Candidate Name _____

Class	Register No.

PEIRCE SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2021
SECONDARY 3 EXPRESS

SCIENCE (PHYSICS, CHEMISTRY) **5076 / 01**
Paper 1 Multiple Choice **8 Oct 2021**
1 hour

Additional Material:
Multiple Choice Answer Sheet,
Periodic Table

INSTRUCTIONS TO CANDIDATES
Write in soft pencil.
Do not use paper clips, highlighters, glue or correction fluid.
Write your name, class and register number on the spaces provided above and on the Multiple Choice Answer Sheet.

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

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

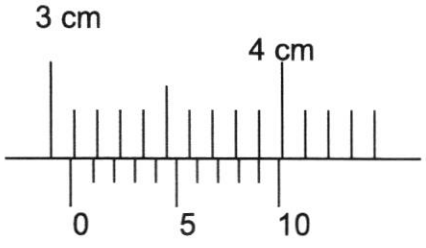
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on this paper.
The use of an approved scientific calculator is expected, where appropriate.

This paper consists of **15** printed pages and **1** blank page.
Setters: Mr Kan Cheng Mun and Mr Tan Kok Heong

1 The van der Waals radius of an oxygen atom is 0.152 nm.
What is this radius in unit of mm?

A 0.000 000 152 mm **B** 0.000 152 mm
C 152 000 mm **D** 152 000 000 mm

2 The diagram shows the reading obtained on a pair of vernier calipers used to measure the thickness of a dictionary.



A 3.09 cm **B** 3.19 cm
C 3.90 cm **D** 3.99 cm

3 Mary travels from Town A to Town B at a uniform speed of 50 km/h for 2 hours, followed by travelling at 60 km/h for another 1 hour to Town C. What is her average speed of the entire journey?

A 50 km / h **B** 53.3 km / h
C 55 km / h **D** 60 km / h

4 An object falls through a vacuum. Which row describes the acceleration and the velocity of the object?

	acceleration	**velocity**
A	increasing	constant
B	increasing	increasing
C	constant	constant
D	constant	increasing

5 A box of mass 4.0 kg moves at a constant speed while it is being pushed horizontally on a rough surface by a 6.0 N force. What is the acceleration of the box if the applied force is now increased to 14 N?

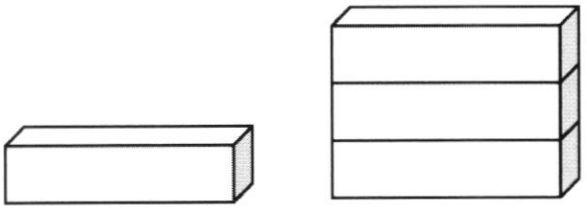
A 0.50 m / s^2 **B** 1.5 m / s^2
C 2.0 m / s^2 **D** 3.5 m / s^2

6 An elephant has four feet on the ground and weights 49 000 N. Each foot has a surface area of 0.07 m^2. What is the approximate pressure each foot exerts on the ground when standing?

A 44 000 Pa **B** 71 000 Pa

C 175 000 Pa **D** 700 000 Pa

7 The diagram shows a single brick and a pile of three bricks. All the bricks are identical.



Compared to the single brick, the pile of bricks has _____ .

A the same density but three times the volume and mass.

B the same mass but three times the density and volume.

C the same volume but three times the density and mass.

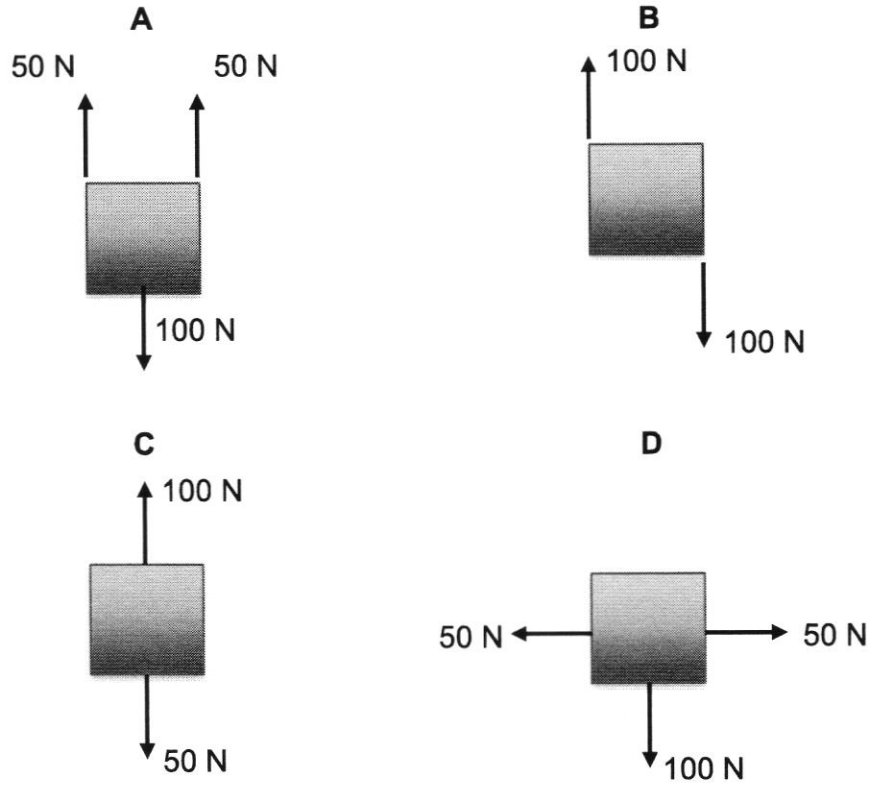
D three times the mass, volume and density.

