ORCHID PARK SECONDARY SCHOOL
Mid-Year Examination 2019

CANDIDATE NAME

CLASS 3 A INDEX NUMBER

SCIENCE (PHYSICS) **5076**

Paper 1 and 2 Theory **14 May 2019**

Secondary 3 Express **1 hour 15 minutes**

Setter: Mr Jason Law **50 Marks**

Additional Materials: OTAS

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class on all the work you hand in.
Write in dark blue or black ink on both sides of the paper.
Do not use paper clips, glue or correction fluid.
The use of a 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 fifteen** multiple choice questions in this section. Choose the **one** (A, B, C or D) you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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

Section C
Answer **ONE** question.
Write your answer in the spaces provided on the question paper.

Take gravitational field strength, g, to be 10 N/kg.
The number of marks is given in brackets [ ] at the end of each question or part question.

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Section A	15
Section B	25
Section C	10
Total	50

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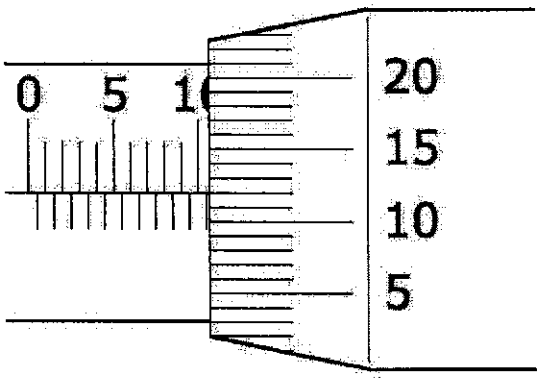
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Section A: Multiple Choice Questions [15 marks]

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 Optical Answer Sheet.

Answer **all** the questions in this section.

A1 A micrometer screw gauge is shown below.



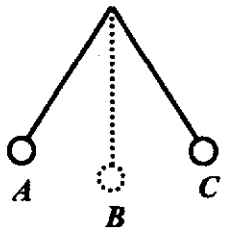
What is the reading shown?

A 10.03 cm **B** 10.12 cm **C** 10.21 cm **D** 10.62 cm

A2 Which of the following group of physical quantities consists of scalar quantities only?

A acceleration, weight, work done
B displacement, speed, time
C mass, energy, velocity
D length, time, volume

A3 A pendulum oscillates between position A and C. B is the mid-point of A and C, as shown below.



If it takes 0.15 s to go from A to B, what is the period of the pendulum?

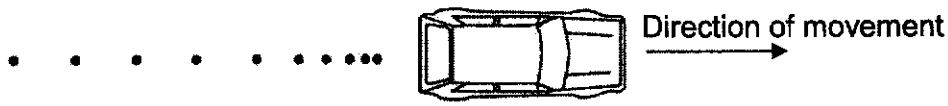
A 0.20 s **B** 0.40 s **C** 0.60 s **D** 0.80 s

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A4 Oil drips at a constant rate from a moving car and the interval between drips show the distance travelled in the same amount of time.

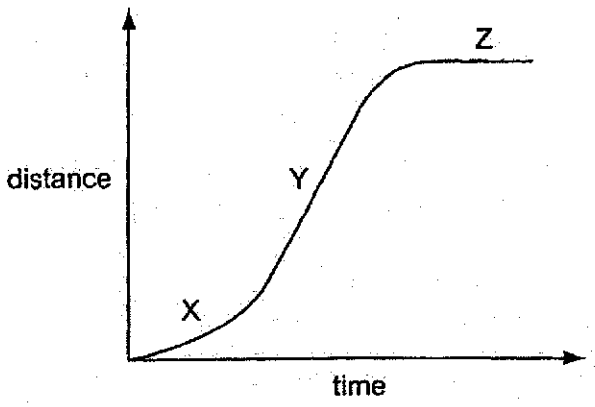
The diagram shows the pattern of the drips on a road



Which statement describes the motion of the car?

A It accelerated and then moved at a steady speed.
B It accelerated and then slowed down.
C It moved at a steady speed and then slowed down.
D It moved at a steady speed and then accelerated.

