KUO CHUAN PRESBYTERIAN SECONDARY SCHOOL
2019 END OF YEAR EXAMINATION

Secondary 3 Express

NAME _____

CLASS _____ **REG. NO** _____

PHYSICS 6091

9 October 2019
2 hours

Candidates answer on the Question Paper.

Additional Materials: Multiple Choice Answer Sheet

Setter: Mr. Yap Shinn

READ THESE INSTRUCTIONS FIRST

Section A
Answer **all** questions
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions in Section A. 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.

Section B
Answer **all** questions
Write your class, index number and name on the work you hand in.
Write in dark blue pen or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section C
Answer **all** questions. Question **9** has a choice of parts to answer
Write your answers on the spaces provided in the question papers.

The use of an approved scientific calculator is expected, where appropriate.
In calculations, you should show all the steps in your working, giving your answer at each stage.
The number of marks is given in brackets [ ] at the end of each question or part question.

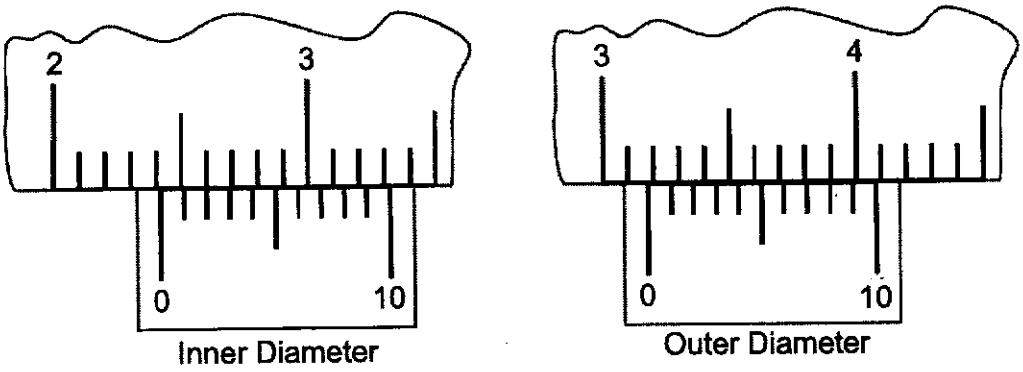
.....
Parent's signature/ Date

FOR EXAMINER'S USE	
Section A	
Section B	
Section C	
Total	

This document consists of **30** printed pages, including the cover page.

Section A (30 marks)

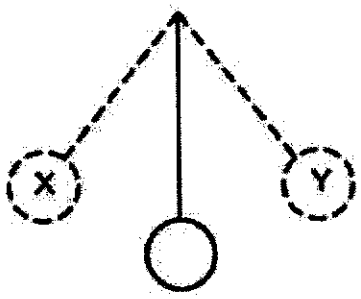
1 A pair of Vernier caliper is used to measure the thickness of the wall of a test tube. The measurement of inner diameter and outer diameter are as shown.



What is the thickness of the test tube?

A 0.77 cm **B** 0.76 cm **C** 0.39 cm **D** 0.38 cm

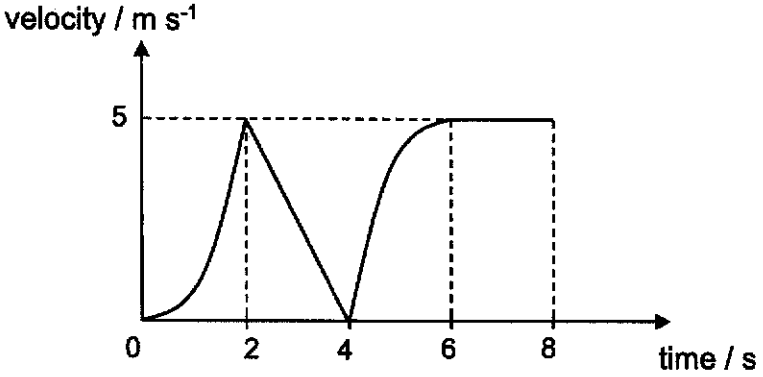
2 A pendulum swings from X to Y and back to X again twenty times in 45.0 s.



What is the period of the pendulum?

A 1.13 s **B** 2.25 s **C** 4.50 s **D** 45.0 s

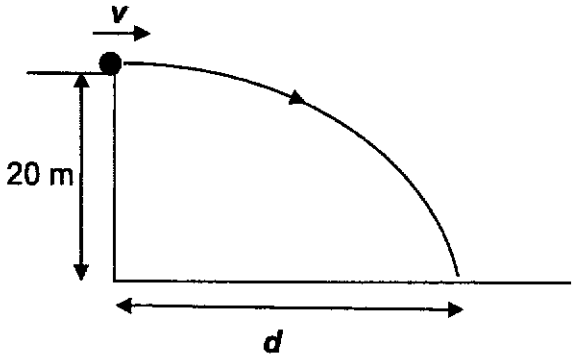
3 The velocity-time graph for a moving object is shown below.



Between which times is the acceleration decreasing?

A 0 s and 2 s **B** 2 s and 4 s **C** 4 s and 6 s **D** 6 s and 8 s

4 The diagram shows the path of a projectile fired with a horizontal velocity ***v*** from a cliff of height 20 m. The projectile lands a distance ***d*** from the base of the cliff.



What should the value of ***v*** be such that ***d*** is maximum?

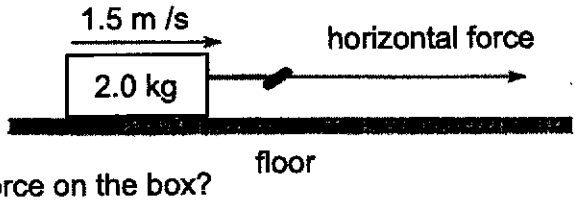
A 10 m/s **B** 15 m/s **C** 20 m/s **D** 25 m/s

5 A bicycle accelerates uniformly from a speed of 2.0 m/s to 10.0 m/s in 6.0 s.

What is its average speed during the journey?

A 5.0 m/s **B** 6.0 m/s **C** 7.0 m/s **D** 8.0 m/s

6 A constant horizontal force is applied to pull a 2.0 kg box across the floor as shown in the diagram below. The box moves at a constant speed of 1.5 m/s. The friction between the box and the floor is 10 N.



What is the resultant force on the box?

A 0 N **B** 3.0 N **C** 7.0 N **D** 10 N

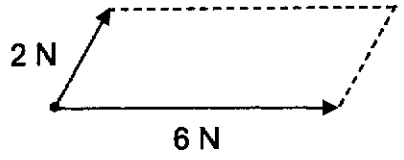
7 A box is resting on a table. How many forces are acting on the box?

A 1 **B** 2 **C** 3 **D** 4

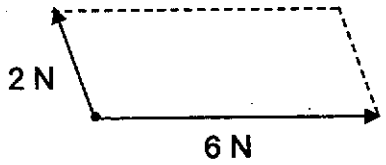
8 Forces of 2 N and 6 N act on a point.

Which diagram shows the forces produces the largest resultant force?

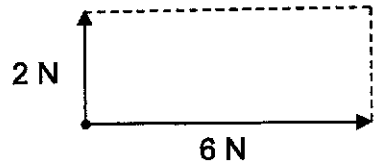
A



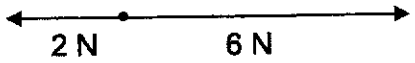
B



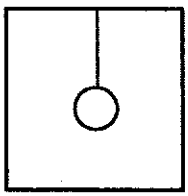
C



D

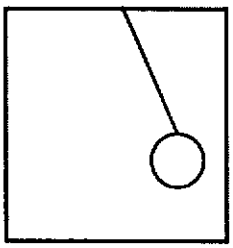


9 Sean hung a ball to the ceiling of his car using a thin thread. The figure below shows the ball when the car is at rest.

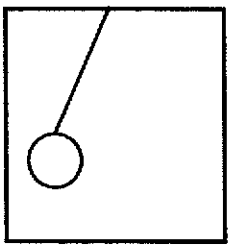


What is the position of the ball when his car starts moving to the right?

