]

(ii) Explain why the vacuum between the double-wall glass of the thermal flask in Fig. 10.2 makes it more effective in keeping the liquid cold as compared to the foam in Fig. 10.1.

.....

.....

.....

..... [2]

(iii) Explain how the silver surface of the double wall glass in Fig. 10.2 helps to keep the liquid cold.

.....

.....

.....

..... [1]

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(b) The liquid is poured into a metal container and heated continuously.

(i) Explain how the entire liquid in the metal container eventually reaches the temperature T_2.

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.....

..... [3]

(ii) The heating curve of the liquid is shown in Fig. 10.3.

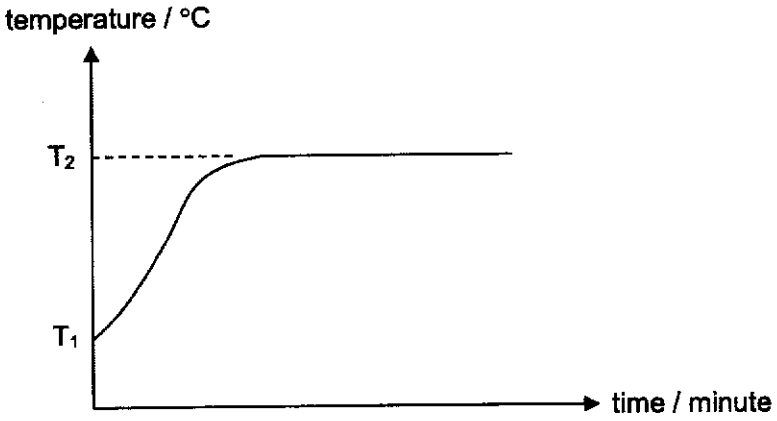


Fig. 10.3

Explain why the temperature remains the same at T_2 even when heat is constantly supplied.

.....

.....

.....

..... [2]

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11 A point object **Y** is placed in front of a plane mirror **PQ** as shown in Fig. 11.1 below.

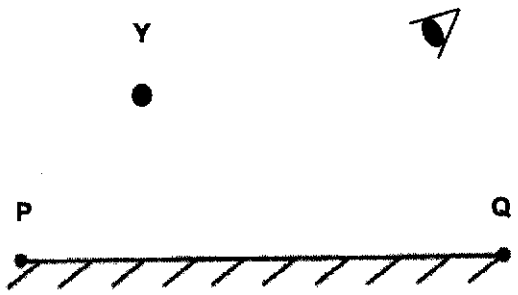


Fig. 11.1

(a) On the Fig. 11.1 above,

(i) Locate and label the image, **I**, of the point object. [1]

(ii) Draw suitable light rays to show how image **I** is formed. [2]

(iii) State one property of the image formed by the plane mirror.

.....

..... [1]

(b) A ray of red light enters a triangular glass block, as shown in the Fig. 11.2.

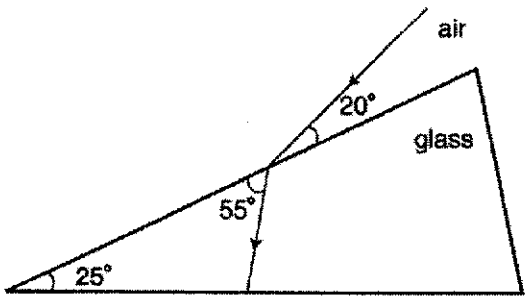


Fig. 11.2

(i) State the angle of incidence and angle of refraction of the light ray.

angle of incidence = ... [1]

angle of refraction = ... [1]

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(ii) Calculate the refractive index of the glass block.

refractive index = ... [2]

(iii) A light ray is incident on a semi-circular glass block at point **X**. The point **O** is the mid-point between point **A** and **B**.

Complete the ray diagram to show the path of the light ray through and out of the semi-circular glass block. [2]

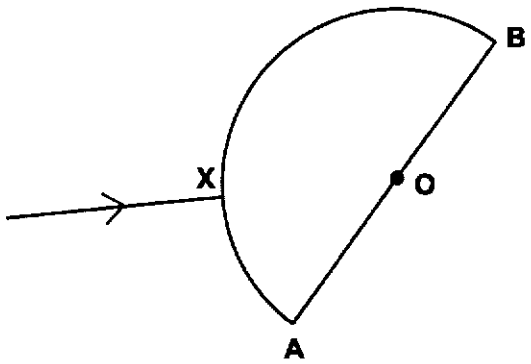


Fig. 11.3

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Answer Scheme for Sec 3 Exp Sc(Phy) EOY Exam 2019