A5 The distance travelled by a scooter over time is shown below.

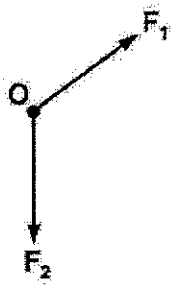


Which statement is **correct**?

A At X, the scooter has zero acceleration.
B At X, the scooter's speed is decreasing.
C At Y, the scooter's speed is uniform.
D At Z, the scooter is accelerates uniformly.

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A6 Two forces F_1 and F_2 act on an object O in the directions shown.



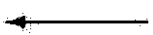
What is the direction of the resultant force?

A



B

C



D



A7 Which of the following describes a gravitational field?

A The gravitational force acting per unit mass
B The gravitational force acting per unit weight
C The region where a mass experiences a force due to gravitational attraction
D The region where a weight experiences a force due to gravitational attraction

A8 On the Earth, the gravitational field strength is 10 N/kg. On the Moon, the gravitational field strength is 1.6 N/kg.

If an object has a weight of 100 N on Earth, what is its weight on the Moon?

A 10 N **B** 16 N **C** 62 N **D** 160 N

A9 A moving aeroplane on the runway has a large mass.

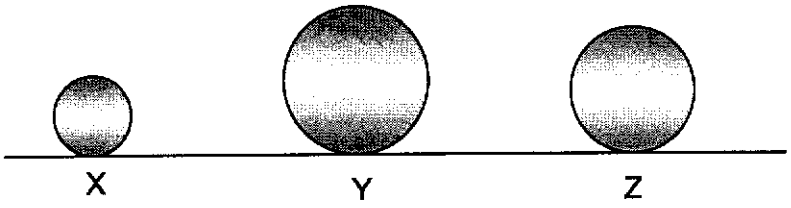
How difficult is it to make it start moving and to slow it down?

	To start moving	To slow down
A	Difficult	Difficult
B	Difficult	Easy
C	Easy	Difficult
D	Easy	Easy

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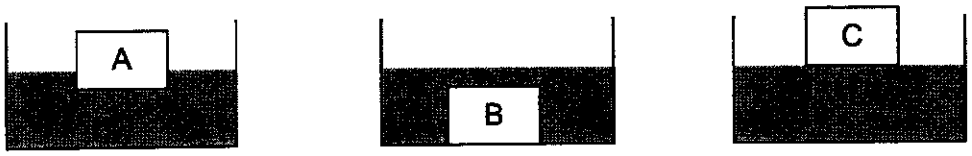
A10 A student examines three copper spheres of different sizes.



Which of the following is true?

A All the spheres have equal density and equal mass.
B All the spheres have equal mass but different densities.
C All the spheres have different masses but sphere X has the least density.
D All the spheres have equal density but sphere Y has the greatest mass.

A11 Three objects A, B and C are introduced into the same liquid as shown below.

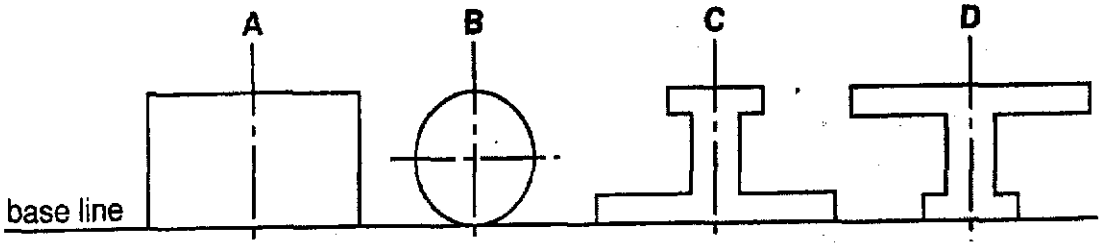


Which of the following shows the densities of the objects in increasing order?

A A, B, C
B B, A, C
C B, C, A
D C, A, B

A12 The diagram shows four shapes, cut from the same piece of card.

Which shape has the lowest centre of gravity?