8 Which property, when increased, causes an increase in the inertia of a body?

A length **B** mass

C surface area **D** volume

9 Which block would remain at rest under the action of the forces shown?
(hint: take moments about the centre of block)



10 Which of the following statements describes moment of a force correctly?

A The amount of force applied to a body.

B The product of mass and gravitational field strength.

C The product of the force and the perpendicular distance from the pivot to the line of action of the force.

D The sum of anticlockwise forces and clockwise forces about a pivot.

11 A pupil runs up a flight of stairs 5.0 m high in 4.0 seconds. If the boy weighs 500 N, what is the power exerted by the boy to bring his body up?

A 25 W **B** 400 W

C 625 W **D** 6 250 W

12 A rubber band is stretched and released vertically upwards into the air. What is the overall energy change in the rubber band when it reaches its highest position?

A elastic potential energy to kinetic energy

B elastic potential energy to gravitational potential energy

C kinetic energy and elastic potential energy to gravitational potential energy

D kinetic energy and gravitational potential energy to elastic potential energy.

13 Using a microscope, we can observe that pollen grains suspended in water move in an irregular manner. This is due to the _____.

A bombardment of pollen grains by water molecules.

B bombardment of water molecules by pollen grains.

C pollen grains colliding with one another.

D pollen grains repelling one another.

14 Which state(s) of matter are very difficult to compress and have a fixed volume?

A Solid only. **B** Solid and liquid only.
C Liquid only. **D** Solid, liquid and gas.

15 Two objects, of different sizes, masses and temperature are placed in contact with each other. Heat energy travels _____.

A from the larger object to the smaller object.

B from the more massive object to the less massive object.

C from the higher temperature object to the lower temperature object.

D from the higher density object to the lower density object.

16 In solids, thermal energy is transferred by conduction. Which of the following best describes how the process of conduction takes place?

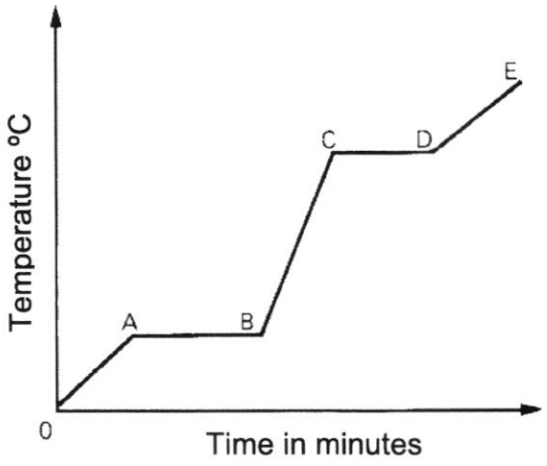
A density change

B expansion of particles

C infra-red emission

D particle vibrations

17 The graph shows the change in temperature against time for a substance which is heated at a constant rate from a low temperature to high temperature.



Which parts of the graph correspond to the substance existing in two states at the same time?

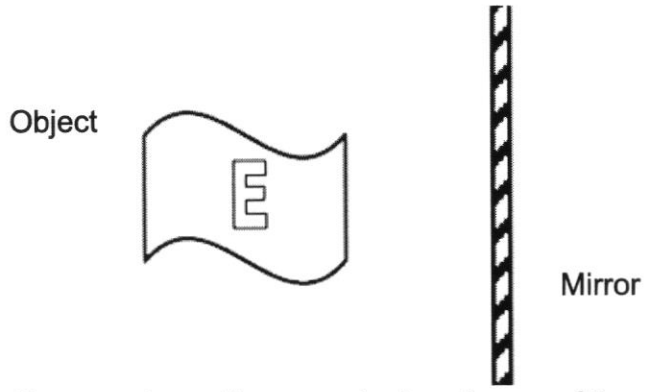
A AB and CD **B** OA and AB

C BC and DE **D** OA, BC and DE

18 Why does the temperature of a liquid decrease during evaporation?

A Air takes away the thermal energy by conduction.
B Air takes away the thermal energy by radiation.
C Energy is gained by the particles to move faster within the liquid.
D The average energy of the liquid particles decreases due to the escape of the higher energy particles into the air.