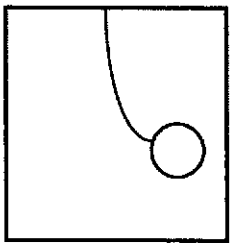
A



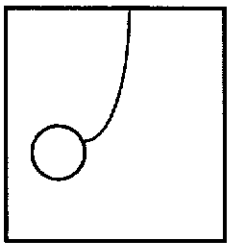
B



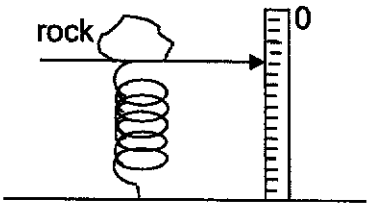
C



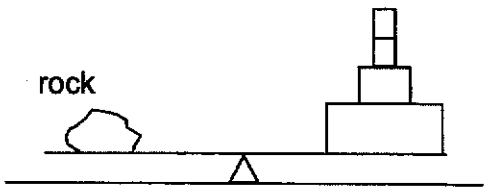
D



10 An astronaut conducted the same experiment as shown below on Earth and on the Moon. He placed the same rock on a spring balance and then on a beam balance. The gravitational field strength of Earth is larger than the Moon.



spring balance



beam balance

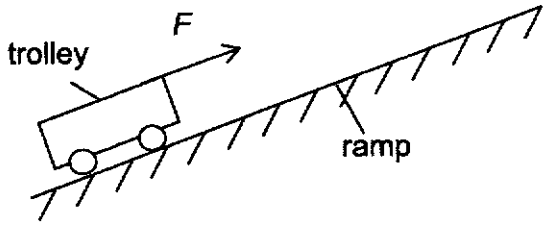
Which of the following options are correct?

	scale reading on spring balance	beam balance reading
A	greater on earth than on moon	more on earth than on moon
B	greater on earth than on moon	same on earth and moon
C	smaller on earth than on moon	more on earth than on moon
D	smaller on earth than on moon	same on earth and moon

11 A car of mass 1200 kg travels a distance of 30 m as it accelerates from rest. What is the kinetic energy gained by the car in 10 s?

A 1800 J **B** 3600 J **C** 5400 J **D** 21600 J

12 A force *F* is used to pull a trolley up a ramp up the slope with constant speed. There is friction on the ramp.



Which quantity is equal to the work done by the force *F*?

A gain in potential energy and kinetic energy of the trolley

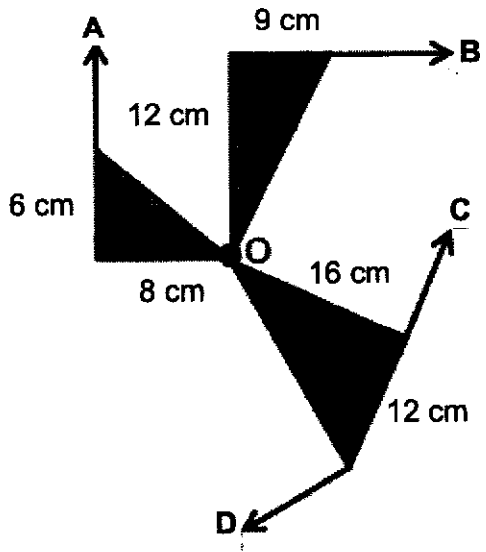
B gain in potential energy of the trolley

C gain in potential energy of the trolley and work done against friction

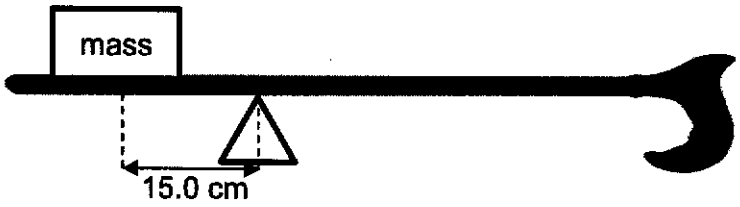
D gain in potential energy, kinetic energy of the trolley and work done against friction

13 A wheel with three arms rotates about O. Four forces A, B, C and D of equal magnitude are directed at different parts of the wheel.

Which force produce the smallest turning effect about O?



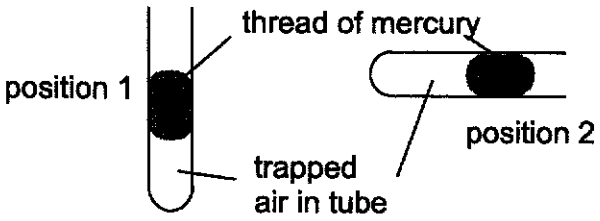
14 A 300 g walking stick is balanced by a 100 g mass placed 15.0 cm from the pivot



How far from the pivot is the centre of gravity of the walking stick?

A 5.0 cm **B** 10.0 cm **C** 15.0 cm **D** 20.0 cm

15 A thin tube in position 1 contains a thread of mercury which traps air at the end of the tube. The other end of the tube is opened to the atmosphere.



When the tube is rotated to position 2, the volume of trapped air changes.

Which statement explains why the volume of trapped air changes?

A The pressure of trapped air becomes zero.

B The pressure of trapped air is lower in position 2 than position 1.

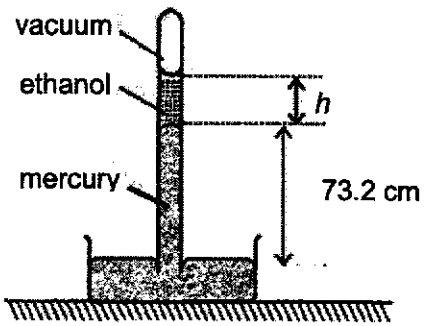
C The pressure of trapped air is higher in position 2 than position 1.

D The pressure of trapped air remains the same.

16 A barometer contains mercury mixed with some ethanol as shown below.

The following data is given:

atmospheric pressure = 76.0 cm Hg
density of ethanol = 790 kg/m^3
density of mercury = 13 600 kg/m^3
gravitational field strength = 10 N/kg



What is *h*?

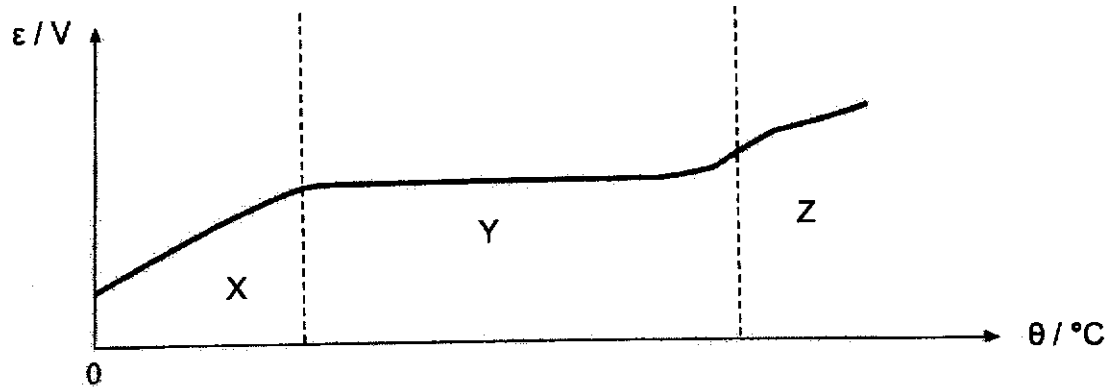
A 2.8 cm **B** 13.1 cm **C** 13.6 cm **D** 48.2 cm

17 A piece of wire has an electrical resistance of 5.0 Ω in 0 °C, and 7.0 Ω in boiling water.

What is the resistance at 20 °C?

A 0.4 Ω **B** 0.5 Ω **C** 5.4 Ω **D** 5.5 Ω

18 A student attempts to build a thermocouple. The figure shows how the e.m.f. of his thermocouple varies with temperature θ. The student wants to use his thermocouple to measure the temperature range indicated in the graph.



Which temperature range is the thermocouple suitable for measuring?

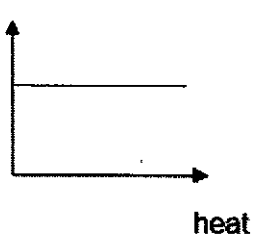
A X and Y **B** X and Z **C** Y and Z **D** X, Y and Z

19 A fixed mass of gas is cooled while kept at constant volume. How do the properties of the molecules of the gas change?