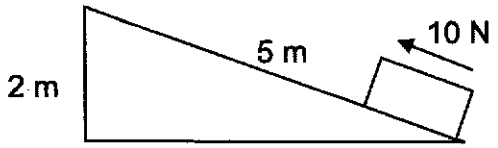


A13 Which of the following is **not** an example of work done?

A Carrying a stack of books
B Pushing a cart of books
C Sliding a book across the floor
D Throwing a book vertically

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A14 A box of mass 2.0 kg is pulled up a slope as shown below. The force exerted to pull the box up to the top of the slope is 10 N.



What is the friction experienced by the box due to the slope?

A 0 N **B** 2 N **C** 8 N **D** 10 N

A15 A cyclist accelerates down a slope.



How does the cyclist's energy change?

	Gravitational potential energy	Kinetic energy
A	Decreases	Decreases
B	Decreases	Increases
C	Increases	Decreases
D	Increases	Increases

– End of Section A –

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Section B: Structured Questions [25 marks]

Write your answers to all questions in this section on the lines or in the spaces provided.

Answer **all** the questions in this section.

B1 A student makes some measurements on an elephant shown in Fig. 1A.

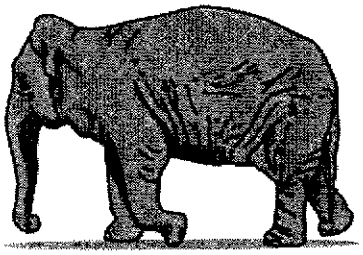


Fig. 1A

(a) The measurements are recorded and shown in the Fig. 1B.

Complete the table by adding a suitable unit for each measurement. One example has been filled in for you.

measurements	value	unit
mass of elephant	6000	
height of elephant	3.0	
average area of an elephant's foot	0.125	cm^2

Fig. 1B [1]

(b) Using information from Fig. 1B,

(i) Calculate the weight of the elephant.

weight = ... N [2]

(ii) Calculate the pressure the elephant exerts on the ground when it is standing on four feet.

pressure = ... N/cm^2 [3]

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B2 The graph in Fig. 2 shows three types of motion.

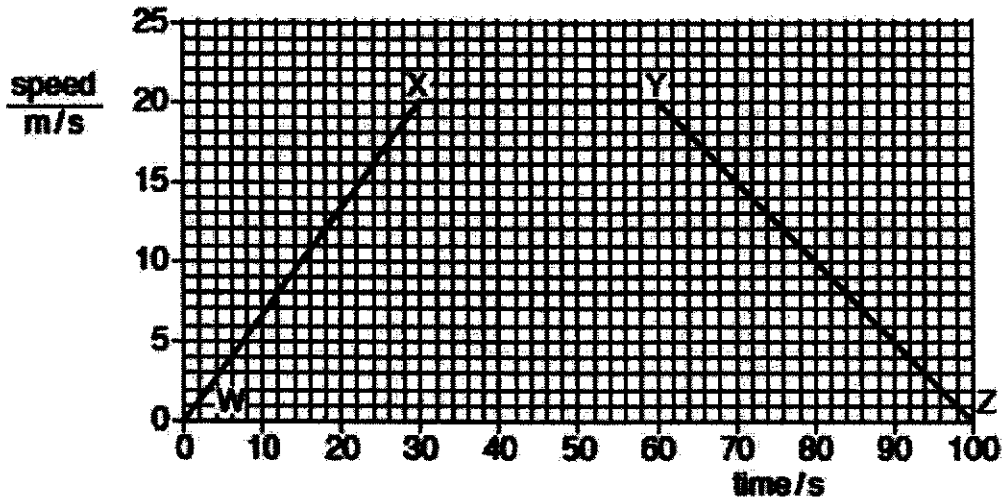


Fig. 2

(a) Complete the table to show when each type of motion occurs. Use the letters shown on Fig. 2. The first row is done for you.

motion	start of motion	end of motion
acceleration	W	X
deceleration		
constant speed		

[2]

(b) The size of the acceleration is greater than the deceleration.

Describe how the graph in Fig. 2 shows this.

.....

