

Centre of Mass

Question Paper

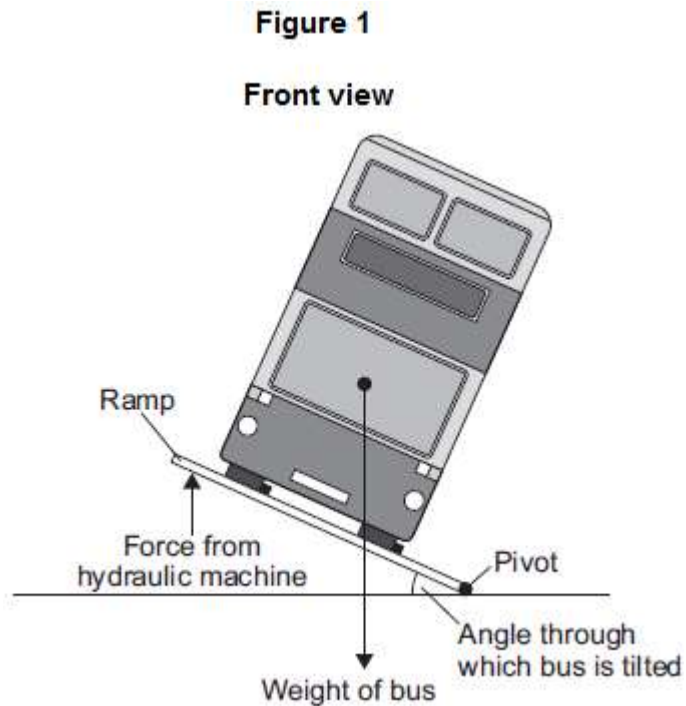
Level	GCSE
Subject	Physics
Exam Board	AQA
Unit	P3
Topic	Centre of Mass
Difficulty Level	Gold Level
Booklet	Question Paper

Time Allowed: 40 minutes

Score: /40

Percentage: /100

Q1. Before a new bus can be used on the roads, it must pass a stability test. **Figure 1** shows how the bus is tested.



(a) (i) The bus will topple over if the ramp is tilted at too great an angle.
Explain why.

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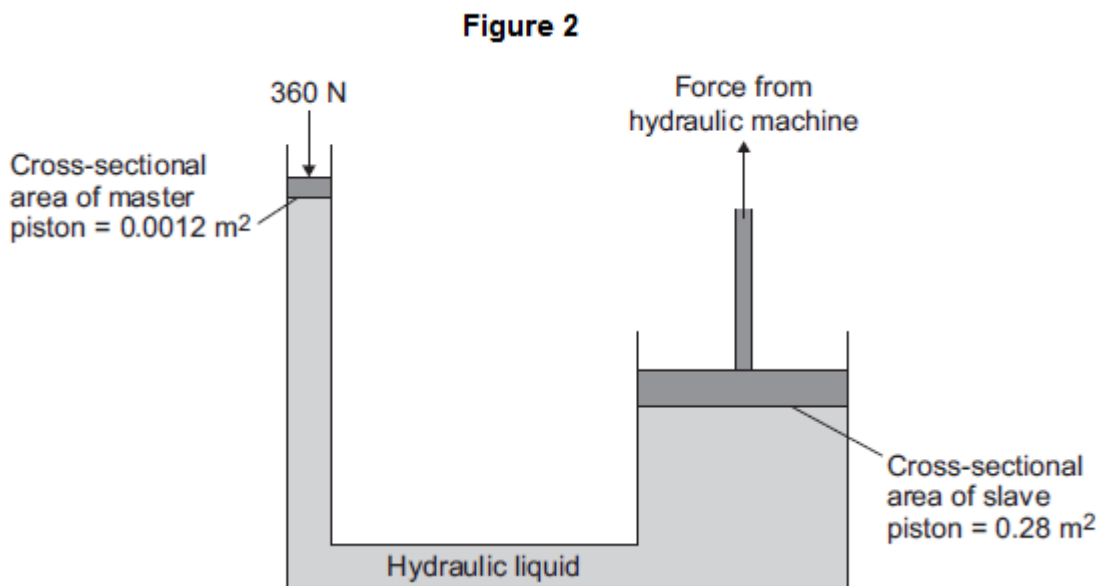
(2)

(ii) The bus is tested to angles of tilt far greater than it would experience in normal use.
Suggest **two** reasons why.

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(2)

- (b) **Figure 2** shows the hydraulic machine that is used to make the ramp tilt.



The pressure applied to the hydraulic liquid at the master piston is the same as the pressure applied by the hydraulic liquid to the slave piston.

- (i) State the property of the liquid that keeps the pressure at both pistons the same.