19 An object is placed in front of a plane mirror as shown below.



Which diagram shows the correct mirror image of the object?

A

B

C

D

20 If a light ray does not undergo bending at the boundary between two media of different optical density, what is the angle of incidence?

A 15° **B** 45° **C** 60° **D** 90°

Class	Register No.

Candidate Name _____

PEIRCE SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2021
SECONDARY 3 EXPRESS

SCIENCE (PHYSICS) **5076 / 02**
Paper 2 Theory **5 October 2021**
1 hour 15 minutes

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

INSTRUCTIONS TO CANDIDATES
Write your name, register number and class on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams and graphs.
Do not use paper clips, highlighter, glue or correction fluid.
Section A
Answer **all** questions.
Section B
Answer any **two** questions.
At the end of the examination, fasten any separate answer paper used securely to the Question Paper. The number of marks is given in brackets [ ] at the end of each question or part question.

PARENT'S SIGNATURE

For Examiner's Use	
Section A	
Section B	
Total	

This paper consists of **15** printed pages and **1** blank page.
Setter: Mr Kan CM

Section A [45 marks]

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

1 For the following quantities, name a suitable apparatus for measuring and estimate the value with the correct units.

quantity to be measured	**name a piece of apparatus for measuring the quantity**	**Estimated value of quantity with correct units**
time taken for 5 swings of a pendulum		
diameter of a marble		
thickness of a piece of paper		

[6]

2 **(a)** Explain why velocity is a vector while speed is not.

_____

_____ [1]

(b) Fig 2.1 shows part of the speed-time graph of the motion of a 40 kg object. The motion lasted 15 s.

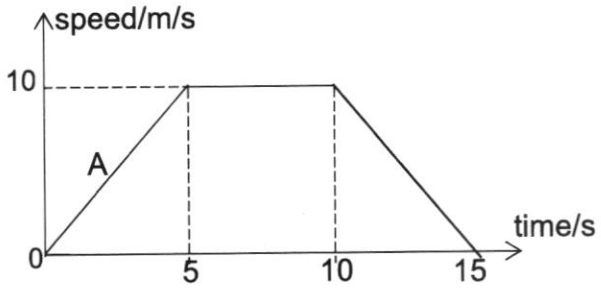


Fig. 2.1

(i) Describe the motion of the object represented by part A of the graph.

_____

_____ [1]

(ii) Calculate the acceleration of the object for the first 5 sec.

acceleration = _____ m s^{-2} [2]

(c) Calculate the average speed of the object for the whole trip.

average speed = _____ m s^{-1} [2]

(d) Calculate the highest kinetic energy of the object.

highest kinetic energy = _____ J [2]

3 Fig. 3.1 shows a reverse bungee in a theme park. A girl wears a harness attached to two stretched elastic ropes. When she is released, the force in the elastic ropes causes the girl to accelerate. The force acting on the girl in each rope is 500 N when the angle between the ropes is 60°.

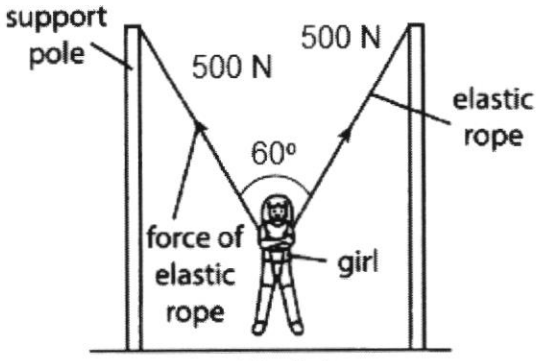


Fig 3.1

(a) By drawing a scaled vector diagram,

(i) Show that the direction of the resultant force from the ropes is upward,

(ii) Determine the magnitude of the total force of the elastic rope.