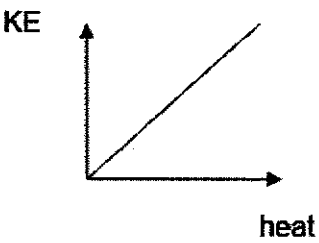
	average speed	frequency of collision with walls	average distance apart
A	decreases	decreases	unchanged
B	decreases	unchanged	decreases
C	unchanged	decreases	decreases
D	unchanged	unchanged	unchanged

20 A crystalline solid at a temperature below its melting point is heated at constant rate to a temperature just before its melting point. Which graph best represents the average internal kinetic energy of the substance as a function of heat energy added?

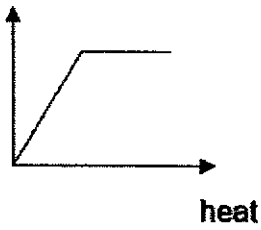
A



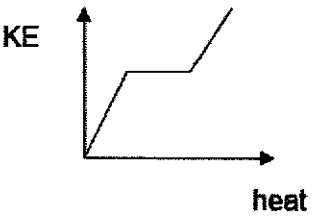
B



C



D



21 When an object is heated, which of the following statement(s) is/are true?

(1) Its internal energy always increases.
(2) Its internal kinetic energy always increases.
(3) Its temperature always rises.

A (1) only **B** (2) only **C** (1) and (2) **D** All of the above

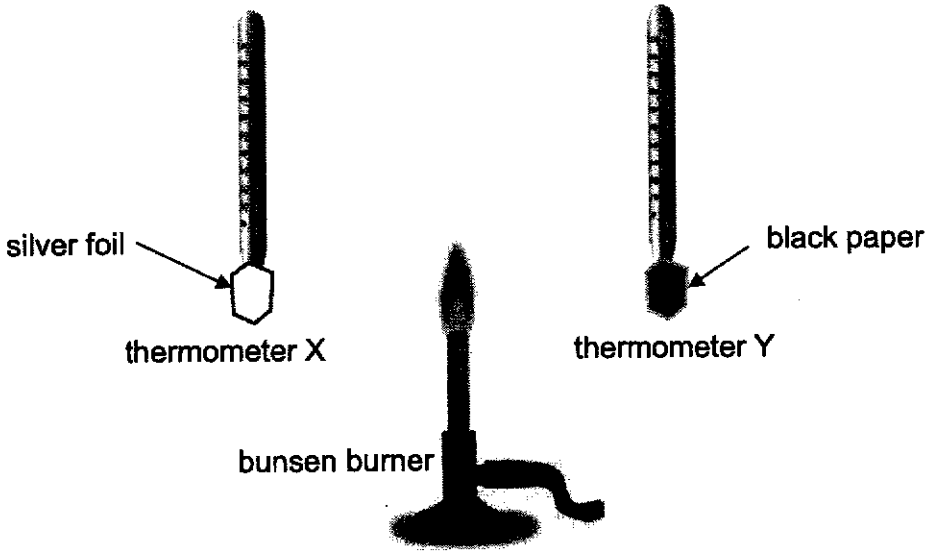
22 A rug is on the tiled floor. Jane has one leg on the rug and the other on the floor.

Which statement(s) correctly explain(s) why the floor feels colder than the rug?

(1) The floor is at a lower temperature than the rug.
(2) The floor is a better conductor of heat than the rug.
(3) The floor has a smaller specific heat capacity than the rug.

A (3) only **B** (1) only **C** (2) and (3) **D** All of the above

23 The diagram below shows two thermometers, X and Y held at the same distance away from a lighted Bunsen burner. The bulb of thermometer X is wrapped with a silver foil while the bulb of thermometer Y is wrapped with a black paper.



Which of the following statements is correct about the temperature rise in the thermometers?

A Temperature in X rises faster because foil is a better conductor of heat.

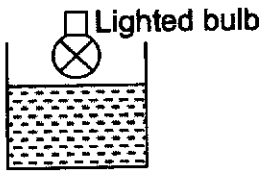
B Temperature in X rises faster because silver foil is a good absorber of infrared radiation.

C Temperature in Y rises faster because black paper is a good absorber of infrared radiation.

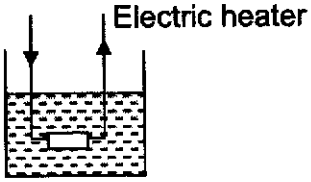
D Temperature in Y rises faster because black paper is a good conductor of heat.

24 Which of the following is convectional currents not formed?

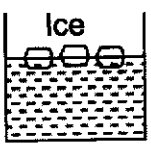
A



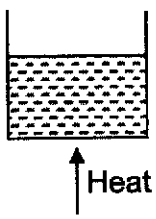
B



C



D



25 When alcohol evaporates rapidly, a cooling effect is produced. This is because

A convection occurs above the alcohol.

B fewer molecules are left behind.

C heat is conducted away from the surface of the alcohol.

D the molecules left behind that not evaporated are less energetic.

26 Water of mass 0.90 kg at 90.0 °C is poured into an insulated metal container of mass 0.50 kg at 20.0 °C. The final temperature of water is 85.0 °C. If the specific heat capacity of water is 4200 J $kg^{-1}K^{-1}$, what is the heat capacity of the metal in J K^{-1}?

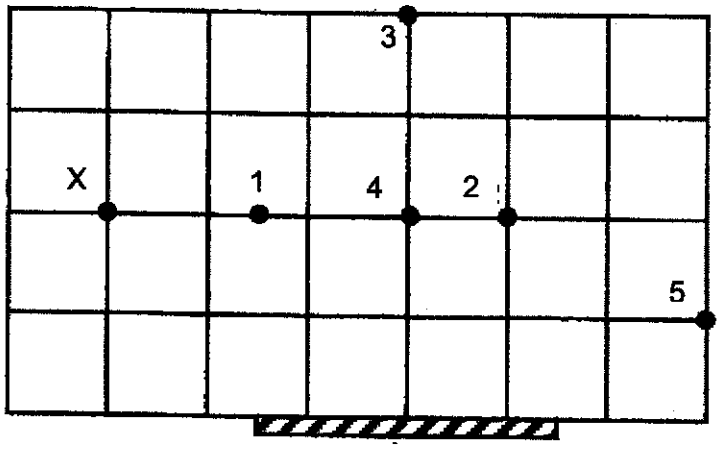
A 179 **B** 270 **C** 291 **D** 582

27 Two different liquids, **P** and **Q** with the same mass and initial temperature, are heated by the same heat source. Liquid **P** reaches a temperature of 70°C faster than liquid **Q**.

Which statement explains why?

A Liquid **P** has a higher specific heat capacity than liquid **Q**.
B Liquid **P** has a higher specific latent heat of vapourisation than liquid **Q**.
C Liquid **P** has a lower specific heat capacity than liquid **Q**.
D Liquid **P** has a lower specific latent heat of vapourisation than liquid **Q**.

28 A person stands at point X as shown in the diagram below.



Which of the pins (1, 2, 3, 4, 5) will the person be able to see in the mirror?

A 1 and 3

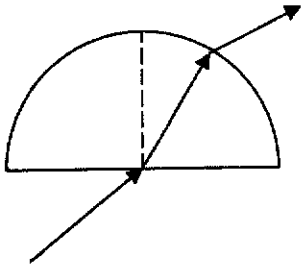
B 2 and 4

C 2, 3 and 5

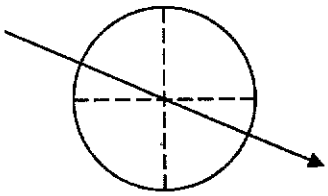
D 2, 4 and 5

29 The diagrams A, B, C and D below show the passage of light through glass blocks. Which diagram is *not* correct?

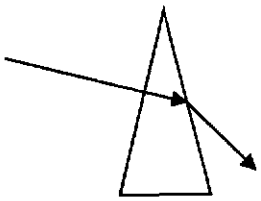
A



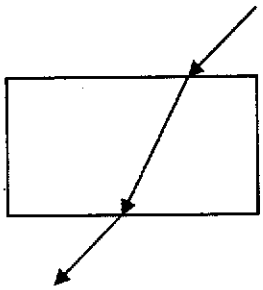
B



C



D



30 Which of the following is not a characteristic of an image formed in a plane mirror?

A Image is laterally inverted.

B Image is real.

C Image is the same size as the object.

