

Name:

Date:

# MOMENTS TEST 1

# AS-Level

Mark

Grade

# PHYSICS

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For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

## Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown

## Information

- The marks for the questions are shown in brackets

1

(a) The torque of a couple is given by

$$\text{torque} = Fs.$$

(i) With the aid of a diagram explain what is meant by a couple. Label  $F$  and  $s$  on your diagram.

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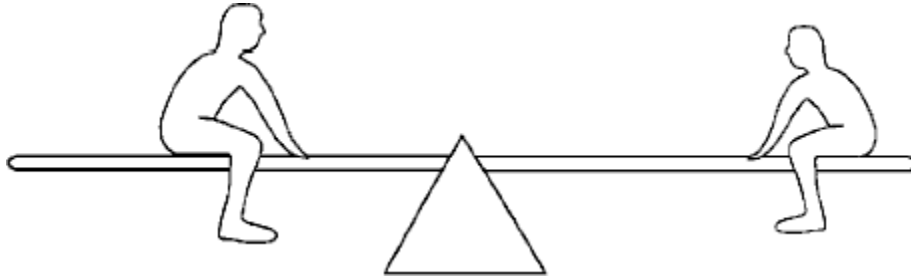
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(ii) State the unit for the torque of a couple.

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(4)

- (b) The see-saw shown in the diagram consists of a uniform beam freely pivoted at the centre of the beam. Two children sit opposite each other so that the see-saw is in equilibrium.



Explain why

- (i) the see-saw is in equilibrium,

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- (ii) the weight of the beam does not affect equilibrium.

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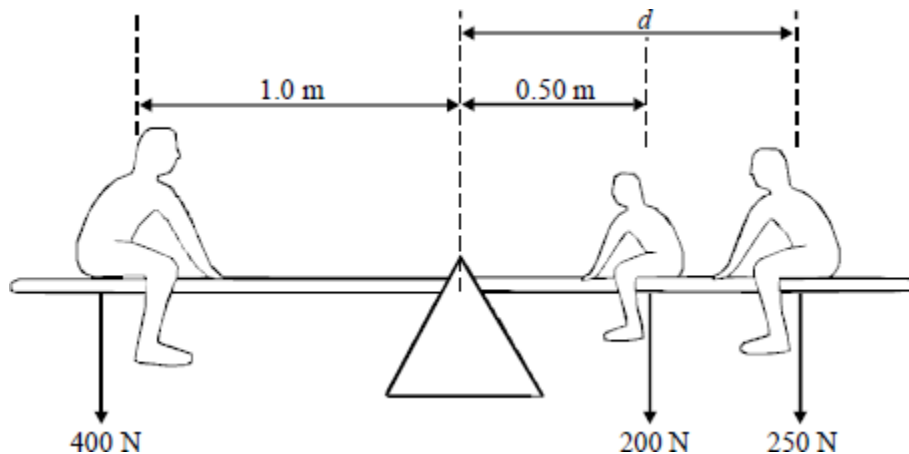
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**(3)**

- (c) The diagram shows the see-saw with three children of weights 400 N, 250 N and 200 N sitting so that the see-saw is in equilibrium.



Calculate the distance,  $d$ .

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(2)

(Total 9 marks)

2

- (a) State the principle of moments.

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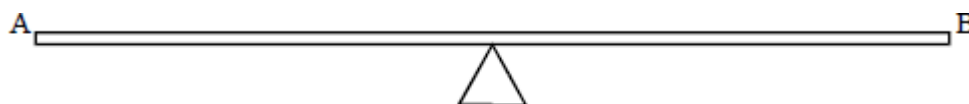
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(2)

- (b) The diagram shows a uniform metre ruler, AB, freely pivoted at its centre of mass.



Explain what is meant by the centre of mass.

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(1)

(c) A 1.0 N weight is placed on the ruler 0.30 m from the middle of the ruler towards A.

(i) Explain which way the pivot must be moved in order for equilibrium to be restored.

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(ii) Calculate the distance the pivot needs to be moved to restore equilibrium when the weight of the ruler is 0.50 N.

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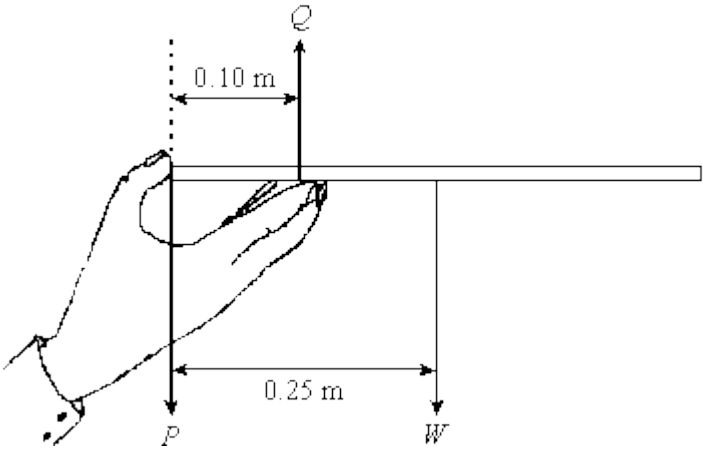
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**(5)**

**(Total 8 marks)**

3

A waiter holds a tray horizontally in one hand between fingers and thumb as shown in the diagram.