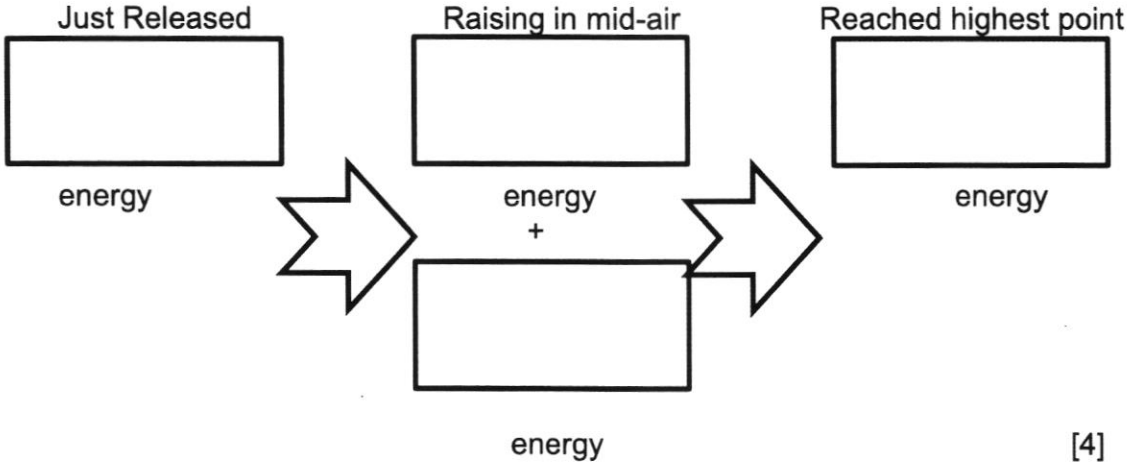
Scale : _____ cm : _____ N

magnitude of resultant force from rope = _____N [4]

(b) Given that the upward acceleration of the girl was 2 m s^{-2}, calculate the mass of the girl.

mass of girl = _____ kg [2]

(c) Fill in the blanks for the **main** energy conversions of the girl as the girl goes up in the reverse bungee, till she reach the highest point.



[4]

(d) A horizontal force F is applied to a **uniform** cylinder weighing 100 N as shown in Fig 3.2. The radius of the cylinder is 0.5 m and the cylinder is rolling up the step of 0.1 m height at pivot P. The center of the cylinder, O, is 0.3 m horizontally from the pivot P.

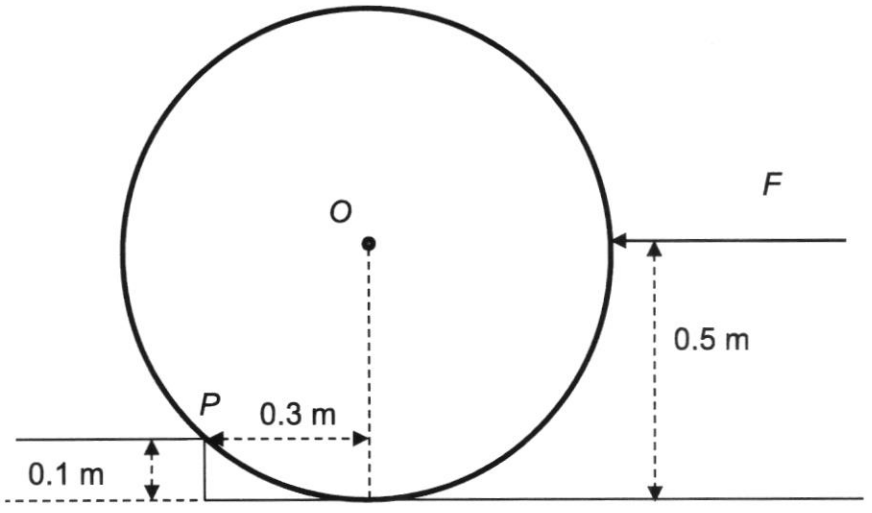


Fig 3.2

(i) Show that the clockwise moment by the weight of cylinder about pivot P is 30 Nm. [1]

(ii) Hence, calculate the smallest force F required to cause the cylinder to roll up.

F required = _____ N [2]

4 Fig. 4.1 shows a metal cylinder which contains 0.000 46 m^3 of oil. The total mass of the cylinder and the oil is 1.2 kg. The mass of the cylinder is 0.800 kg. The gravitational field strength is 10 N / kg.

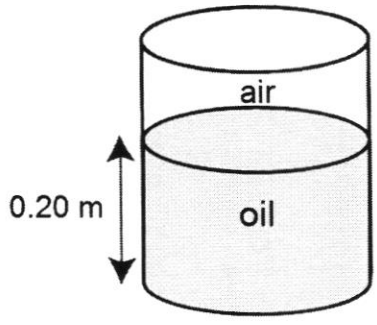


Fig 4.1

(a) State **two** differences between the mass and the weight of a substance.

Difference 1:

_____

_____ [1]

Difference 1:

_____

_____ [1]

(b) Calculate the density of the oil.

density = ... kg/m^3 [2]

(c) Calculate the weight of the oil.

weight = ... N [1]

(d) Hence, compute the pressure of the oil due to its weight at the bottom of the cylinder.

pressure = _____Pa [3]

(e) The cylinder and the oil is brought to the Moon, where the gravitational field strength is reduced. State and explain how the density of oil would change.