D Object distance to mirror is the same as image distance to mirror.

Section B (40 marks)

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

1 A sphere that weighs 10 N on earth rests between two boards 90° apart as shown in Fig. 1.1. The boards are smooth. Each board exerts an equal force F on the sphere and two forces F meet at the centre of the sphere.

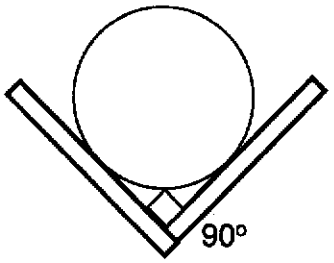


Fig. 1.1

(a) On Fig. 1.1. draw and label all the forces acting on the sphere. [2]

(b) Using a scale diagram, determine the magnitude of F.

scale: .....

F = ... [3]

(c) The sphere is now brought to the moon and placed on the two boards as shown in Fig. 1.1.

(i) Explain how the magnitude of F would change.

.....

.....

..... [1]

(ii) The sphere is taken off the boards and then shaken in a left and right motion. It is noticed that it is as difficult to shake the sphere on the moon as on earth. Explain this observation.

.....

..... [1]

2. A ball is thrown upwards. Fig. 2.1 shows the velocity time graph of the ball in the first 4 s. The ball reaches the maximum height at 2 s before falling back back towards the ground.

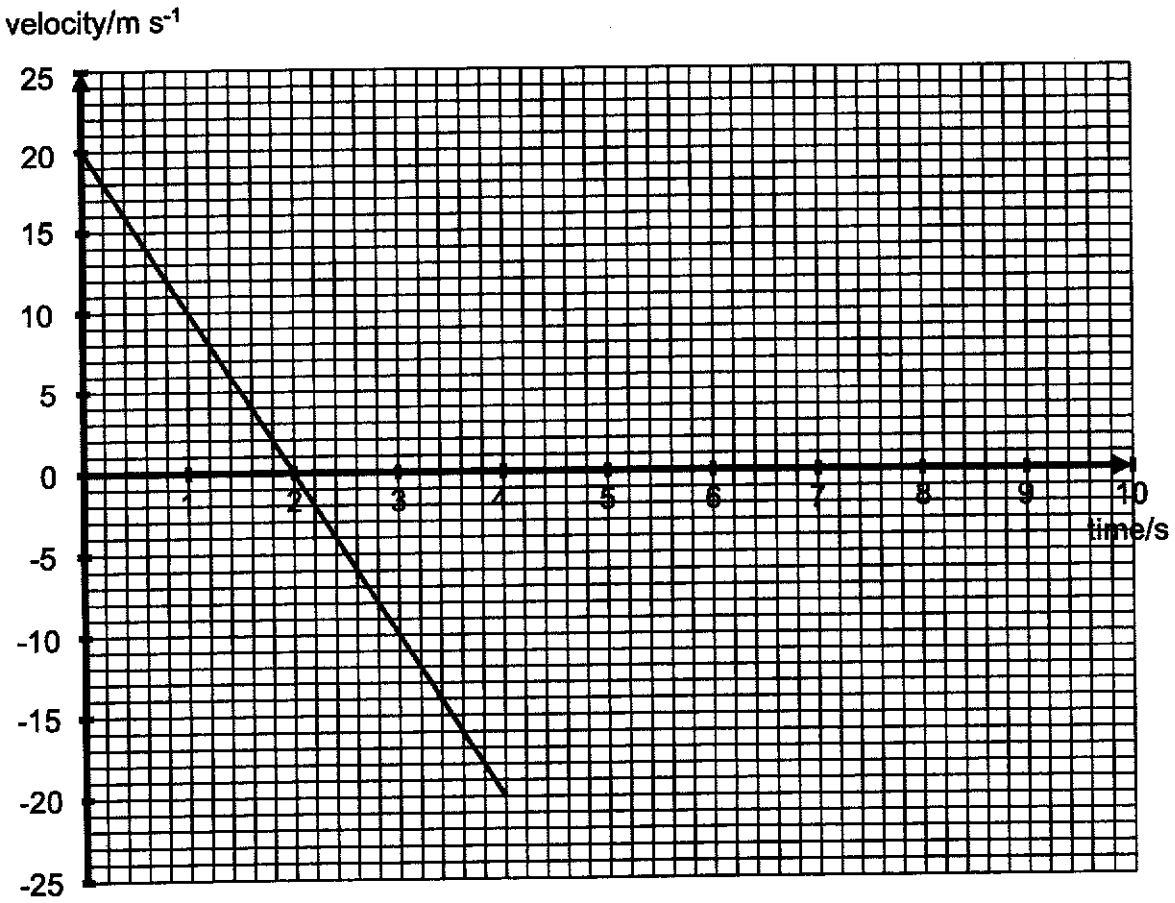


Fig. 2.1

(a) Using Fig. 2.1, determine if air resistance is acting on the ball.

.....

.....

.....

..... [2]

(b) Determine the maximum height reached by the ball.

height = ... [2]

(c) On Fig. 2.2, sketch, with labels, how the displacement of the ball changes for the first 4s.

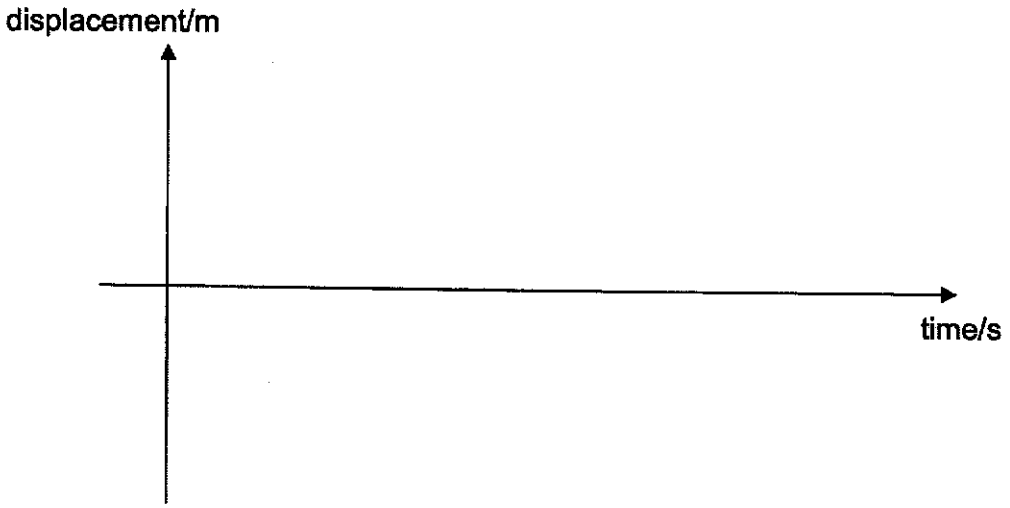


Fig. 2.2 [2]

(d) Explain why the actual height reached by the ball after 4 s is lower than your answer in **(b)**.

.....

.....

.....

..... [2]

3 A simple pendulum of length 1.00 m has a body of mass 0.15 kg. The bob is pulled aside for a horizontal distance of 0.20 m and is then released as shown in Fig. 3.1.

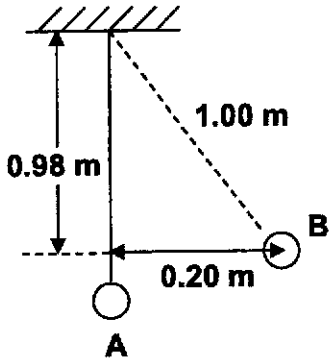


Fig. 3.1

(a) Calculate the change in gravitational potential energy of the bob when it is moved from A to B.

gravitational potential energy = ... [2]

(b) As the bob oscillates, work can be done against air resistance and friction at the pivot. The speed of the bob at A is 0.50 ms^{-1}. Determine if work is done against air resistance and friction at the pivot.

.....

.....

.....

..... [2]

(c) Determine the efficiency of the system.

efficiency = ... [2]

4 Fig. 4.1 below represents a hydraulic braking system in which the effort is applied to a pedal at the end of a lever arm, 2000 mm from a pivot. On the other side of the pivot, 40 mm away, the lever connects to Piston 1 of area 5.0×10^{-5} m^2. Piston 1 transmits pressure through oil to Piston 2 of area 1.0×10^{-4} m^2, which is connected to the brake.