$P$ ,  $Q$  and  $W$  are the three forces acting on the tray.

- (a) (i) State **two** relationships between the forces that must be satisfied if the tray is to remain horizontal and in equilibrium.

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- (ii) If the mass of the tray is 0.12 kg, calculate the magnitude of the force  $W$ .

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- (iii) Calculate the magnitudes of forces  $P$  and  $Q$ .

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(6)

- (b) The waiter places a glass on the tray. State and explain where the glass should be positioned on the tray if the force,  $P$ , is to have the same value as in part (a).

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(2)

(Total 8 marks)

4

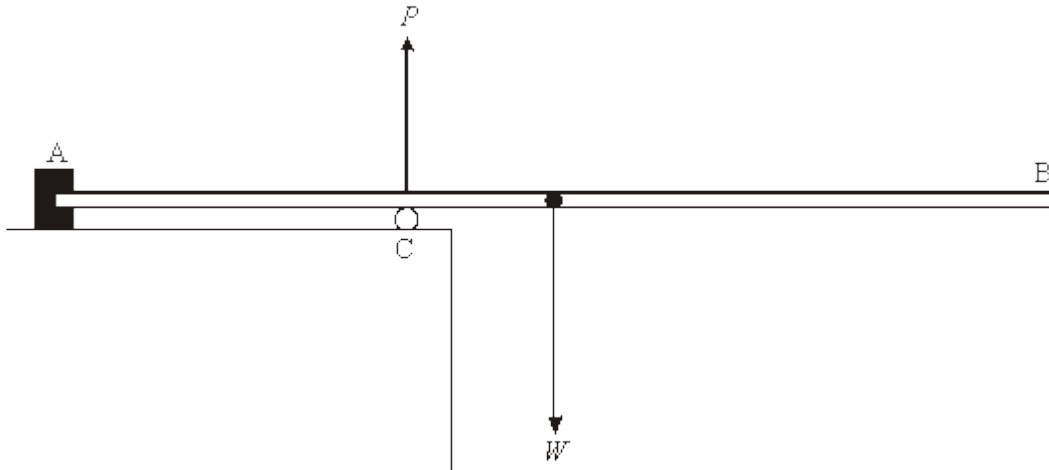
- (a) Define the moment of a force.

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(2)

- (b) The diagram shows a uniform diving board of weight,  $W$ , that is fixed at A. The diving board is supported by a cylinder at C, that exerts an upward force,  $P$ , on the board.



- (i) By considering moments about A, explain why the force  $P$  must be greater than the weight of the board,  $W$ .

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- (ii) State and explain what would be the effect on the force  $P$  of a girl walking along the board from A to B.

