FUCHUN SECONDARY SCHOOL
MID YEAR EXAMINATION 2019
SECONDARY 3 EXPRESS

NAME:

CLASS: | | | |

INDEX NUMBER: | | | |

SCIENCE (PHYSICS)

5076
15 May 2019
1 hour 30 minutes
Maximum mark: 70

Additional Material: OTAS Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil. Do not use staples, glue or correction fluid.

Section A
There are **twenty** questions on this section. Answer **all** the 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 OTAS Sheet provided.

Section B
Answer **all** the questions.
Write your answers in the spaces provided on the question paper.

Section C
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

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

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

For Examiner's Use	
Section A	
Section B	
Section C	
Total	

Name of setter: Mdm Rohizan Talib

This document consists of 20 pages.

Section A [20 marks]

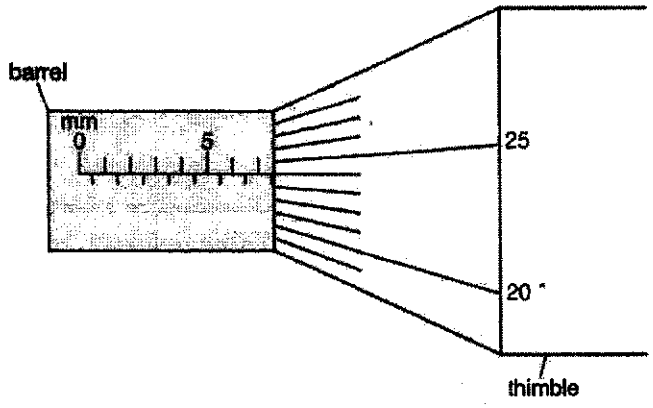
Answer **ALL** the questions on the OTAS sheet provided.

1 The thickness of a strand of human hair is 12 μm (micrometre) and its mass is 0.57 mg (milligram).

Which row gives the thickness and mass in SI units?

	thickness / m	mass / kg
A	0.012	0.00057
B	0.012	0.0000057
C	0.000012	0.00057
D	0.000012	0.0000057

2 A student measures the thickness of her smartphone using a micrometer screw gauge. The diagram shows the reading on the micrometer.



What is the thickness of the smartphone?

A 5.24 mm **B** 7.24 mm **C** 7.26 mm **D** 7.74 mm.

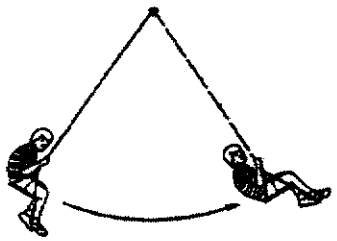
3 Which quantity is a derived quantity?

A force **B** mass **C** temperature **D** time

4 Why is velocity a vector quantity?

A It acts on a body in a straight line.
B It has direction and size.
C It has direction but no size.
D It is a change of speed.

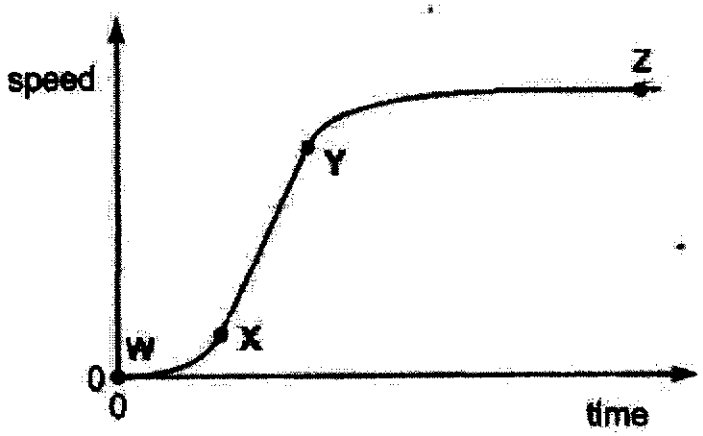
5 The diagram shows a boy on a swing. The boy's father, who is twice as heavy as the boy, takes over the swing from the boy. In both cases, the swing oscillates freely.



Which statement about their periods of oscillation is correct? (ignore air resistance)

A The boy and his father have the same period of oscillation.
B The period of oscillation of the boy is four times larger than his father's.
C The period of oscillation of the boy is half of his father's.
D The period of oscillation of the boy is two times larger than his father's.

6 The graph shows the speed of a weather balloon as it rises through the atmosphere.

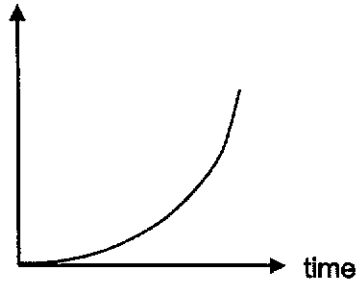


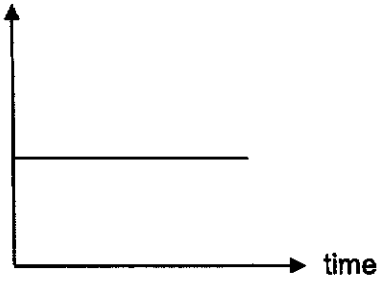
Which row shows the correct description of the acceleration at various positions of the balloon?