..... [1]

(c) Calculate

(i) the total distance travelled;

distance = ... m [2]

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(ii) average speed for the entire travel.

average speed = ... m/s [2]

B3 A block of mass 5.0 kg slides from point A to point C as shown in Fig. 3

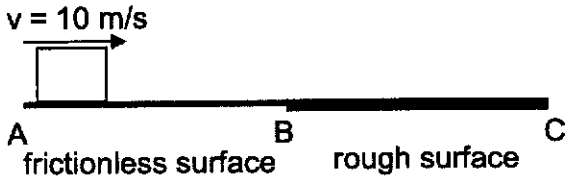


Fig. 3

AB is a frictionless surface while BC is a rough surface. The block starts moving from A with a speed of 10 m/s, and starts decelerating uniformly between B to C.

(a) The block has a speed of 10 m/s just as it enters B.

Explain, in terms of forces, why this is so.

.....

.....

..... [2]

(b) The block took 5.0 s to travel between BC and slowed down to 4.0 m/s at C.

Determine the

(i) deceleration of the block between BC;

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

(ii) resultant force experienced by the block between BC.

resultant force = ... N [2]

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B4 A student carries out an experiment to determine the density of a lump of metal. Its mass and volume were determined to be 75 g and 20 cm^3 respectively.

(a) The student uses the set up shown in Fig. 4 to determine its volume.

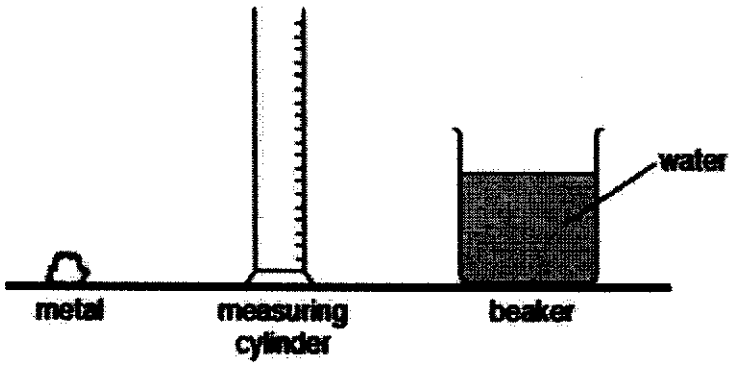


Fig. 4

(i) Describe briefly how the volume of the metal can be determined using the apparatuses shown in Fig. 4.

.....

.....

.....

.....

..... [3]

(ii) The method described in **(a)(i)** is not suitable to determine the volume of a low density object such as Styrofoam.

Explain why.

.....

..... [1]

(b) Calculate the density of the lump of metal.

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

– **End of Section B** –

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Section C: Free Response Questions [10 marks]
Write your answers to all questions in this section on the lines or in the spaces provided.

Answer **only one** of the questions in this section.

C1 **(a)** .State the Principle of Moments.

.....

.....

..... [1]

(b) A uniform rod which is 2.0 m long in length is shown in Fig. 1A. The weight of the rod is 210 N.

It is balanced by suspending it using ropes X and Y, which have tensions P and Q in them respectively. The rod is in equilibrium.

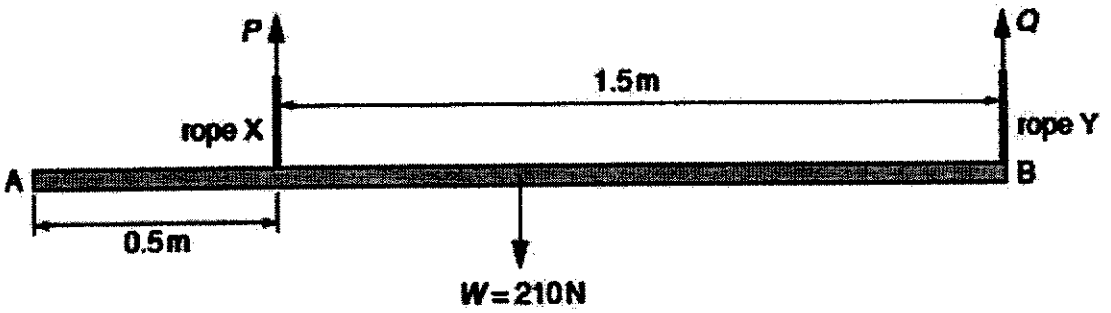


Fig. 1A

(i) By taking moments about point B, calculate the moment due to the weight of the rod, *W*.

moment due to *W* = ... [2]

(ii) Determine the value of P, by taking moments about point B.