_____ [1]

5 **(a)** Fig. 5.1 shows an observer's eye and an object, *O* in front of a plane mirror, *M*.

Complete the ray diagram to show **two** rays going from the object to the eye. Label the image as *I*.

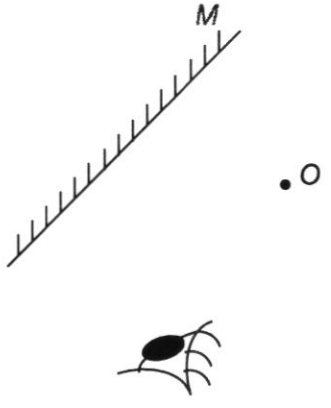


Fig. 5.1

[3]

(b) Fig. 5.2 shows an object O placed on a line that passes through the centre of a converging lens.

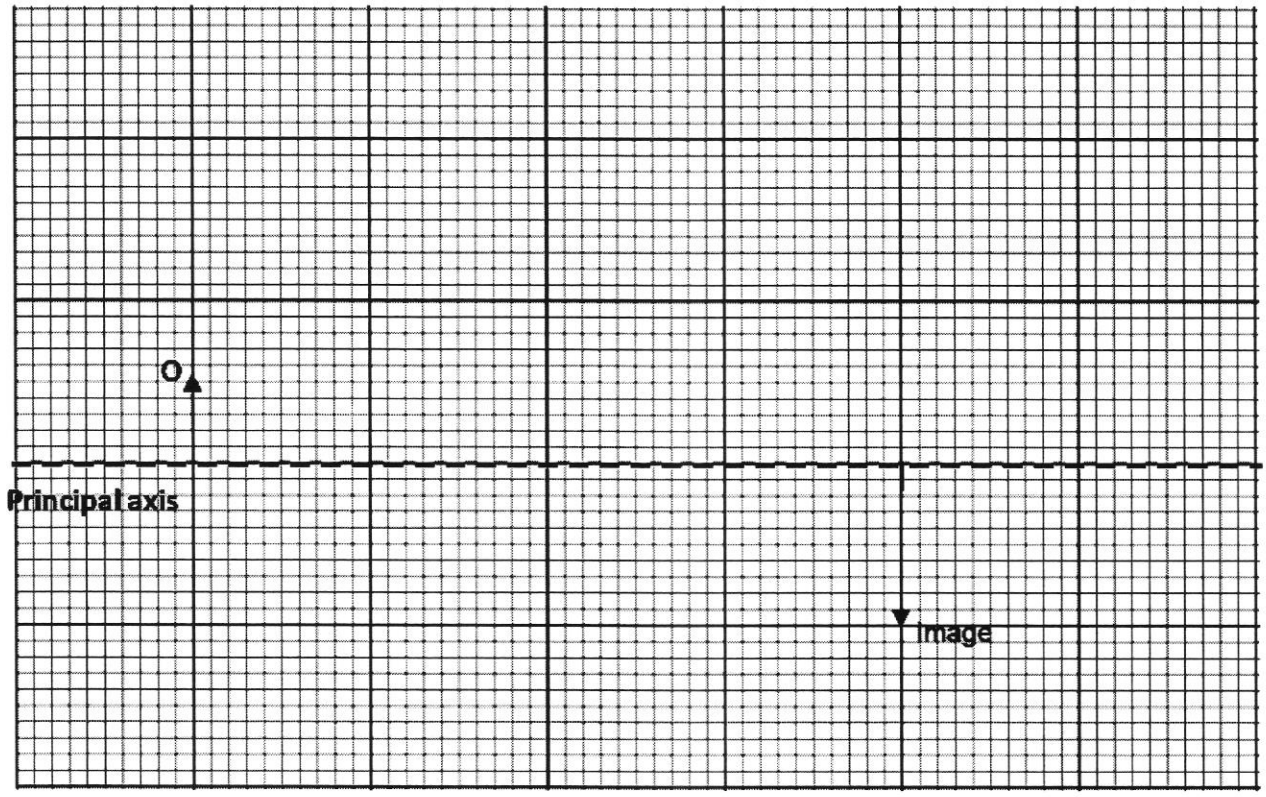


Fig. 5.2

An image of the object is produced by the lens. On Fig. 5.2,

(i) By drawing an appropriate line, draw and label the lens in a suitable position. [2]

(ii) By drawing another suitable line, determine the focal point of the lens and label it as F. [1]

(iii) State 3 characteristics of the image produced.

_____

_____ [2]

(iv) State an application for this arrangement of lens and object.

_____ [1]

Section B [20 marks]

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

6 In an air conditioner, a cooling liquid which is easy to evaporate, is pumped into a copper tube. The copper tube is connected to the fins as shown in Fig. 6.1.