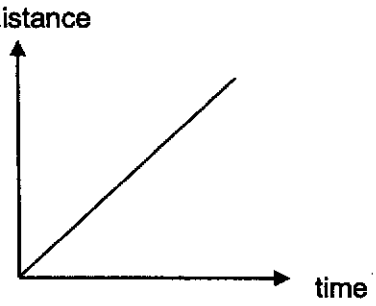
	WX	XY	YZ
A	decreasing	constant	increasing
B	decreasing	increasing	constant
C	increasing	constant	decreasing
D	increasing	increasing	decreasing

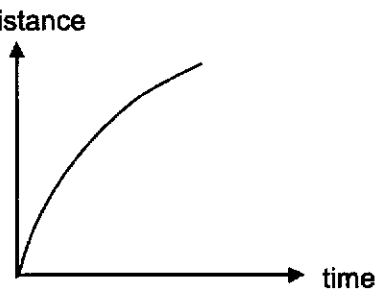
7 An object starts its motion from rest and accelerates uniformly.

Which distance-time graph shows the motion of the object?

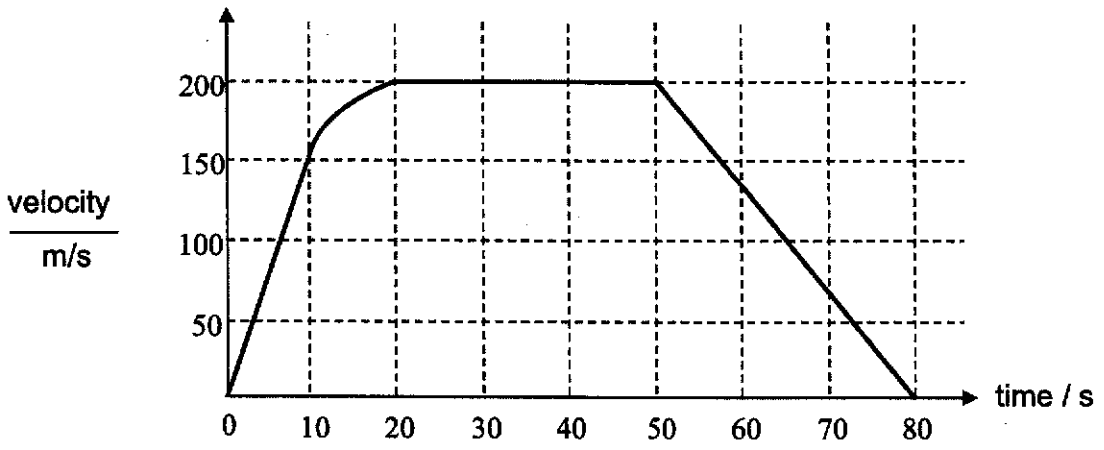
A


B


C


D


Refer to the following velocity-time graph representing a motion of an object for questions **8** and **9**.



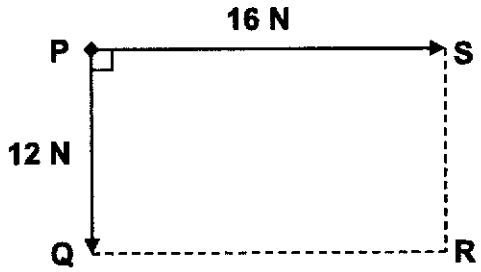
8 What is the distance travelled by the object in the first 10 seconds?

A 750 m **B** 1500 m **C** 3000 m **D** 6000 m

9 Describe the motion of the object in the final 30 seconds.

A The object is travelling at a decreasing acceleration.
B The object is travelling at a uniform acceleration of - 6.7 m/s^2.
C The object is travelling at a uniform acceleration of 6.7 m/s^2.
D The object is travelling at a uniform speed of 6.7 m/s.

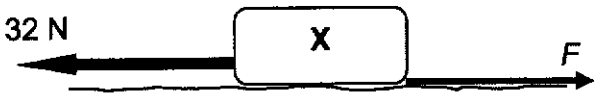
10 Two forces act at right angles at a point P as shown.



What is the magnitude and direction of the resultant force?

	magnitude	direction
A	20 N	PR
B	20 N	SQ
C	28 N	PR
D	28 N	SQ

11 A block **X** of mass 2.5 kg is pulled across a rough surface by a force of 32 N, against a friction force *F*.



The block moves with an acceleration 2 m/s^2. What is the value of *F*?

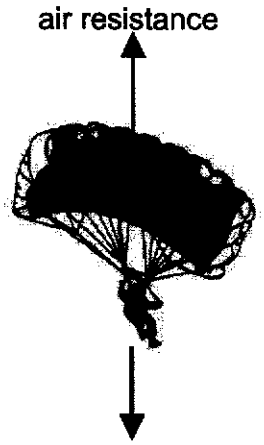
A 5 N **B** 27 N **C** 32 N **D** 37 N

12 The inertia of a body is its resistance to change its motion.

Which property is a measure of the body's inertia?