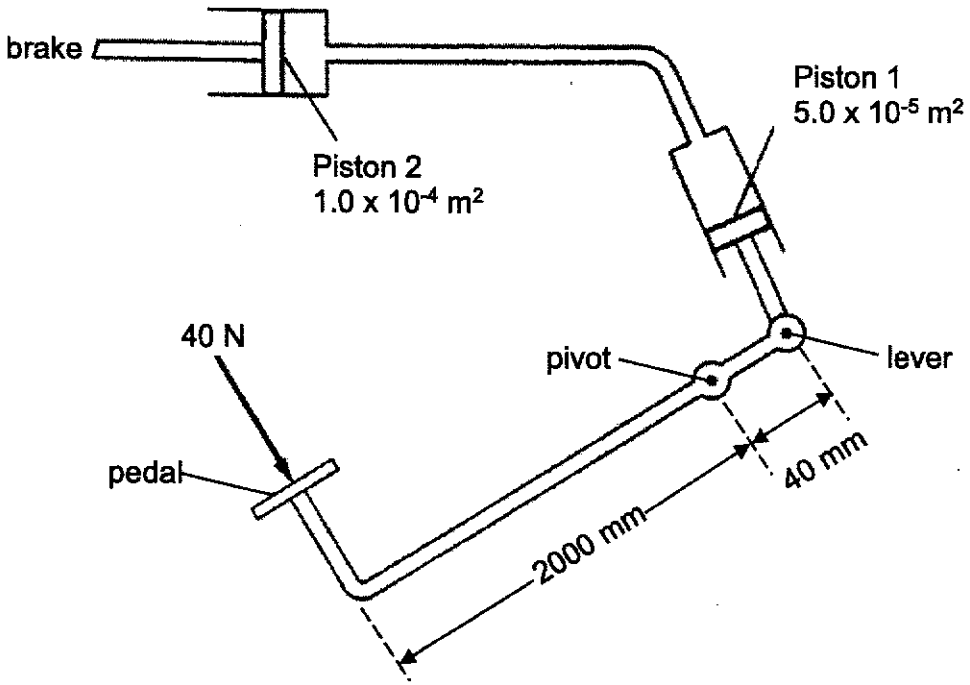


Fig. 4.1

(a) Calculate the force exerted on Piston 1 when 40 N is exerted on the pedal.

force = ... [2]

(b) Calculate the pressure exerted on the oil by Piston 1.

pressure = ... [1]

(c) Hence, determine the force exerted on the brakes by Piston 2.

force = ... [2]

5 In a simple experiment, an aluminum container half-filled with water is heated over a Bunsen burner as shown in Fig. 5.1.

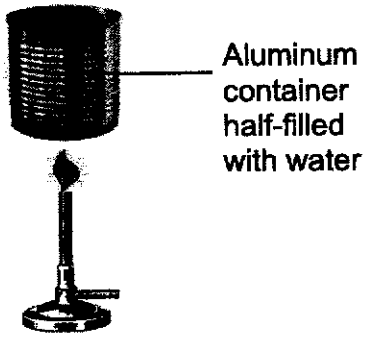


Fig. 5.1

(a) Using the kinetic model of matter, explain why the air pressure in the container increases when the aluminium can is heated.

.....

.....

.....

.....

.....

..... [2]

(b) After some time, the bunsen burner is turned off and ice water is poured over the container. The container becomes crushed.

Explain this observation.

.....

.....

.....

.....

.....

..... [3]

6 A container of negligible specific heat capacity containing 0.50 kg of unknown solid is placed in a an oven rated 70 J/s. Fig. 6.1 shows the temperature against time graph of the solid as it changes to liquid.

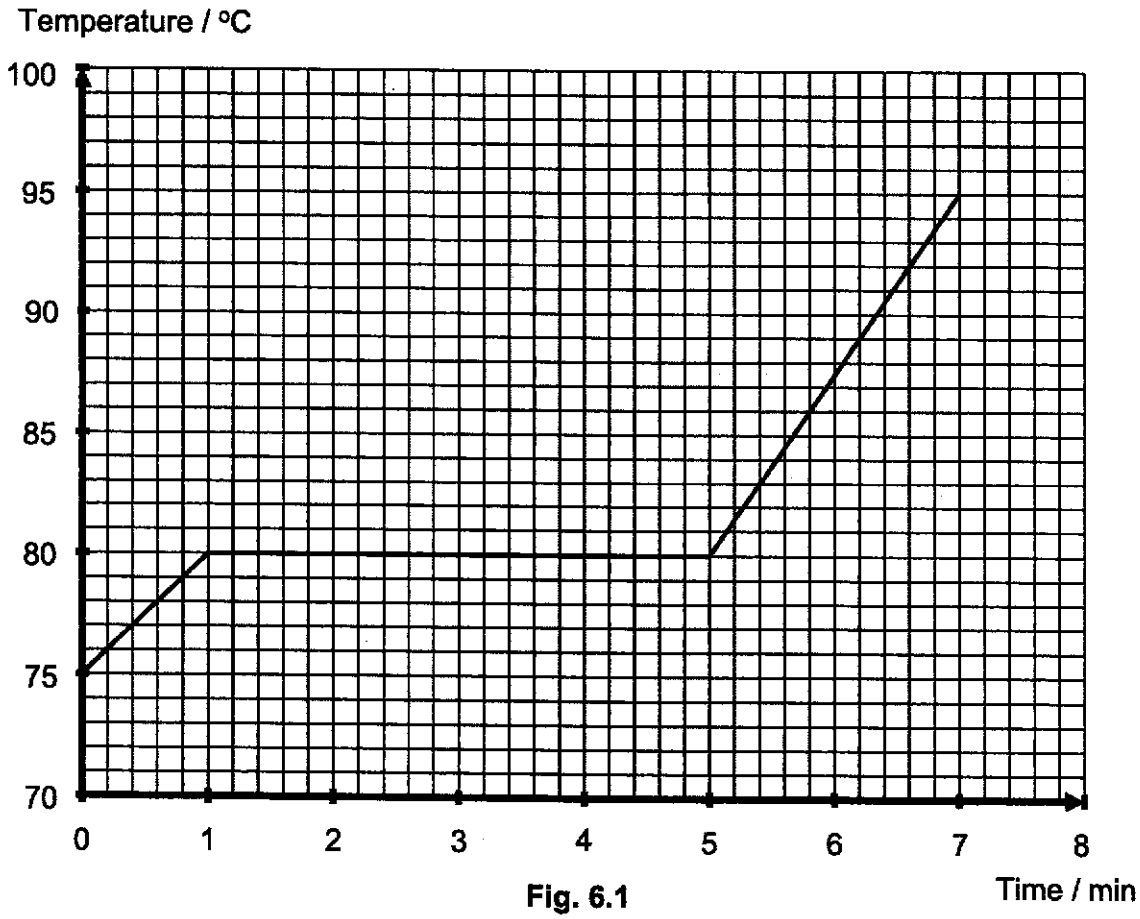


Fig. 6.1

(a) Explain what is meant by *"the specific heat capacity of the container is negligible."*

.....

.....

..... [1]

(b) Explain why the temperature of the substance remains constant between 1 and 5 min.

.....

.....

.....

..... [2]

(c) Using Fig. 6.1, determine the specific latent heat of fusion of the substance.

specific latent heat of fusion = ... [2]

(d) In actual fact, the specific heat capacity of the container is not negligible. Explain how your answer in **(c)** will change.

.....

.....

.....

..... [2]

(e) Using Fig. 6.1, explain why the specific heat capacity of the solid is greater than the specific heat capacity of the liquid.

.....

.....

.....

..... [2]

[Turn over

Section C (30 marks)

Answer **all** questions from this section in the spaces provided.

7 (a) Complete Table 7.1

Table 7.1

thermometer	thermometric property
constant volume gas thermometer	
resistance thermometer	electrical resistance
thermocouple	

[2]

(b) Fig. 7.2 shows a simple household thermometer can be built using a large one-litre bottle, coloured unknown liquid, and a long straw. A hole is drilled in the lid of the bottle and the straw is inserted so that it sticks up above the lid. The straw is glued so that the joint between it and the lid is water-tight.

Fig. 7.2

The following information is given.