P = ... [2]

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(iii) Hence, determine the value of *Q*.

Q = ... [1]

(c) A plastic bottle is partially filled with water as shown in Fig. 1B below.

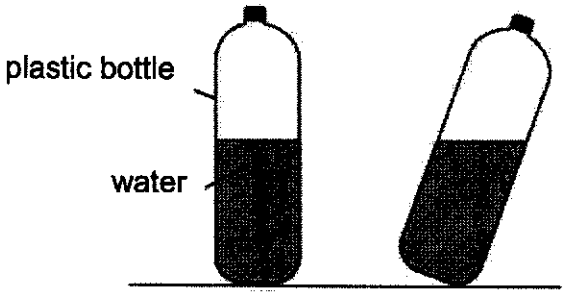


Fig. 1B

(i) When pushed to the right slightly as shown in Fig. C1B, the plastic bottle is still able to return to its original position.

Explain why.

.....

.....

..... [2]

(ii) The plastic bottle is now completely filled with water.

Describe and explain any difference in observation when the now completely filled plastic bottle is now pushed to the right.

.....

.....

..... [2]

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C2 A 40 kg package is raised using a conveyor belt as shown in Fig. 2.

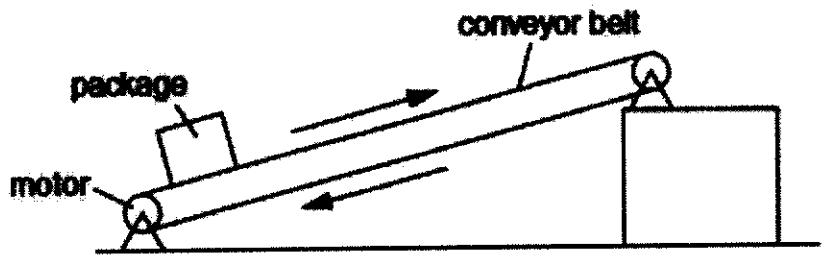


Fig. 2

The package is raised through a vertical height of 3.5 m.

(a) Calculate the increase in the gravitational potential energy of the package when it is raised through the vertical height of 3.5 m.

increase = ... [2]

(b) The total energy supplied by the motor in 3.8 s is 1900 J

(i) Determine the speed of the package as it moves on the conveyor belt.

speed = ... [2]

(ii) Calculate the total power supplied by the motor.

total power = ... [2]

(c) The electrical power supplied by the motor is much greater than your answer to **(b)(ii)**.

Explain why this is so, by making reference to how the principle of conservation of energy applies to this system.

.....

.....

..... [2]

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(d) A package of mass greater than 40 kg is now raised on the same conveyor belt through the same height.

Assume that the power supplied by the motor to raise packages is the same as in **(b)**.

Suggest and explain how this increase in mass will affect the operation of the conveyer belt.

.....

.....

..... [2]

– **End of Section C** –

– **End of Paper** –

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Mid-Year Examination 2019

Marker 1	Mr Jason Law
Marker 2	
Marker 3	
Marker 4	

SCIENCE (PHYSICS)	**5076**
Paper 1 and 2 Theory	**14 May 2019**
Secondary 3 Express	**1 hour 15 minutes**
Setter: Mr Jason Law	**50 Marks**
Additional Materials: Optical Answer Sheet	

Answer Cover Page

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MYE 2019
Mark Scheme: 3E SCI (PHY)

Section A

A1	D	**A6**	D	**A11**	D
A2	D	**A7**	C	**A12**	C
A3	C	**A8**	B	**A13**	A
A4	C	**A9**	A	**A14**	B
A5	C	**A10**	D	**A15**	B

Section B

B1 **(a)**

measurements	value	unit
mass of elephant	6000	kg
height of elephant	3.0	m
average area of an elephant's foot	0.125	cm^2

B1

NOTE: No partial award.