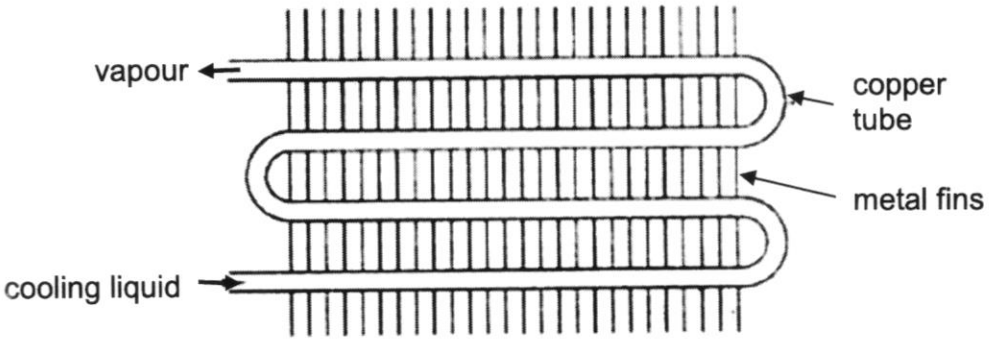


Fig. 6.1

(a) The cooling liquid changes to vapour by absorbing thermal energy from the surroundings.

(i) State one reason why the liquid changes to vapour by the process of evaporation rather than by boiling.

_____

_____ [1]

(ii) Using kinetic model of matter, explain why energy is needed to change a liquid to a gas.

_____

_____ [1]

(iii) Hence, briefly describe about the particle separation after vaporisation.

_____

_____ [1]

(iv) State the main process of transfer of thermal energy from the metal fins to the copper tube.

_____ [1]

(v) State the main process of heat transfer of thermal energy from the surrounding air to the metal fins.

_____ [1]

(vi) In order to increase the rate of heat flow in **(v)**, **circle** the ideal surface and colour of the metal fins.

Smooth / Rough

Black / Silver [2]

(b) Explain why the air conditioner should be installed at the top of a room.

_____

_____

_____

_____

_____ [3]

7 Fig. 7.1 shows a ray of light **TR** as it enters a semi-circular glass block. Light ray **TR** continues in the path **TRS** as shown. The refractive index of glass is 1.5.

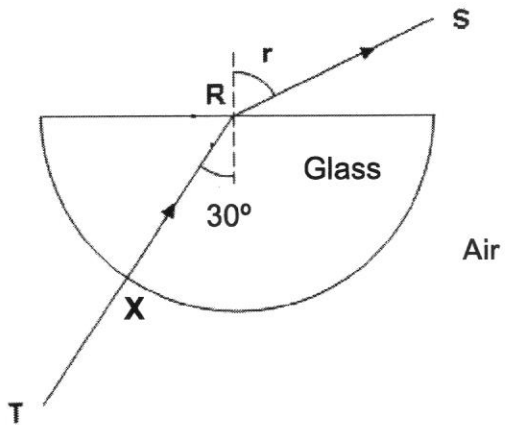


Fig. 7.1

(a) Explain why the light ray does not undergo bending at point **X**.

_____

_____ [1]

(b) Given that the speed of light in air is 3×10^8 m / s. Calculate the speed of light in the glass block.

speed of light in glass = _____ m / s [2]

(c) Calculate the angle of refraction, **r**.

angle of refraction = _____ ° [2]

(d) Explain why the direction of light changes as it passes from glass into air at point **R**.

_____

_____ [1]

(e) Calculate the critical angle of the glass block.

critical angle = _____° [2]

(f) Describe and explain how the direction of the light at the boundary changes as the angle of incidence of light ray TR is increased to 50°.

_____

_____

_____ [2]

8 A **uniform** meter rule is suspended by a string at the 40 cm mark, and is balanced by a weight of 3 N at the 10 cm mark, as shown in Fig. 5.1.

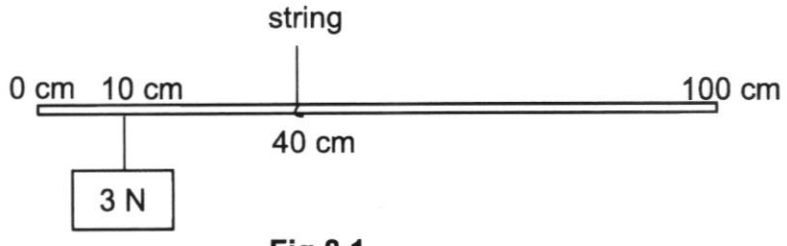


Fig 8.1

(a) **(i)** State the Principle of Moments.