Boiling Point of unknown liquid	97.0 °C
Melting Point of unknown liquid	-12.0 °C
Boiling Point of pure water at one atmospheric pressure	100.0 °C
Melting Point of pure water	0 °C
Boiling Point of alcohol	78.0 °C
Melting Point of alcohol	-114.0 °C

(i) List down the steps of how to calibrate this thermometer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(ii) To make the thermometer more responsive, Lois painted the bottle with a silver paint. Do you agree with what Lois did? Explain your answer.

.....

.....

.....

..... [2]

(iii) Besides changing the surface of the bottle, suggest another way to improve the responsiveness of the thermometer.

.....

..... [1]

8 Since personal mobility devices such as e-scooters were allowed on footpaths, cycling paths and park connector networks, there have been more accidents. In many instances, pedestrians were injured. The Straits Times published an article to educate the public on the dangers of PMDs. Fig. 8.1 shows an excerpt of the article.

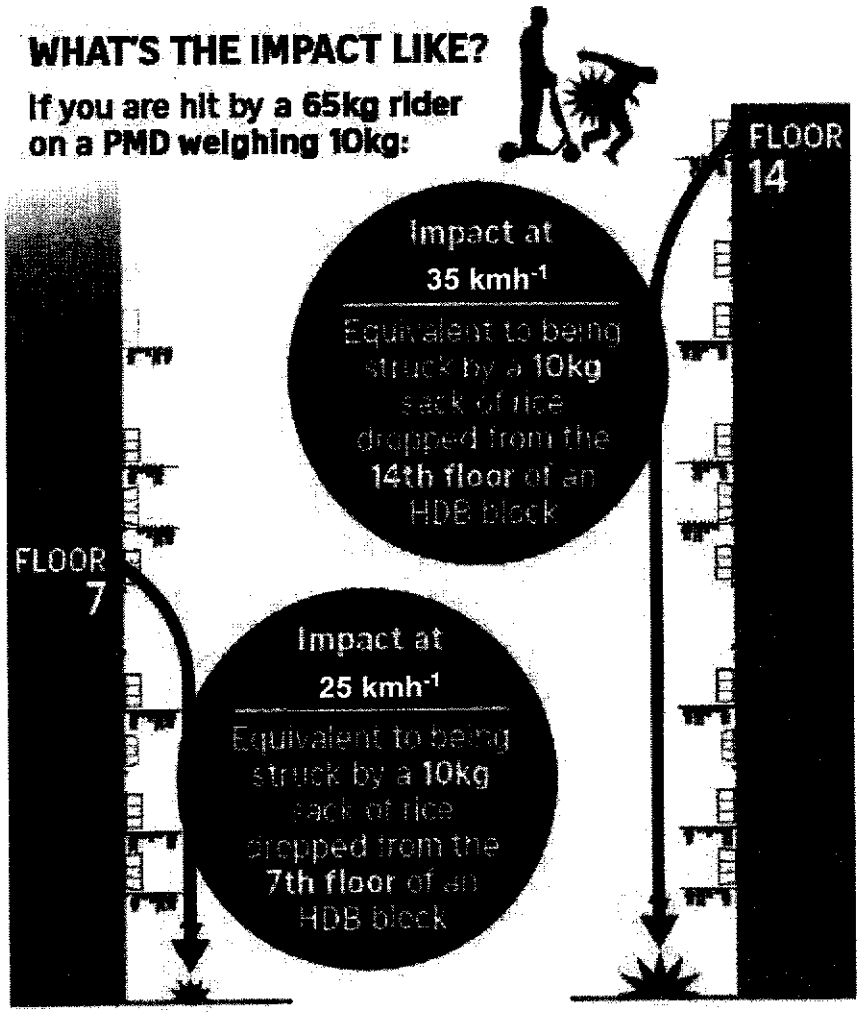


Fig. 8.1

(a) Determine the maximum kinetic energy of the 10 kg sack of rice when it falls from the top of the 14th floor of an HDB block. Assume each floor of the HDB block is 3.0 m high.

maximum kinetic energy = ... [2]

(b) The sack of rice exerts a force on the ground upon impact. In Fig. 8.2, draw and label the action-and-reaction pair of forces. [2]

Fig. 8.2

(c) Upon impact, the sack of rice sinks 3.0 cm into the ground before coming to a stop. Calculate the average impact force exerted on the ground.

force = ... [2]

(d) When a PMD hits a child at 35 km/h, he is likely to fall backwards with the child's CG acting as the pivot point as shown in Fig. 8.3. The child's CG is 45 cm below the line of impact.

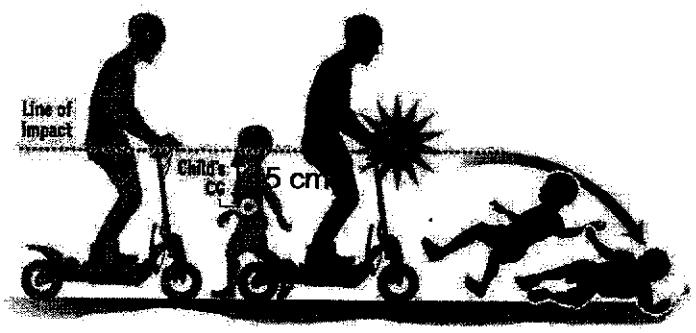


Fig. 8.3

(i) Calculate the turning effect on the child due to the impact force.

turning effect = ... [1]

(ii) Explain how the person will rotate if the PMD hits an adult person as shown in Fig. 8.4.

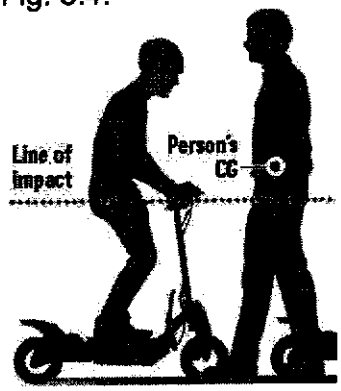


Fig. 8.4

.....

.....

.....

..... [2]

(iii) Explain why the weight of the person does not contribute to the turning effect of the person.

.....

.....

..... [1]

EITHER

9 Read the following article about the use of fibre optic endoscope in medicine and answer the questions that follow.

Light can be carried to inaccessible places in the body using fibre optic endoscope as shown in Fig. 9.1. This consists of a flexible tube containing bundles of glass fibres which allow light to travel along them. Light can travel down a bundle of fibres from a source into the body and then another bundle of fibres with lenses is used to transmit an image back to the eyepiece. A fibre optic endoscope is commonly used by doctors to look into the colon and the gastrointestinal tract of patients.

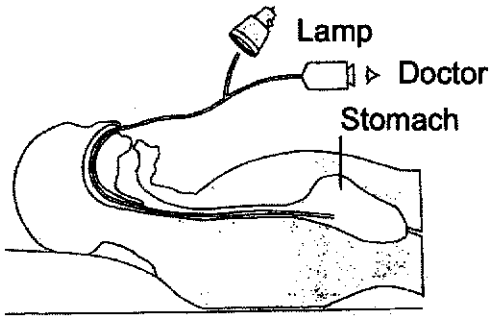


Fig. 9.1

Each optical fibre consists of an inner glass core of refractive index 1.60 and an outer cladding of lower refractive index as shown in Fig. 9.2. The relative refractive index between the outer cladding and inner glass core is 1.14.

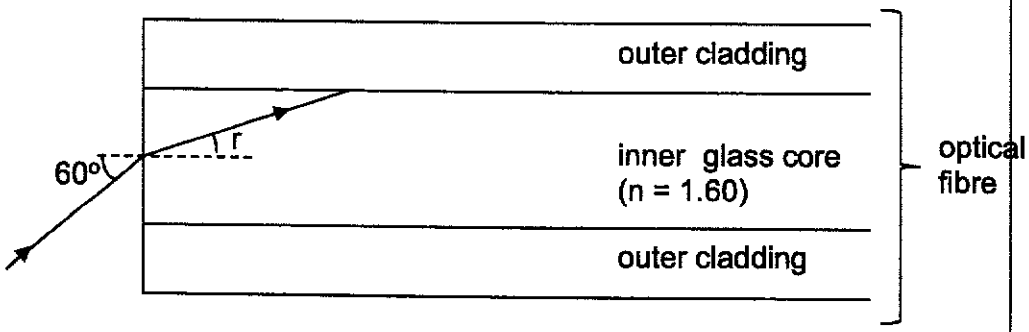


Fig. 9.2

(a) Explain what is meant by *refractive index of inner glass core is 1.6.*

.....