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(1)

- (ii) A 360 N force acts on the master piston.

Use information from **Figure 2** to calculate the force applied by the hydraulic liquid to the slave piston.

Use the correct equation from the Physics Equations Sheet

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Force = N

(3)

(Total 8 marks)

Q2.(a) **Figure 1** shows a sheet of card.

Figure 1



Describe how to find the centre of mass of this sheet of card.

You may draw diagrams as part of your answer.

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(5)

(b) **Figure 2** shows a person in his wheelchair.

Figure 2



AndreyPopov/iStock/Thinkstock

- (i) Tipping the wheelchair at a large angle may cause it to become unstable and to topple over.

Explain why.

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(2)

- (ii) Some disabled athletes use a wheelchair in sports.

State **two** ways of changing the design of the wheelchair in **Figure 2** so that it is more stable when used by a disabled athlete.

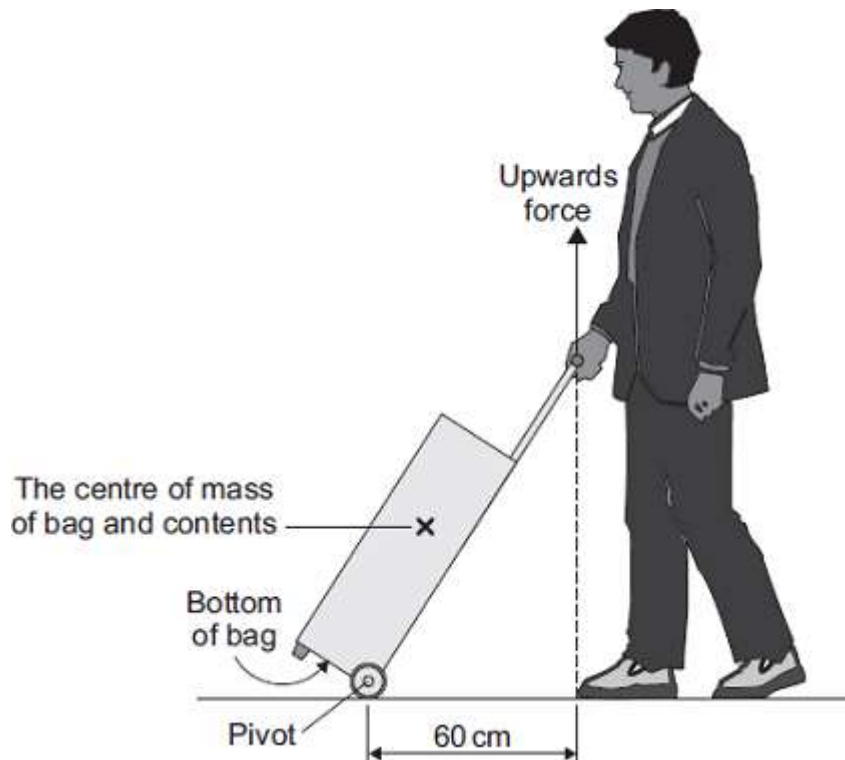
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2

(2)
(Total 9 marks)

Q3. The diagram shows a man standing in an airport queue with his wheeled bag.



- (a) The man applies an upward force to the handle of his bag to stop the bag from falling.

The moment of this force about the pivot is 36 Nm.

Calculate the upward force the man applies to the handle of his bag.

Use the correct equation from the Physics Equations Sheet.

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Force = N

(2)

- (b) When the man lets go of the bag handle, the bag falls and hits the floor.

Explain why.

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(2)

- (c) During his holiday the man visits the Foucault Pendulum in Paris, France.
The pendulum makes 10 complete swings every 160 seconds.

Calculate the frequency of the pendulum and give the unit.

Use the correct equation from the Physics Equations Sheet.

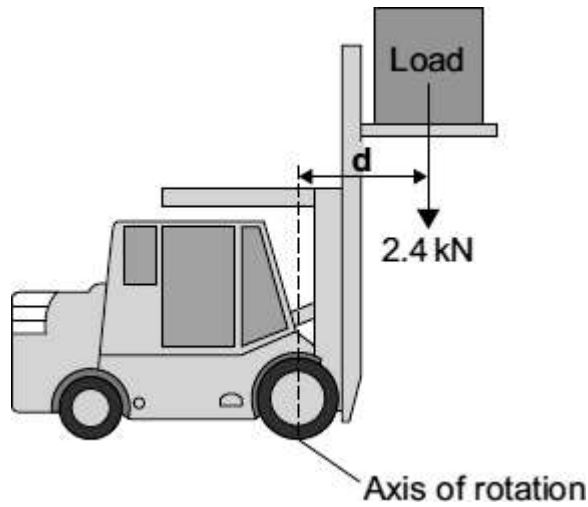
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Frequency =

(3)

(Total 7 marks)

- Q4.** The diagram shows a fork-lift truck with a load of 2.4 kN. The clockwise moment caused by this load is 2880 Nm.