A its density
B its mass
C its volume
D its weight

13 The diagram shows a parachutist falling after a jump. The total weight of the parachutist and his parachute is 800 N.



When the air resistance is equal to 800 N, which statements describes the motion of the parachutist?

A The parachutist continues to fall at a constant velocity.
B The parachutist continues to fall at a decreasing velocity.
C The parachutist moves upward.
D The parachutist remains at the same height.

14 Which of the following statements about the weight of an object is / are correct?

I Weight depends on the gravitational field strength at the location of the object.
II Weight depends on the mass of the objects.
III Weight is the same as mass on the earth surface but different on different planets.
IV Weight of an object is the same on different planets.

A **II** only
B **I** and **II** only
C **III** and **IV** only
D **I**, **II** and **IV** only

15 The weight of the spacecraft named Viking 1 on Earth is 6500 N and on Mars it is 2405 N.

The gravitational field strength on Earth is 10 N/kg.

What is the gravitational field strength on Mars?

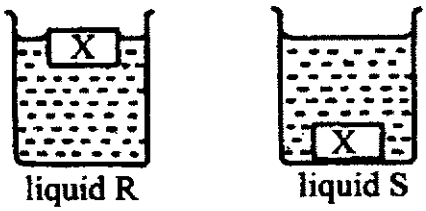
A 0.37 N/kg **B** 2.7 N/kg **C** 3.7 N/kg **D** 27.0 N/kg

16 Five identical steel balls were dropped into a measuring cylinder containing 50 cm^3 of water. The reading of the water level rose to 80 cm^3.

If the density of steel is 9.0 g/cm^3, what is the mass of one ball?

A 6 g **B** 54 g **C** 90 g **D** 540 g

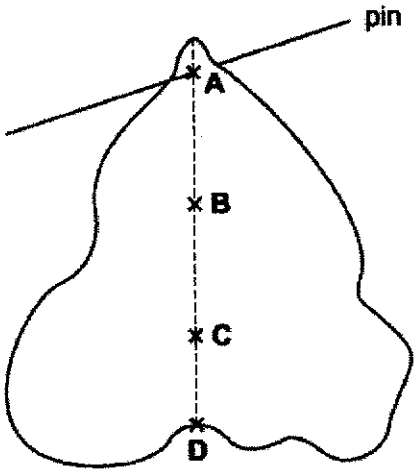
17 An object **X** floats in liquid **R** but sinks in liquid **S**, as shown in the diagram.



Which statement is true?

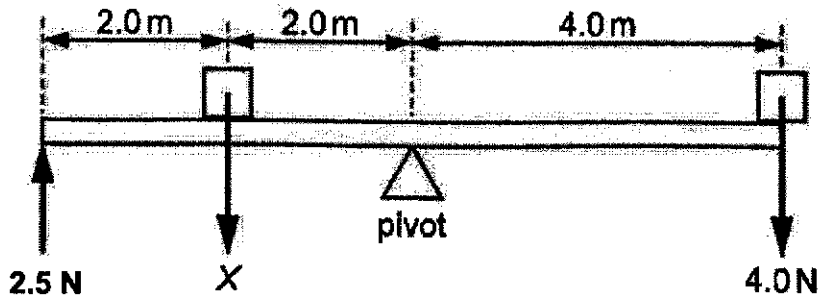
A Liquid **R** is as dense as liquid **S**.
B Liquid **R** is less dense than liquid **S**.
C Liquid **R** is more dense than liquid **S**.
D Object **X** is more dense than liquid **R**.

18 A piece of uniform card is suspended freely from a horizontal pin.



At which point is the centre of gravity of the card likely to be?

19 A uniform plank is pivoted at its mid-point and a weight is added on either side in the positions shown.



The plank is balanced by the upward 2.5 N force.

What is weight *X*?

A 1.5 N **B** 6.5 N **C** 10 N **D** 13 N

20 A performer sits on a large number of pointed nails pointing upwards through a horizontal board. The performer suffers no skin damage.

Which statement explains this?

A The performer's weight is spread over a large area, which decreases the pressure.
B The performer's weight is spread over a large area, which increases the pressure.
C The performer's weight is spread over a small area, which decreases the pressure.
D The performer's weight is spread over a small area, which increases the pressure.

End of Section A

Section B [30 marks]
Answer **ALL** the questions in the spaces provided.

1 Complete the following table.

factor	symbol	prefix
10^6	M	
	μ	micro
10^3	k	
	m	milli

[2]

2 Vernier calipers are used to measure the inner diameter and outer diameter of a tube. A cross section of the tube and two vernier caliper readings are shown in Fig. 2.1.