Paper 1 (20 marks)

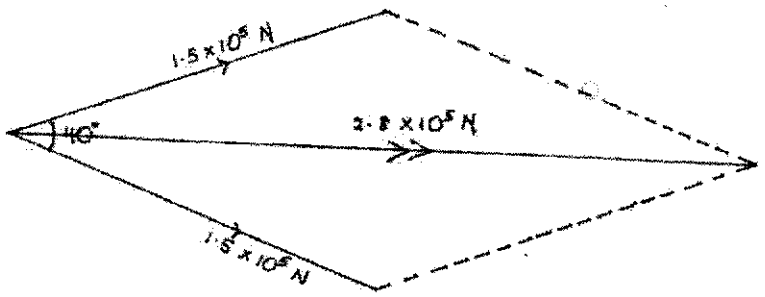
1	2	3	4	5	6	7	8	9	10
B	D	A	D	C	D	C	A	A	C

11	12	13	14	15	16	17	18	19	20
A	A	D	B	D	A	C	B	C	C

Paper 2 - Section A (45 marks)

Qn No		Answers	Mks
1	(a)	Arrangement **C** [B1]	[1]
	(b)	Gases are easier to compress because the molecules are <u>very far apart</u> [B1] from one another.	[1]
	(c)(i)	D [B1]	[1]
	(c)(ii)	A, C and E [B1]	[1]
	(c)(iii)	Any one of the following: [B1]	[1]

Boiling	Evaporation
Occurs at a particular temperature	Occurs at any temperature
Relatively fast	Relatively slow
Takes place throughout the liquid	Takes place only at the liquid surface
Bubbles are formed in the liquid	No bubbles are formed in the liquid
Temperature remains constant	Temperature may change
External thermal energy source needed	External thermal energy source not needed

2		 [1] – Labelling of the 2 pulling forces and angle between them. [1] – Correct drawing of the 2 pulling forces with arrows, resultant force	[4]

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		with double arrow and 2 dotted lines. Scale = 1 : 20 000 N [1] Resultant force = 2.8×10^5 N (280000 N) [1]	
	(b)	The mass of the ship cause the ship to have a high inertia [B1] and hence though the tugboats stops pulling, the ship is reluctant to change its state of motion due to its inertia. [B1]	[2]
3	(a)	The principle of conservation of energy states that energy cannot be created or destroyed. [B1] Energy cah only be converted/changed/transformed from one form to another. The total energy of the system remains constant. [B1]	[2]
	(b)	KE = ½ mv^2 = ½ (2 500)(9.6^2) [M1] = 115000 J (3 sf) or 120000 J (2 sf) [A1]	[2]
	(c)	115 200 = mgh 115 200 = (2 500)(10)(h) [M1] (ecf) h = 4.61 m (3 sf) or 4.6 m (2 sf) [A1]	[2]
	(d)	All the initial gravitational potential energy of the hammer lost has been converted to the final kinetic energy gained by the hammer [B1] when it hits the base plate. (or no energy is lost to the surrounding)	[1]
	(e)	Input = output Work done by gravity = work done in penetrating + work done against friction 115000 = F × 0.05 + 10000 [M1] (ecf) F = 2100000 N [A1]	[2]
4	(a)	Centre of gravity is defined as a point through which the whole weight of an object appears to act. [B1]	[1]
	(b)	• The stool is unstable because the line of action of its weight lies outside the base area of the table. [B1] • This results in a clockwise moment about the pivot P due to the weight of the stool causing the stool to topple over. [B1] (Award 1 mark if only "weight" is mentioned instead of "line of action of weight".)	[2]
	(c)	SAM = SCM F × 0.25 = 30 × 0.05 [M1] F = 6.0 N [A1]	[2]
5	(a)	Reading on spring balance = 5.0 N [B1] Reading on beam balance = 0.50 kg [B1]	[2]
	(b)	Reading on spring balance = 0.80 N [B1] (ecf from (a)) Reading on beam balance = 0.50 kg [B1] (ecf from (a))	[2]