.....

..... [1]

(b) Explain what is meant by *the relative refractive index between the two materials is 1.14.*

.....

.....

..... [1]

(c) Complete Fig. 9.2 to show light passes through the optical fibre into the patient's body. [1]

(d) Calculate the angle of refraction, r.

r = ... [2]

(e) Define critical angle.

.....

.....

..... [1]

(f) Calculate the critical angle of the inner glass core at the **glass-core interface**.

critical angle = ... [2]

(g) It is recommended that the relative refractive index between the glass core and outer cladding be as large as possible. Suggest a reason for this.

.....

.....

.....

..... [2]

OR

9 Fig. 9.3 shows the relationship between the angle of refraction and the angle of incidence for light entering water and glass from a vacuum.

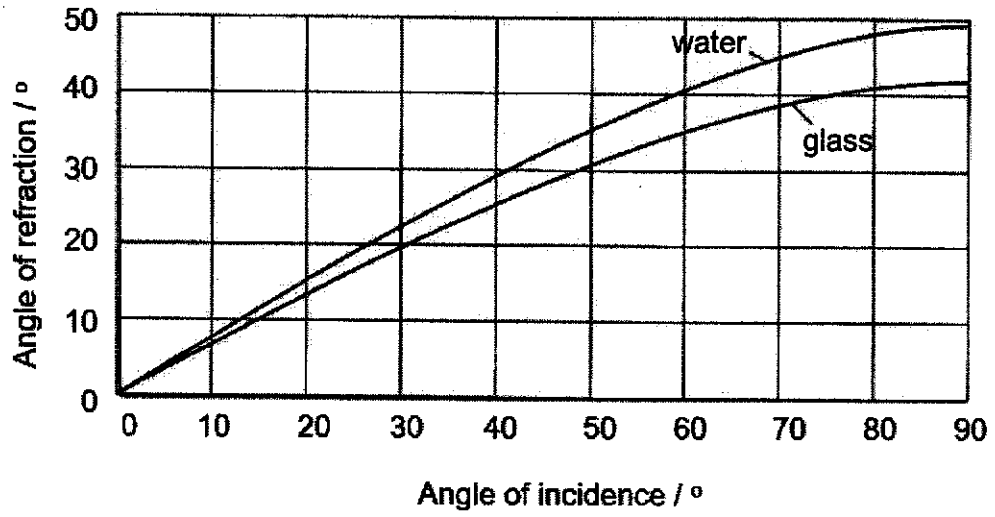


Fig. 9.3

(a) What is meant by *refractive index*?

.....

.....

..... [1]

(b) Estimate the refractive index of glass when angle of incidence is 30.0°.

refractive index = ... [2]

(c) In Fig. 9.3, draw a line to show the relationship between the angle of refraction and angle of incidence for light entering air from vacuum, given that the refractive index of air is 1.0 [1]

(d) Define critical angle.

.....

.....

..... [1]

(e) State the critical angle of water.

critical angle = ... [1]

(f) Figure 9.4 shows a point source of light placed 40.0 cm below the surface of a body of water. A circle of light with diameter AB is seen at the surface of the water.

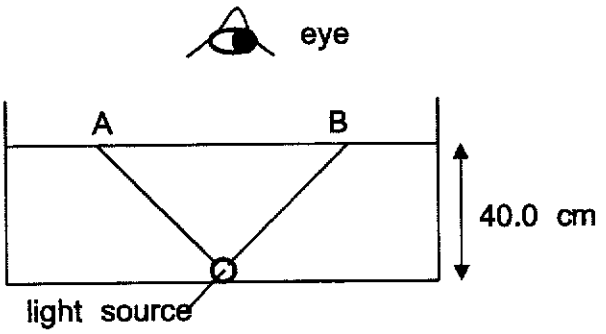


Fig. 9.4

(i) Explain why a circle of light is seen at the surface of water.

.....

.....

.....

.....

..... [2]

(ii) Explain how the diameter AB would change if the water is changed to another liquid of higher optical density.

.....

.....

.....

.....

..... [2]

END OF PAPER

Sec 3 Express Physics

2019 EOY Examination

Marking scheme

Section A (30 marks)

1	**D**	2	**B**	3	**C**	4	**D**	5	**B**
6	**A**	7	**B**	8	**A**	9	**B**	10	**B**
11	**D**	12	**C**	13	**A**	14	**A**	15	**B**
16	**D**	17	**C**	18	**B**	19	**A**	20	**B**
21	**A**	22	**C**	23	**C**	24	**A**	25	**D**
26	**C**	27	**C**	28	**D**	29	**A**	30	**B**

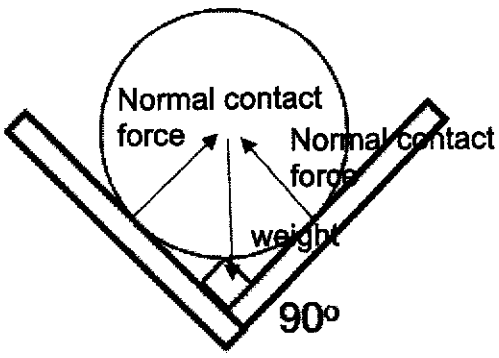
Section B (40 marks)

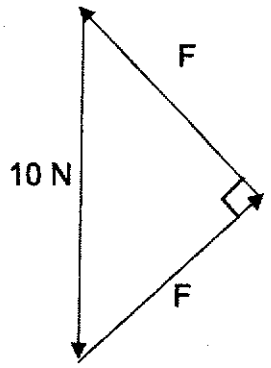
Marks are Precious!

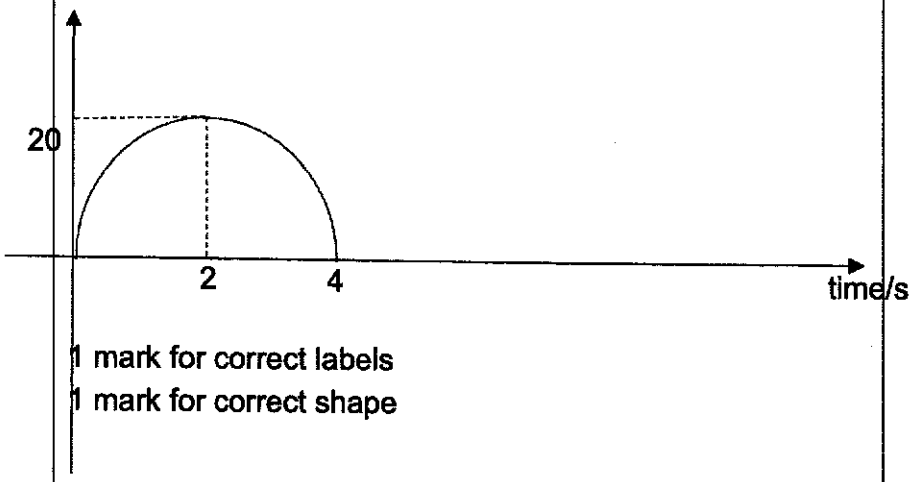
Minus 2 marks max for :

- Accuracy
- Units
- sf

Max is 6 m being deducted.