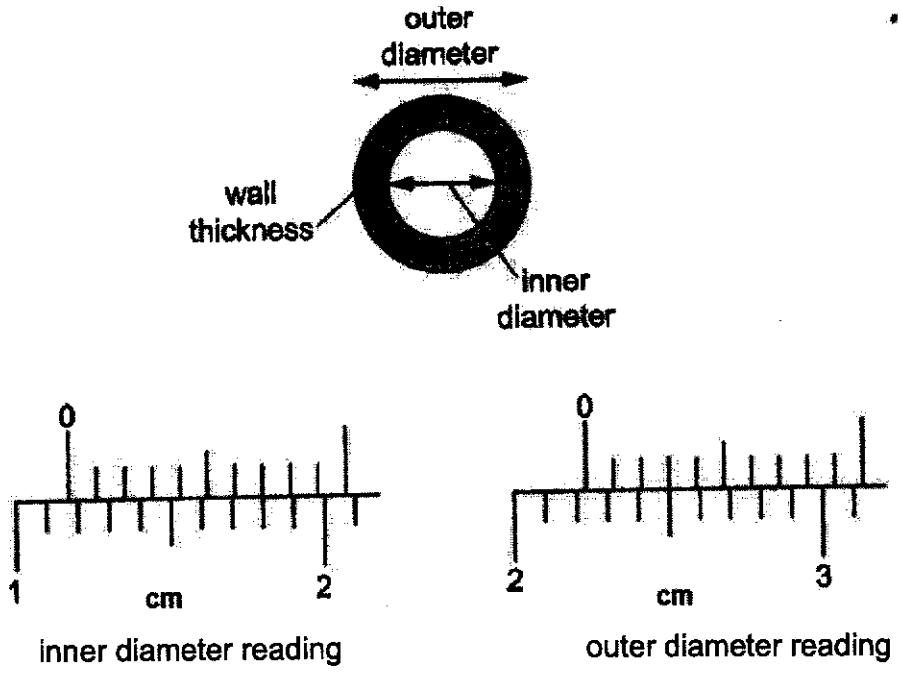


Fig. 2.1

Record the readings as shown by the vernier calipers and calculate the thickness of the wall of the tube in mm.

inner diameter reading = ... cm

outer diameter reading = ... cm

thickness of wall of tube = ... mm [3]

3 **(a)** State what is meant by the *period* of a pendulum.

..... [1]

(b) An experiment is conducted using the set up as shown below. The lengths of the different pendulums are as shown in Fig. 3.1. The bobs used in **P** and **S** are of the same mass and are lighter than those used in **Q** and **R**. **Q** and **R** have the same mass.

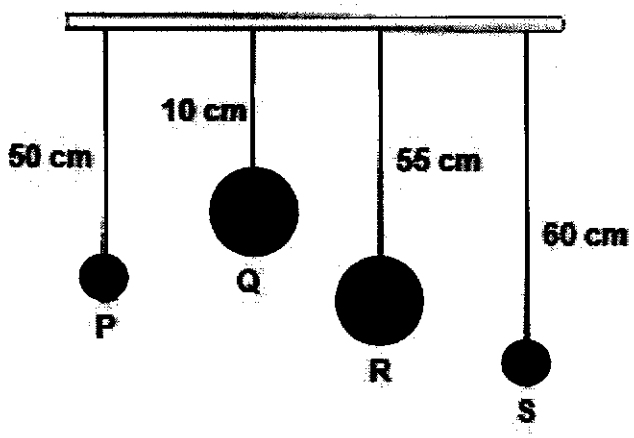


Fig. 3.1

(i) In two separate measurements of 20 oscillations, pendulum **P** clocks 16.84 s and 16.77 s.

Show that the periodic time of pendulum **P** is 0.84 s.

[1]

(ii) Identify the other pendulums that correspond to the following periodic times:

periodic time / s	pendulum
0.65	
0.97	
1.18	

[2]

4 An athlete runs a 400 m race in 1 min 2.5 s.

Calculate his average speed in m/s and km/h.

speed = ...m/s

speed = ... km/h
[3]

5 An SUV (sports utility vehicle) of mass 1920 kg starts from rest and moves along a straight road with a constant acceleration, reaching a speed of 20 m/s after 8.0 s. The car then travels at a constant speed of 20 m/s.

(a) Calculate the acceleration of the car during the first 8 seconds of travel.

acceleration = ...m/s^2 [2]

(b) Calculate the resultant force acting on the car during the first 8 seconds of travel.

resultant force = ...N [2]

(c) The friction between the car and the road is 1200 N. Calculate the minimum forward driving force provided by the engine of the car during the first 8 seconds of travel.

forward driving force = ...N [2]

6 In a recording studio, a microphone is suspended by wire X from the ceiling in the studio. A horizontal wire Y is used to hold the microphone in correct position as shown in Fig. 6.1.