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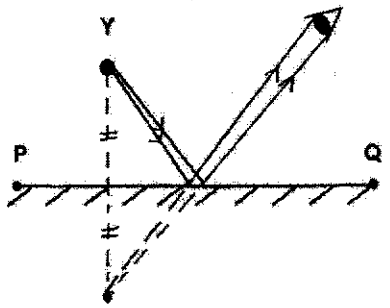
6	(a)	Density = mass / volume = (135 – 125) / (65.0 – 50.0) [M1] = 0.667 g/cm^3 (3 sf) or 0.67 g/cm^3 (2 sf) [A1]	[2]
	(b)	• Since the density of each cube is less than the density of water, the cube is not fully submerged. [B1] • Thus the increase in volume does not show the actual volume of the wooden cube. [B1]	[2]
7	(a)	$P = F / A$ = (4.0)(10) / (4)(0.032)(0.032) [M1] = 9.77×10^3 Pa (3 sf) or 9.8×10^3 Pa (2sf) [A1]	[2]
	(b)	$P_x = P_y$ $F_x / A = F_y / A$ } [B1] $F_x = F_y$ $m_A g = m_B g$ } [B1] $m_A = m_B$ $d_A v_A = d_B v_B$ Since $v_B > v_A$, $d_A > d_B$. } [B1] Therefore, liquid A has a larger density than B.	[3]
8	(a)	Critical angle $c = \sin^{-1}(1 / n)$ $= \sin^{-1}(1 / 1.8)$ [M1] = 33.7° [A1]	[2]
	(b)	$n = c / v$ Speed of light ray = v = c / n = $3.0 \times 10^8 / 1.8$ [M1] = 1.67×10^8 m/s (2 or 3 sf) [A1]	[2]
	(c)	Total internal reflection [B1]	[1]
	(b)	• The cladding has a lower optical density than the core. [B1] • The angles α, β and γ must be greater than the critical angle of 33.7°. [B1]	[2]

Paper 2 - Section B (20 marks)

Qn No		Answers	
9	(a)(i)	acceleration = (v – u) / t = (10 – 6.0) / 4.0 [M0] = 1.0 m/s^2 [A1]	[2]
	(a)(ii)	$F_R = ma$ = (9000)(1.0) [M0] = 9000 N [A1]	[2]

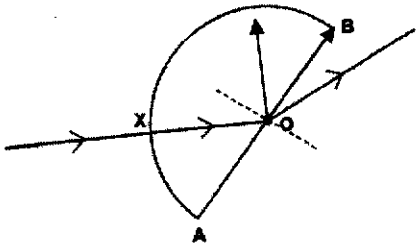
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	(a)(iii)	Distance = ½ × (6 + 10) × 4.0 [M1] = 32 m [A1]	[2]
	(a)(iv)	Average velocity = 32 / 4.0 [M1] = 8.0 m/s [A1]	[2]
	(b)(i)	From C to D, the lorry is travelling at constant speed.	[1]
	(b)(ii)	From D to E, the lorry is travelling with decreasing acceleration.	[1]
10	(a)(i)	• Foam reduces heat gain by conduction [A1] since it is a poor conductor of heat. [M1] OR • Air trapped in the tiny pockets of the foam reduces heat gain by conduction [A1] since air is a poor conductor of heat. [M1]	[2]
	(a)(ii)	Heat transfer by conduction and convection requires a medium. [B1] Vacuum has no medium and hence heat transfer by conduction and convection is prevented by the vacuum. [B1]	[2]
	(a)(iii)	The silvered surface is a poor absorber of infrared radiation / heat and thus heat gain from surroundings due to radiation is reduced. [B1]	[1]
	(b)(i)	• The liquid at the bottom of the metal container is heated up, expands, become less dense and rises. [B1] • Cold water at the top is denser and sinks to take its place. [B1] • As a result, the cycle of rising and sinking repeats to create a convection current that eventually heat up the liquid till temperature T_2. [B1]	[3]
	(b)(ii)	During boiling at temperature T_2, the heat supplied is used to break the molecular bonds of attraction (or overcome the intermolecular forces of attraction). [B1] Since the average kinetic energy of the molecules remains constant, there is no change in temperature. [B1]	[2]
11	(a)(i)	 Image I with equidistant dotted lines – [B1]	[1]
	(a)(ii)	Each correct light ray from Point Y to the eye – [B1]	[2]
	(a)(iii)	Any of the following is accepted: [B1] • The image is upright.	[1]

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		• The image is of the same size as the object. • The image is laterally inverted. • The image is virtual. • The distance from mirror to the image is equal to the distance from the mirror to the object.	
	(b)(i)	Angle of incidence = 70° [A1] Angle of refraction = 35° [A1]	[2]
	(b)(ii)	n = sin i / sin r = sin 70 / sin 35 [M1] = 1.64 (2 or 3 sf) [A1]	[2]
	(b)(iii)	 • 1st correct ray into glass block – [B1] • 2nd correct ray: (3 possible answers) [B1] (a) total internal reflection (b) along glass block (c) out of glass block	[2]

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