1	(a)			 Normal contact forces perpendicular to surfaces Weight from centre of circle Labels in words 1 mark for 2 correct.	2

	(b)			Scale: 1cm represents 1N  Correct diagram with correct orientation F = 7.1 N (6.4 N to 7.8 N)	1 1 1
	(c)			The magnitude of F will decrease. The weight of the sphere is smaller.	 1
	(d)			The mass of the sphere remains the same. Since inertia depends on mass, the sphere has the **same inertia** on the moon.	1
				Total	7

2	(a)			There is no air resistance acting on the ball. The graph is a linear graph. / The gradient of the graph which gives the acceleration of the ball is constant.	1 1
	(b)			Max ht = area under the graph from 0s to 2s = ½(20)(2) = 20 m	1 1
	(c)			displacement/m  1 mark for correct labels 1 mark for correct shape	2

	(d)		**Energy is lost** when the ball hits the ground. The **amount of kinetic energy after rebound** which will be converted to gravitational potential energy **is lower**.	1 1
			Total	**8**

3	(a)		h = 1.00 - 0.98 = 0.02 m Change in GPE = mgh = 0.15(10)(0.02) = 0.0300 J	1 1
	(b)		KE = $1/2mv^2$ = ½(0.15)$(0.50)^2$ = 0.0188 J Only **0.0188 J** of GPE is converted to KE when the bob moves to A. (0.300 – 0.0188 = 0.0112 J) of GPE is used to do work against air resistance and friction	 1 1
	(c)		Efficiency = Useful energy output / Total energy input x 100% = 0.0188 / 0.0300 x 100% = 62.7%	1 1
			Total	**6**

4	(a)		ACW moment due to F(Piston 1) = ACW moment due to 40 N = 40 (2000) = 80000 Nmm 80000 = F(40) F = 2000 N	 1 1
	(b)		P = F/A = 2000 / 5.0 x 10^{-5} = 4.0 x 10^7 Pa Allow ecf	 1
	(c)		By Pascal's principle, Pressure on Piston 1 = Pressure on Piston 2 4.0 x 10^7 = F / 1.0 x 10^{-4} F = 4000 N	 1 1
			Total	**5**

5	(a)		The air molecules gain kinetic energy and move **more rapidly**. **Force** of collision between air molecules and walls of container and **frequency** of such collisions **increases**. Since pressure is force per unit area, pressure increases.	1 1

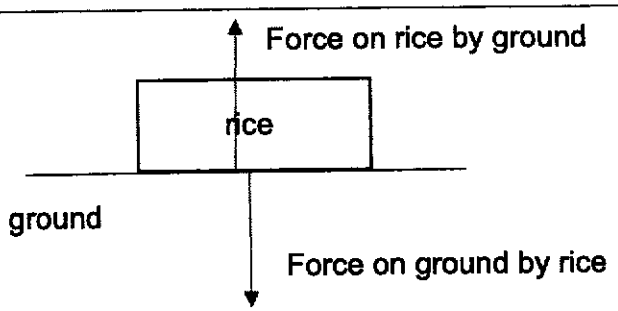
	(b)		**Temperature of air decreases.** The air molecules move **less rapidly.** **Force** of collision between air molecules and walls of container and **frequency** of such collisions **decreases.** Since pressure is force per unit area, **pressure decreases.** The can becomes crushed when pressure in can is **lower than atmospheric pressure.**	1 1 1
			Total	**5**

6	(a)		The amount of heat needed to increase the temperature of 1 kg of container by 1 K is negligible.	1
	(b)		The substance is melting. **Heat is gained to break the bonds between the particles. Internal PE increases. Internal KE remains the same.** Temperature remains constant.	1 1
	(c)		$Q = ml_f$ $70 \times (4 \times 60) = 0.50\ l_f$ $l_f = 33600$ J/kg	1 1
	(d)		The answer will be smaller. Not all the heat supplied in 4 mins is used to melt the substance.	1 1
	(e)		The **gradient between 0 min and 1 min is smaller than the gradient between 5 min and 7 min.** This shows that the **temperature change for solid is smaller for the same amount of heat supplied.**	1 1
			Total	**9**

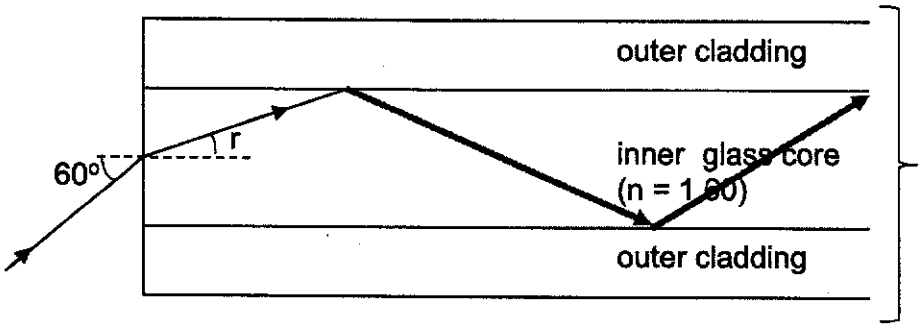
Section C (30 marks)

7	(a)		**thermometer** / **thermometric property** constant volume gas thermometer / Pressure of fixed mass of gas resistance thermometer / electrical resistance thermocouple / emf	2
	(b)	(i)	• Place thermometer in melting pure ice. • Make a mark on the straw when the level of liquid in straw remains steady. Mark it 0°C. • Place thermometer in boiling alcohol. • Make a mark on the straw when the level of liquid in straw remains steady. Mark it 78°C. • Divide the length of straw between the two markings equally into 78 parts.	5

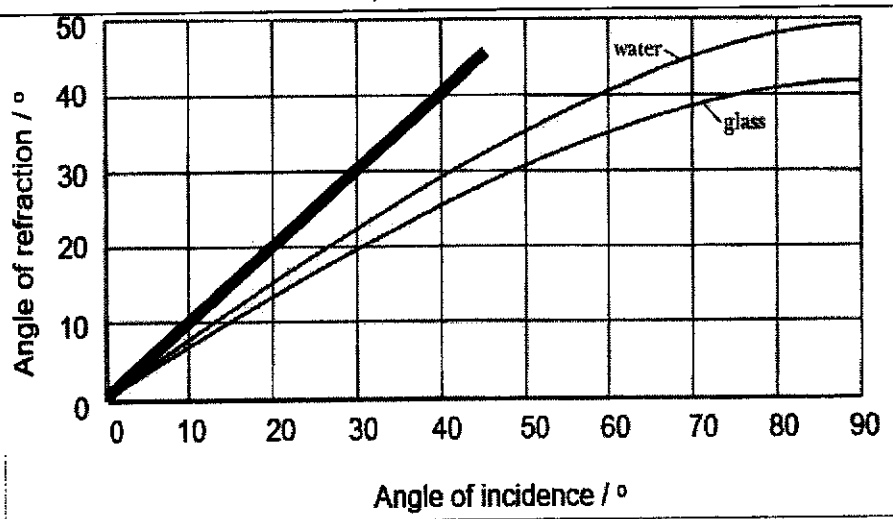
		(ii)	No. Silver surface is a **poor absorber of infrared radiation**. It will **take a longer time** for the thermometer to absorb the heat.	1 1
		(iii)	Use a liquid which is a better conductor of heat. Use a bottle with thinner walls. Any reasonable answer	1
			Total	**10**

8	(a)		Max KE = GPE at 14th floor = mgh = 10(10)(14 x 3.0) = 4200 J	1 1
	(b)		 1 mark for each	2
	(c)		Max KE = WD against impact force 4200 = F(0.03) F = 140000 N Allow ecf	1 1
	(d)	(i)	Turning effect = 140000 x 0.45 = 63000 Nm	1
		(ii)	The person will rotate CW. The impact force produces a CW moment about the pivot.	1 1
		(iii)	The weight is acting from the CG. The **perpendicular distance between line of action of weight to pivot is zero.**	1 1
			Total	**10**

9 either	(a)		The ratio of speed of light in vacuum to speed of light in the inner glass core is 1.60	1
	(b)		The ratio of speed of light in the outer cladding to speed of light in the inner glass core is 1.14.	1

	(c)		Total internal reflection along the glass-cladding interface  	1
	(d)		n = sin i / sin r 1.6 = sin 60° / sin r r = 32.8°	1 1
	(e)		Critical angle is the angle of incidence in the optically denser medium when the angle of refraction in the optically less dense medium is 90°.	1
	(f)		n = 1 / sin c 1.14 = 1 / sin c c = 61.3°	1 1
	(g)		The critical angle will be small. More light can undergo total internal reflection.	1 1
			Total	**10**

9 OR	(a)		The ratio of speed of light in vacuum to speed of light in medium.	1
	(b)		n = sin i / sin r n = sin 30° / sin 20° n = 1.46	1 1
	(c)		Straight line through (30°, 30°)	1

				
	(d)		Critical angle is the angle of incidence in the optically denser medium when the angle of refraction in the optically less dense medium is 90°.n = sin i / sin r.	1
	(e)		49°	1
	(f)	(i)	Light rays undergo total internal reflection outside of A and B. Light rays undergo refraction and exit from the surface of the water within A and B,	1 1
		(ii)	The diameter will decrease. Critical angle decreases for medium of higher optical density. Light rays with a smaller range of angle of incidence undergo total internal reflection.	1 1
			Total	**10**