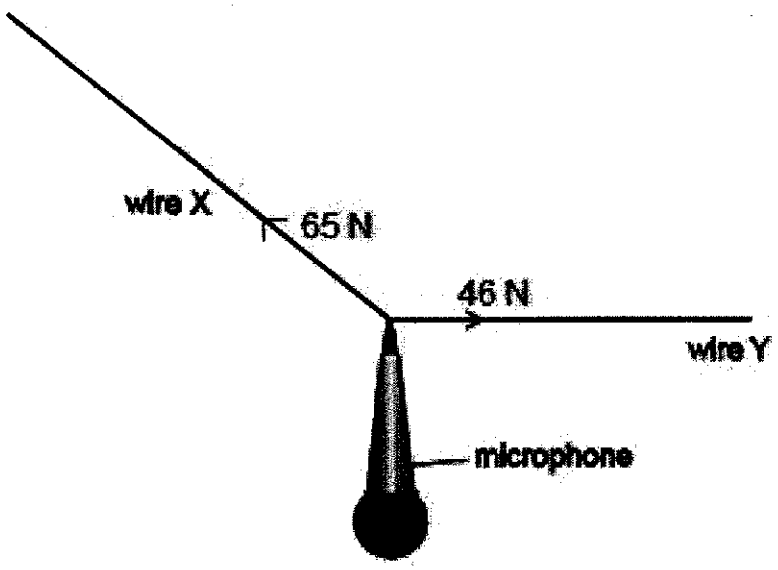


Fig. 6.1

There is a force of 65 N in wire **X** and a force of 46 N in wire **Y**.

(a) Using an appropriate scale, draw a vector diagram on Fig 6.1 to determine resultant force due to forces in wires **X** and **Y**.

scale: .....

resultant force = ... N [3]

(b) Deduce the weight of the microphone from the vector diagram.

weight = ... N [1]

7 A rectangular iron bar of mass 5.25 kg rests on a horizontal surface, as shown in Fig. 7.1.

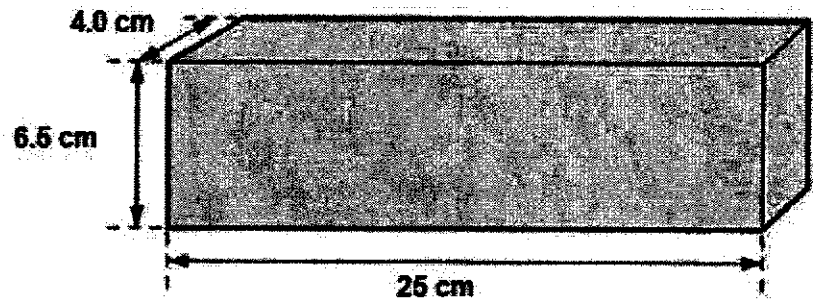


Fig. 7.1 (not to scale)

The length of the bar is 25 cm, the height is 6.5 cm and the width is 4.0 cm.

The gravitational field strength g is 10 N/kg.

(a) For this bar, calculate

(i) the volume of the bar,

volume = ... cm^3 [1]

(ii) the density of iron bar.

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

(b) Fig. 7.2 shows a side view of the iron bar placed on the horizontal surface.

Fig. 7.2

(i) Draw a free body diagram on Fig. 7.2 showing the forces acting on the iron bar. Label the forces clearly. [1]

(ii) Calculate the weight of the iron bar.

weight = ...N [2]

(c) The bar is placed with one of its flat side on the horizontal surface such that it exerts the greatest pressure on the surface.

Calculate the greatest pressure the bar exerts on the surface.

pressure = ...N/cm^2 [2]

End of Section B

Section C [20 marks]

Answer any **two** questions from this section. Answer in the spaces provided.

8 In an amusement park, bumper cars collide with one another and change their speeds and directions. Fig. 8 is a graph showing the motion of a car during the first 65 seconds of a ride.

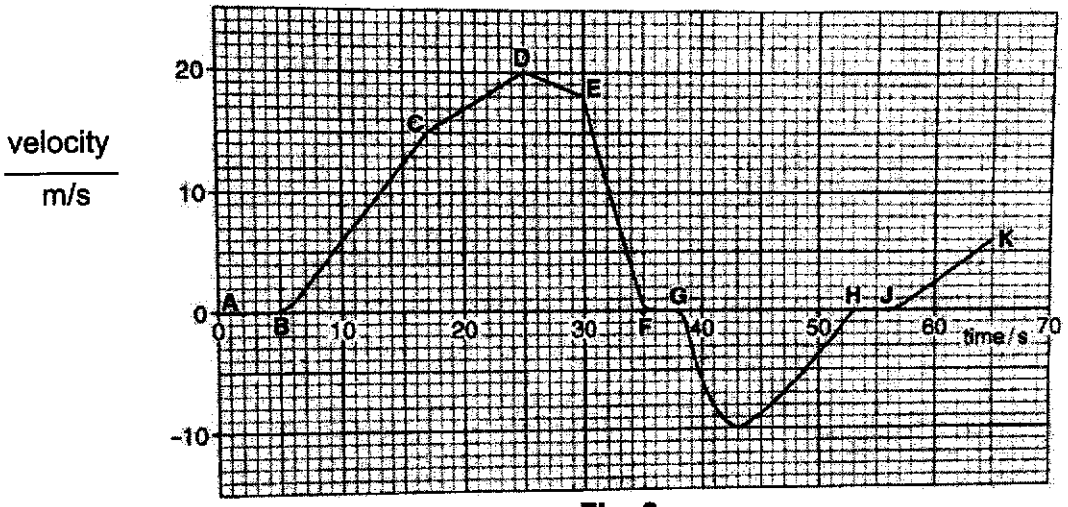


Fig. 8

(a) From **A** to **F**, Fig. 8 shows the car

- braking
- colliding with another car and stopping
- increasing speed
- increasing speed at its greatest rate
- stationary

but not in this order.