_____

_____

_____

_____ [2]

(ii) Calculate the anticlockwise moment generated by the 3 N weight about the string.

moment = _____ Nm [2]

(iii) Calculate the weight of the meter rule.

weight = _____ N [2]

(b) The 3 N weight is now moved to the 0 cm mark of the metre rule. A downward force **F** must now be applied on the 80 cm mark to keep the meter rule balanced as shown in Fig. 8.2.

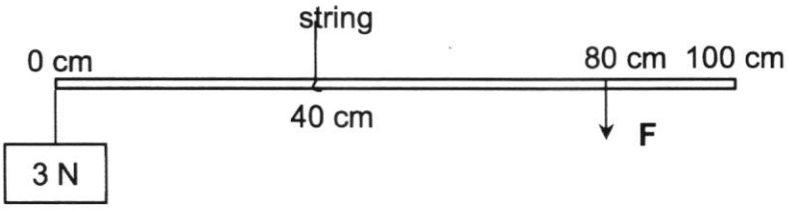


Fig 8.2

(i) Explain why force **F** is necessary to keep the metre rule balanced, when the 3 N is shifted to 0 cm mark.

_____

_____

_____ [2]

(ii) Calculate the magnitude of **F** required to keep the rule balanced.

F = _____ N [2]

End of Paper 2

Suggested Solution 2021 Sci Physics Paper 1

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

Mark Scheme for 2021 3E EoY Sci(Phy)

1 [6]

quantity to be measured	name a piece of apparatus for measuring the quantity	Estimated value of quantity with correct units
time taken for 5 swings of a pendulum	Stop watch	5.00 to 20.00 s
diameter of a marble	Vernier Calipers	1.00 to 5.00 cm
thickness of a piece of paper	Micrometer screw gauge	0.01 mm

Estimated value to be on the correct D.P. according to the apparatus.

2 **(a)** Velocity is a vector as it has **magnitude and direction**. [1]

(b)(i) Increasing at constant rate / constant acceleration [1]

(ii) $a = \frac{v-u}{t}$ $a = \frac{10-0}{5}$ M1

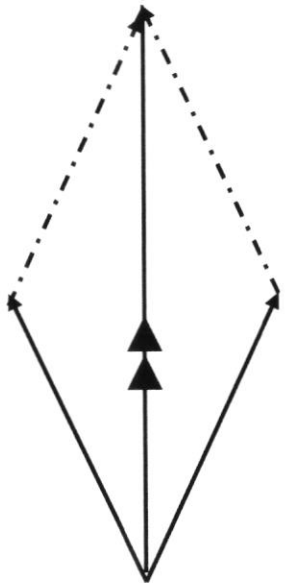
$a = 2\ m/s^2$ A1

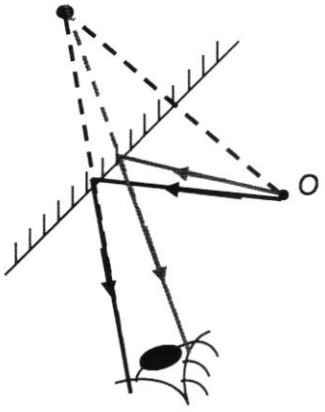
(c) Total distance = Area under graph = $\frac{1}{2} \times 10 \times (5 + 15) = 100\ m$ M1

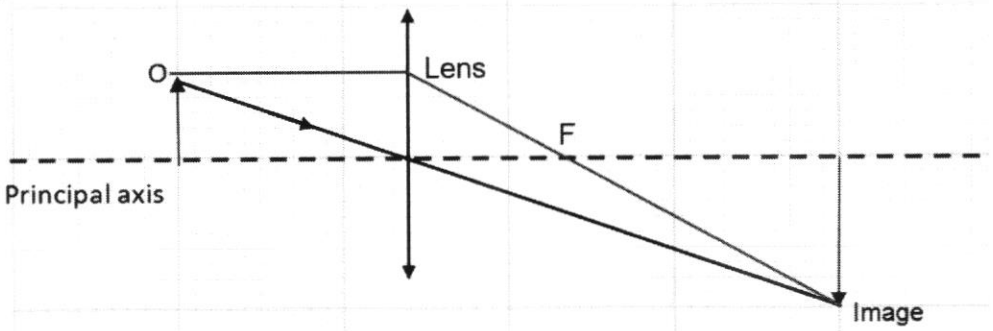
Average speed = $\frac{\text{Total Distance}}{\text{Time}} = \frac{100}{15} = 6.67\ m/s$ A1

(d) Highest kinetic energy = $\frac{1}{2} m v^2 = \frac{1}{2} \times 40 \times 10^2$ M1