(b)

(i) $W = mg = 6000 \times 10$ B1
$= \underline{60\ 000}$ N A1

(ii) $A_T = 4 \times 0.125 = 0.50\ cm^2$ C1
$p = \frac{F}{A_T} = \frac{60000}{0.50}$ B1
$= \underline{120\ 000}\ N/cm^2$ A1

B2 **(a)**

motion	start of motion	end of motion
acceleration	W	X
deceleration	Y	Z
constant speed	X	Y

B2

NOTE: Award [B1] per correct row

(b) Gradient of WX is greater than YZ OR reverse argument B1
OR calculation of gradient of WX greater than that of YZ
OR description of determining gradient of WX being greater than that of YZ
OR time taken for acceleration is shorter than that for deceleration

(c)

(i) distance = area under graph = ½ × (30 + 100) × 20 B1
$= \underline{1300}$ m A1

(ii) $v_{avg} = \frac{d_T}{t_T} = \frac{1300}{100}$ B1
$= \underline{1.3}$ m/s A1

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B3 **(a)**

- No horizontal forces act on block after it moves from A on block OR No resultant forces act on block OR idea of balanced forces on block — B1
- No acceleration OR no deceleration OR Does not speed up OR Does not slow down OR Remains at constant speed — B1

(b)

(i) deceleration = $-a = -\frac{(4)-(10)}{(5)}$ — B1

$= 1.2\ m/s^2$ — A1

(ii) $F_{net} = ma = 5 \times 1.2$ — B1

$= 6\ N$ — A1

NOTE: Ignore +/– sign for a

B4 **(a)**

(i)

- Add known volume of water from beaker into measuring cylinder and note initial volume of water — B1
- Add lump of metal into measuring cylinder and note new/final volume of water — B1
- Difference between new/final volume and initial volume of water will be the volume of lump of metal — B1

NOTE: Accept OWTTE

(ii) Floats on surface of water OR unable to sink OR unable to displace correct volume of water equivalent to volume of Styrofoam — B1

NOTE: Accept other reasonable answers

(b) $\rho = \frac{m}{V} = \frac{75}{20}$ — B1

$= 3.75\ g/cm^3$ — A1

Section C

NOTE: Deduct [1] per whole question if missing/wrong units given for any part.

C1 **(a)** For object in equilibrium, sum of clockwise moment about a pivot/point is equal to sum of anticlockwise moment about the same pivot/point — B1

(b)

(i) moment = $W \times \perp_d = 210 \times 1.00$ — B1

$= 210\ N\ m$ — A1

(ii) $P \times 1.5 = 210\ N$ — B1

$P = 140\ N$ — A1

(iii) $Q = 210 - P = 70\ N$ — A1

(c)

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(i) ANY ONE: B1
- CG is raised
- Line of action of weight still falls within base area

- (Anticlockwise) moment about pivot causes plastic bottle to return to original position B1

(ii) - Bottle topples B1

ANY ONE: B1
- CG is raised
- More mass nearer to top compared to case in (c)(i)
- (Clockwise) moment about pivot

C2 **(a)** increase in GPE = $mg\Delta h = 40 \times 10 \times 3.5$ B1
= 1400 J A1

(b)
(i) $KE = \frac{1}{2}mv^2 = \frac{1}{2} \times 40 \times v^2 = 1900 - 1400$ B1
$v = \ldots =$ 5 m/s A1

(ii) $P = \frac{E}{T} = \frac{1900}{3.8}$ B1
= 500 W A1

(c)
- Energy also converted to thermal energy (+ others) B1
- Due to movement of conveyor belt OR Due to friction as conveyor belt moves B1

(d) ANY ONE: B1
- Motor needs to operate over a longer time
- Conveyor belt moves slower

ANY ONE explanation: B1
- More work done required to raise larger mass
- More energy to be converted into gravitational potential energy for larger mass
- Not enough power to raise larger mass now

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