(i) Use each phrase once only to describe the motion of the car between point **A** and point **F**.

A to **B** .....

B to **C** .....

C to **D** .....

D to **E** .....

E to **F** .....

[3]

(ii) By considering the forces on the car, explain why the speed of the car decreases between **D** and **E**.

.....

.....[1]

(b) Describe the motion of the car between points **F** and **K**.

.....

.....

.....

.....

.....[4]

(c) Calculate the acceleration of the car between points **C** and **D**.

acceleration =..... m/s^2 [2]

9 **(a)** State what is meant by *centre of gravity*.

.....[1]

(b) A homemaker is hanging out the laundry to dry using a pole as shown in Fig. 9.1. The trousers, shirt and towel have weights 3.0 N, 1.0 N and 0.2 N respectively.

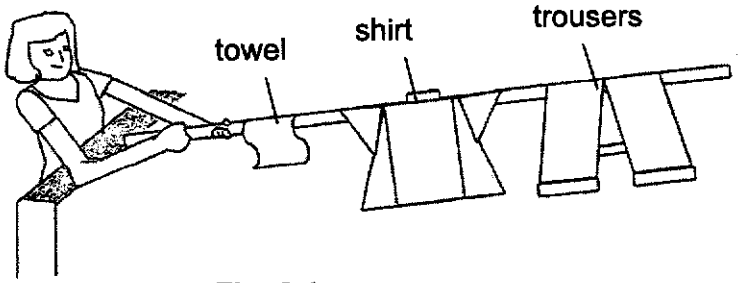


Fig. 9.1

The centres of gravity of the towel, shirt and trousers are at 0.5 m, 1.0 m and 1.5 m away from the right hand of the housewife. Her two hands are 0.3 m apart as shown in Fig. 9.2.

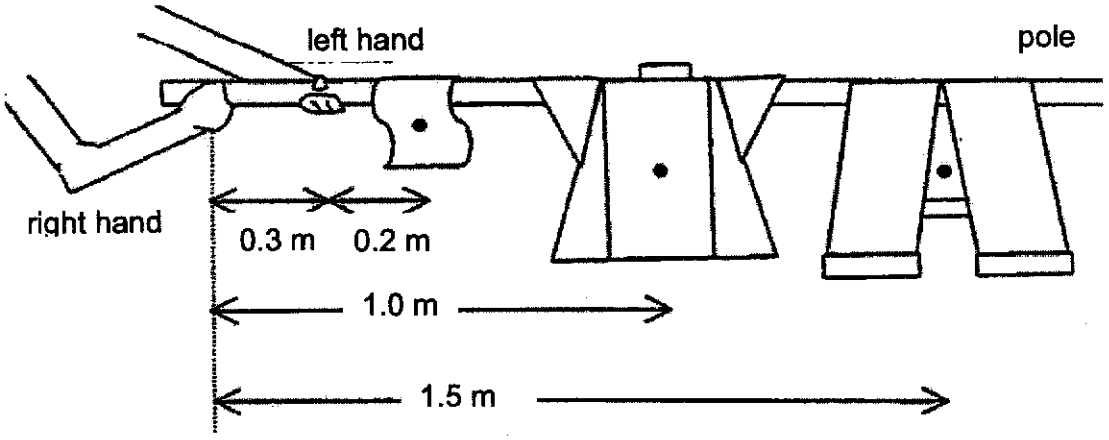


Fig. 9.2

(i) Taking moment about her left hand, calculate the magnitude of the total moments due to the three clothes.

total moments = ...Nm [3]

(ii) Describe and explain how the homemaker should arrange the clothes on the pole so that her task of hanging the laundry using the pole is easier.

.....

.....

.....[2]

(c) A glass vase is used to hold flowers. Fig. 9.3 (a) shows when the vase is empty and Fig. 9.3 (b) shows when it is filled with water.