$= 2\,000\ J$ A1

3	Scale = 1 cm : 100 N	A1
		
	Drawing of correct parallel lines (dotted)	M1
	Drawing of total force with double arrow pointing upward(shown)	M1
	Magnitude of total force = 866 $\pm$ 10 %, 800 N to 900 N	A1
	(b) $F_{NET} = ma$	
	$T - mg = m\,a$	
	$866 - m\,(10) = m\,(2)$	M1
	$m = 72.2$ kg	A1
	(c) Elastic Potential Energy	[4]
	=> Kinetic Energy + Gravitational Potential Energy	
	=> Gravitational Potential Energy	
	(d)(i) Clockwise moment about P = F x d = 100 N x 0.3 m = 30 Nm (shown)	M1
	(ii) For cylinder to roll up the step, principle of moments is achieved.	
	Clockwise moments = anticlockwise moment	
	$30\ \text{Nm} = F \times (0.5 - 0.1)$	M1
	$F = 75$ N	A1

4	**(a)** Difference 1: mass is an amount of matter, and weight is a force	[1]
	Difference 2: mass is scalar and weight is a vector/ Weight depends on the gravitational field strength.	[1]
	Units is kg for mass and Newtons for weight	M1 A1
	(b) Density = $\frac{\text{mass}}{\text{volume}} = \frac{0.4\text{ kg}}{0.000\,46}$	
	Density = 870 kg m^{-3} (3sf) A1	[1]
	(c) weight = mass x g = 0.4 x 10 = 4 N	M1
	(d) cross-sectional area = $\frac{0.000\,46}{0.2} = 0.0023\ m^2$	M1 A1
	Pressure = $\frac{\text{force}}{\text{area}} = \frac{4}{0.0023}$	
	Pressure = 1740 (3sf)	[1]
	(e) No change as the mass and volume is still the same.	
5	**(a)** 	
	[1] for correct position of *I* with the dotted line showing perpendicular and equal distance between of mirror from image and object [1] for each correctly drawn rays with arrows 1 mark deduction for the 2 correct rays with no/wrong arrows.	[3]

	(b)  **(i)** Ray (with arrow) from the top of the object to the top of the image Arrow with label (lens) at the intersection of ray and Principal axis **(ii)** Horizontal line to lens, and down to the top of image, intersection of ray with Principal axis as focal point, F **(iii)** Inverted, magnified and real Minus [1] for each wrong answer till [2] **(iv)** Projector.	M1 A1 A1 [2] [1]
6	**(a)(i)** it is occurring at **any temperature** other than the boiling point. **(ii)** For a liquid molecules to change to a gas, energy is required to to **break the bonds** between the liquid particles. **(iii)** The particle separation of a gas will be more **far apart**. **(iv)** Conduction **(v)** Radiation **(vi)** Black and Rough **(b)** Easier to create the **convection current**, or flow of cool air in the room. Air at the top is cooled by the air conditioner, and **contracts** to form colder **denser** air, which **sinks** down Warmer air **expands** and so the **less dense** air will **raise up**.	[1] [1] [1] [1] [1] [2] [1] [1] [1]
7	**(a)** Ray of light is **perpendicular** to the circular surface **(b)** $n = \frac{\text{speed of light in air}}{\text{speed of light in glass}}$	[1]

	$1.5 = \frac{3 \times 10^8}{\text{speed of light in glass}}$	M1
	speed of light in glass = 2×10^8 m / s	A1
	(c) $\frac{1}{n} = \frac{\sin i}{\sin r}$	
	$\frac{1}{1.5} = \frac{\sin 30^\circ}{\sin r}$	M1
	$r = \sin^{-1}[(1.5) \sin 30^\circ]$	A1
	$= 48.6$ (3sf)	[1]
	(d) Light travels from an optically denser (glass) medium to an optically less dense medium (air)	
	(e) $n = \frac{1}{\sin c}$	M1
	$c = \sin^{-1}(\frac{1}{1.5})$	A1
	$c = 41.8^\circ$	[1]
	(f) Given that 50° is **more** than the critical angle,	[1]
	Light ray TR will undergo **total internal reflection**.	
8	**(a)(i)** Principle of moments states that when a body is in equilibrium	[1]
	the sum of clockwise moments about a pivot is equal to the sum of the anticlockwise moments about the same pivot.	[1]
	(ii) moments = 3 x 0.3 m M1	M1
	= 0.9 Nm A1	A1
	(iii) Using Principle of moments,	
	sum of clockwise moments = sum of anticlockwise moments	
	$W_{Rule} \times \frac{10}{100} = 0.9$ Nm M1	M1
	Weight of rule = 9 N A1	A1
	(b)(i) when the 3 N is shifted to the left, there is **more anti-clockwise** moments about the string	[1]
		[1]

	Need F to produce **clockwise** moments to maintain balance.	
(ii)	sum of clockwise moments = sum of anticlockwise moments	M1
	F x 0.4 + 9 x 0.1 = 3 x 0.4 M1	A1
	F = 0.75 N A1	