(a) Use the equation in the box to calculate the distance **d**.

$\text{moment} = \text{force} \times \text{perpendicular distance from the line of action of the force to the axis of rotation}$

Show clearly how you work out the answer and give the unit.

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Distance **d** =

(3)

(b) This warning notice is in the driver's cab.

<p style="text-align: center;">Warning</p> <p style="text-align: center;">Maximum load 10.0 kN</p> <p style="text-align: center;">This load must not be exceeded</p>

Explain in terms of moments why the maximum load must not be exceeded.

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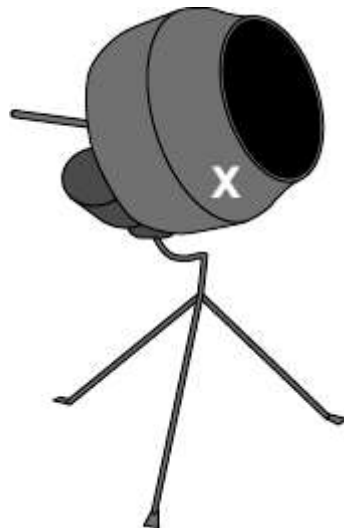
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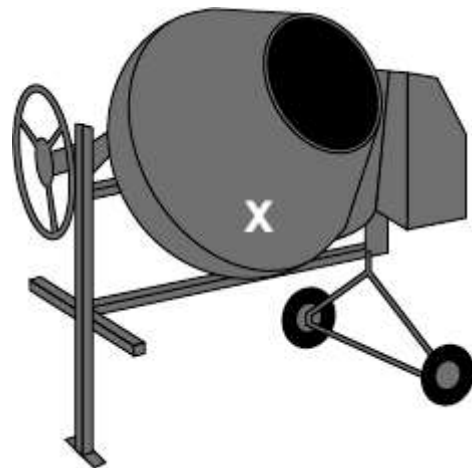
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(2)
(Total 5 marks)

Q5. The diagrams show two concrete mixers.



Concrete mixer A



Concrete mixer B

On each diagram, the centre of the white **X** marks the centre of mass of the concrete mixer and its contents.

(a) Complete the sentence to explain what the term *centre of mass* means.

The centre of mass of a concrete mixer and its contents is

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(1)

(b) Both diagrams are drawn to the same scale.

Concrete mixer **B** is more stable than concrete mixer **A**.

The two features which make concrete mixer **B** more stable are:

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(2)

(c) Use the terms 'line of action of the weight' and 'resultant moment' to explain why a stable concrete mixer does not fall over when it is given a small push.

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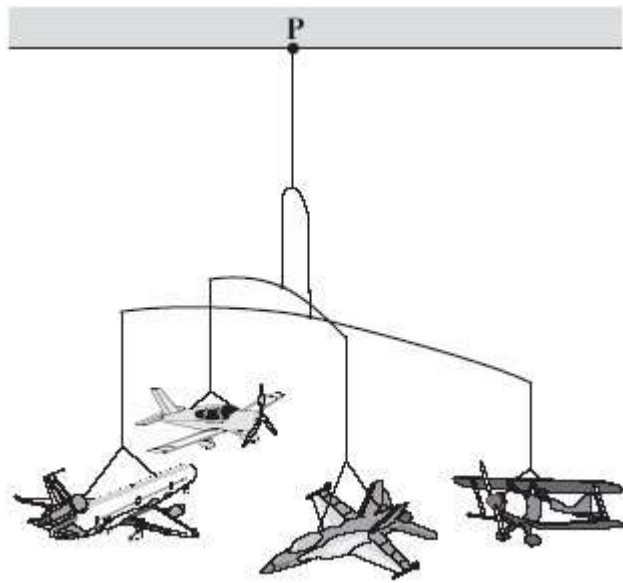
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(2)

(Total 5 marks)

Q6. (a) The diagram shows a child's mobile. The mobile hangs from point **P** on the ceiling of the child's bedroom.

(i) Mark the position of the centre of mass of the mobile by drawing a letter **X** on the diagram. Do this so that the centre of the **X** marks the centre of mass of the mobile.



(1)

(ii) Explain why you have chosen this position for your letter X.

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(2)

(b) The diagram shows a device which helps to prevent a ladder from falling over.



Use the term *centre of mass* to explain why the ladder, in the situation shown, is unlikely to topple over.
You may add to the diagram to illustrate your explanation.

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(3)
(Total 6 marks)