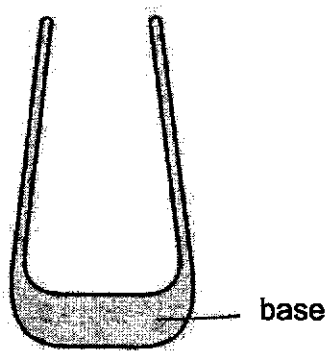


Fig. 9.3 (a)

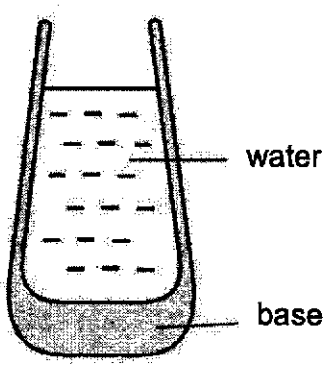


Fig. 9.3 (b)

(i) Mark with an **X**, in Fig 9.3 (a) and in Fig. 9.3 (b), the centre of gravity of the vase when it is empty and when it is filled with water. [2]

(ii) Explain how the stability of the vase is improved by having a wider base.

.....

.....

.....[2]

10 This question is about how the brakes on a car work. Fig. 10.1 shows part of the braking system on a car.

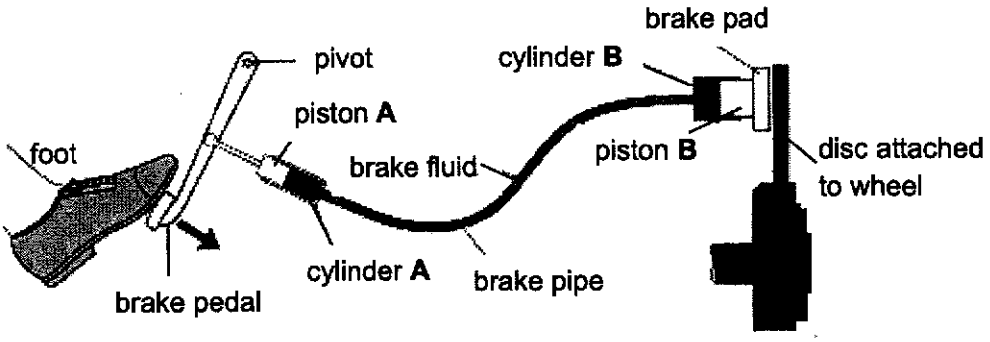


Fig. 10.1

The driver's foot presses on the brake pedal causing piston **A** to move and exert a force of 640 N on the oil in the cylinder **A**. The cross-sectional area of piston **A** and cylinder **C** is 2.0 cm^2.

(a) The force causes a pressure in the brake fluid in the cylinder.

Calculate the pressure in the brake fluid due to the force on piston **A**.

pressure =.....N/cm^2 [2]

(b) The pressure in the brake fluid is equally transmitted through the brake pipe to cylinder **B**. The cross-sectional area of piston **B** is 18 cm^2.

Calculate the force exerted by piston **B** on the brake pad.

force =.....N [2]

(c) The contact force between the brake pad and the brake disc will cause the disc and the wheel of the car to stop turning.

Name the contact force ..... [1]

(d) The force on piston **A** is exerted by the driver's foot. Explain why the magnitude of the force on the piston is more than that exerted by the driver's foot.

.....

.....

.....

.....[3]

(e) Suggest two modifications of the braking system such that the driver does not have to exert too much force to cause the wheels of the moving car to eventually stop turning.

1.....

.....

2.....

.....[2]

End of Paper

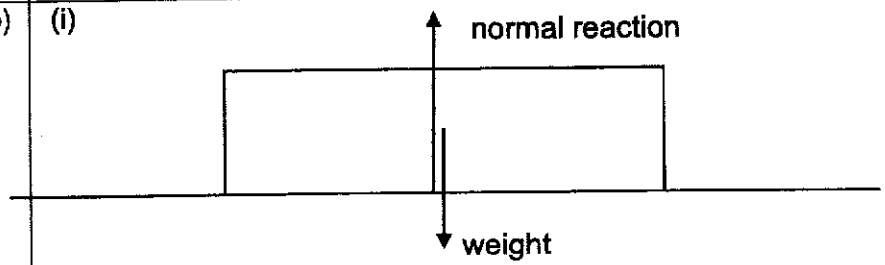
Mark Scheme
Secondary 3 E Science Physics Mid-Year Exam 2019

SECTION A (20 marks)

Qn no.	Answer	Comment	Qn no.	Answer	Comment
1	**D**		11	**B**	
2	**D**		12	**B**	
3	**A**		13	**A**	
4	**B**		14	**B**	
5	**A**		15	**C**	
6	**C**		16	**B**	
7	**A**		17	**C**	
8	**A**		18	**C**	
9	**B**		19	**D**	
10	**A**		20	**A**	

Section B (30 marks)

<table>
<tr><td>No.</td><td>Working/Answer</td><td>Mark</td></tr>
<tr><td>1</td><td>
<table>
<tr><th>Factor</th><th>Symbol</th><th>Prefix</th></tr>
<tr><td>10^6</td><td>M</td><td>mega</td></tr>
<tr><td>10^{-6}</td><td>μ</td><td>micro</td></tr>
<tr><td>10^3</td><td>k</td><td>kilo</td></tr>
<tr><td>10^{-3}</td><td>m</td><td>milli</td></tr>
</table>
</td><td>1 mark for each 2 entries [2 m]</td></tr>
<tr><td>2</td><td>
<table>
<tr><td></td><td>inner diameter reading = 1.17 cm</td></tr>
<tr><td></td><td>outer diameter reading = 2.23 cm</td></tr>
<tr><td></td><td>thickness of wall of tube = (2.23 -1.17)/2 =1.06/2 cm = 5.3 mm</td></tr>
</table>
</td><td>1m
1m
1m (ECF)</td></tr>
<tr><td>3a</td><td>period is the time taken for one complete oscillation</td><td>1 m</td></tr>
<tr><td>3b</td><td>(i) (16.84 +16.77)/2x20 = 0.84 s</td><td>1 m</td></tr>
<tr><td></td><td>(ii)
<table>
<tr><th>Periodic time / s</th><th>Pendulum</th></tr>
<tr><td>0.65</td><td>Q</td></tr>
<tr><td>0.97</td><td>R</td></tr>
<tr><td>1.18</td><td>S</td></tr>
</table>
</td><td>1 m for any correct entry
1 m for the next two correct entry</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

4	speed = 400 m / 62.5 s = 6.4 m/s = 23.0 km/h	1 m 1 m 1 m
5 (a)	a = (20 – 0)/8 = 2.5 m/s^2	1 m 1 m
5 (b)	F_R = ma = 1920 x 2.5 = 4800 N	1 m (ECF) 1 m (ECF)
5 (c)	$F_R = F_D$ – friction $F_D = F_R$ + friction = 4800 + 1200 = 6000 N	1 m (ECF) 1 m (ECF)
6	scale = 1cm rep 10N correct drawing (graphical method) resultant force = 47 N (±5mm) weight = resultant force	2 m 1 m 1 m (ECF)
7 (a)	(i) Volume = l x b x h = 6.5 x 4 x 25 = 650 cm^3 (ii) density = mass / volume = 5.25x1000/650 = 8.08 g/cm^3	1 m 1 m (ECF) 1 m (ECF)
7 (b)	(i)  both forces shown (ii) Weight = mg = 5.25 x 10 = 52.5 N	1 m (both forces drawn) 1 m 1 m
7 (c)	smallest surface area = 4.0 cm x 6.5 cm = 26 cm^2 pressure = 52.5 / 26 = 2.02 N/cm^2	1 m 1 m (ECF)

<table>
<tr><td colspan="2">SECTION C (20 marks)</td><td></td></tr>
<tr><td>8 (a)</td><td>(i)
<table>
<tr><td>A to B</td><td>stationary</td></tr>
<tr><td>B to C</td><td>increasing speed at its greatest rate</td></tr>
<tr><td>C to D</td><td>increasing speed</td></tr>
<tr><td>D to E</td><td>braking</td></tr>
<tr><td>E to F</td><td>colliding with another car and stopping</td></tr>
</table>
(ii) Upon braking → friction increases → forward driving force is removed so resultant force is in opposite direction so car decelerates</td><td>1 m for each correct 2 entries
3 m for all correct entries

1 m</td></tr>
<tr><td>8 (b)</td><td>FG – stationary
GH – car moves backwards and then stops
HJ – stationary
JK – increases speed in forward direction</td><td>1 m
1 m
1 m
1 m</td></tr>
<tr><td>8 (c)</td><td>a = (20-15) / (25 – 17)
= 0.625 m/s^2</td><td>1 m
1 m</td></tr>
<tr><td>9 (a)</td><td>A point through which the whole weight appears to act</td><td>1 m</td></tr>
<tr><td>9 (b)</td><td>(i) Total Moment = (0.2 N x 0.4 m) + (1.0 x 0.7) + (3.0 x 1.2)
= 0.04 + 0.7 + 3.6
= 4.34 Nm

(ii) arrange such that heavier clothes are closer to left hand
clockwise moment due to the clothes is lesser → easier to handle the pole</td><td>2 m

1 m

1m
1m</td></tr>
<tr><td>9 (c)</td><td>(i) 9.3 (a) X is closer to base
9.3 (b) X is higher within the water and base

(ii) for wider base, the line of action of weight (at CG) is likely to stay within base even though vase is tilted at a greater angle → vase is more stable</td><td>1 m
1 m

1 m
1 m</td></tr>
</table>

10 (a)	Pressure = force / area = 640 N / 2.0 cm = 320 N/cm^2	 1 m 1 m
10 (b)	Force = Pressure x area = 320 x 18 = 5760 N	 1 m (ECF) 1 m
(c)	frictional force	1 m
(d)	distance between brake pedal and pivot is **more than** distance between piston A and pivot Moment of force (turning effect) due to driver's foot is **equal** to moment of force on piston So, the **lesser the perpendicular distance of piston to pivot, the more force is** exerted on the piston.	1 m 1 m 1 m
(e)	any two: 1. make the distance of piston to pivot lesser 2. make brake pedal longer 3. cross-section area of cylinder A smaller 4. cross-section area of cylinder B larger	2 m

End of markscheme