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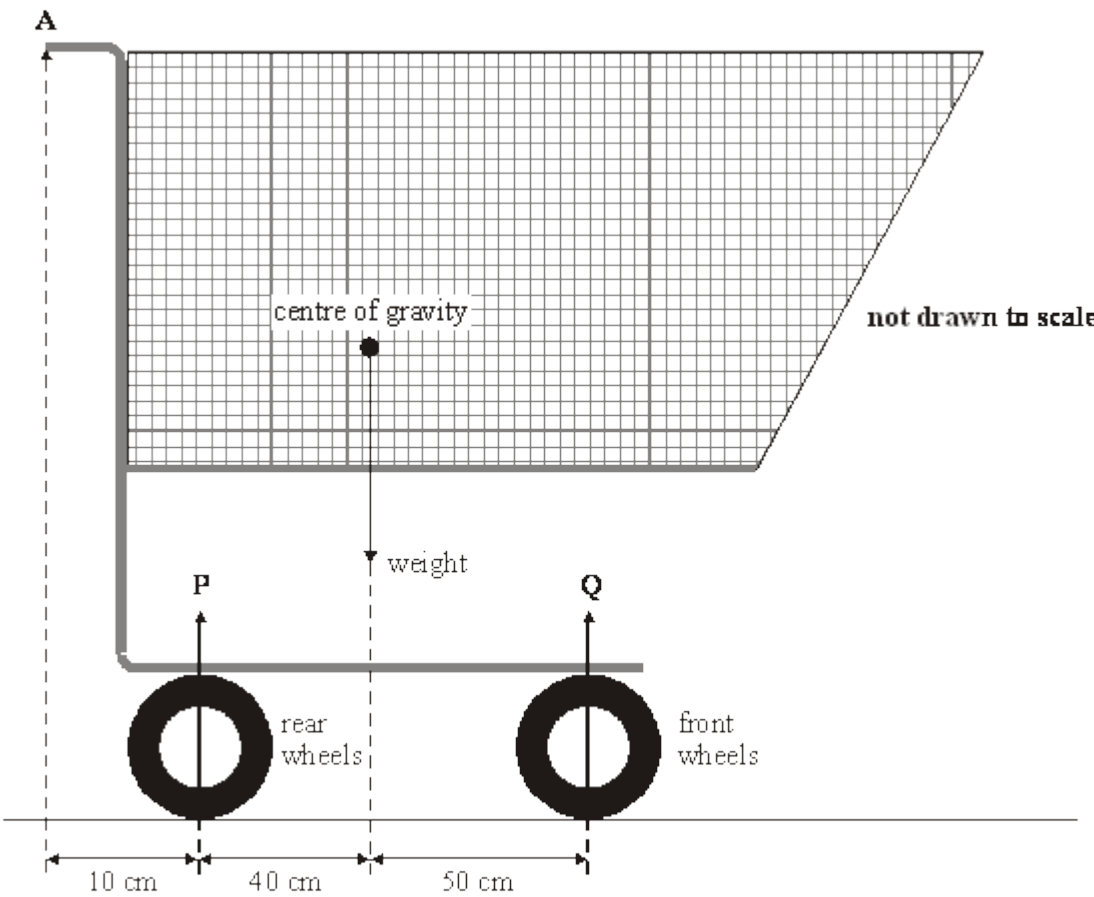
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(4)

(Total 6 marks)

5

The figure below shows a supermarket trolley.



The weight of the trolley and its contents is 160 N.

- (a) Explain what is meant by centre of gravity.

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(2)



(b) **P** and **Q** are the resultant forces that the ground exerts on the rear wheels and front wheels respectively. Calculate the magnitude of

(i) force **P**,

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(ii) force **Q**.

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**(3)**

(c) Calculate the minimum force that needs to be applied vertically at **A** to lift the front wheels off the ground.

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**(2)**

(d) State and explain, without calculation, how the minimum force that needs to be applied vertically at **A** to lift the rear wheels off the ground compares to the force you calculated in part (c).

You may be awarded marks for the quality of written communication in your answer.

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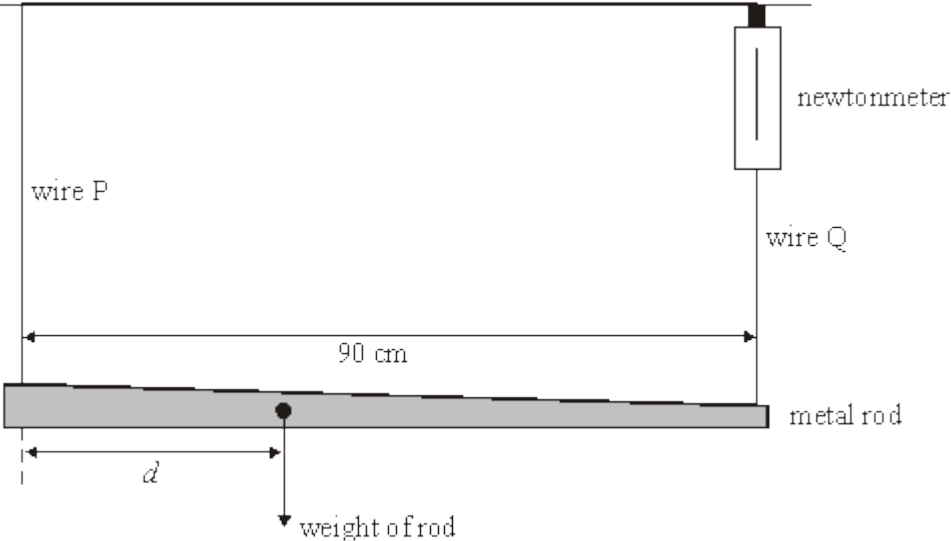
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**(3)**

**(Total 10 marks)**

6

The figure below shows an apparatus used to locate the centre of gravity of a non-uniform metal rod.



The rod is supported horizontally by two wires, P and Q and is in equilibrium.

(a) State **two** conditions that must be satisfied for the rod to be in equilibrium.

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(2)

(b) Wire Q is attached to a newtonmeter so that the force the wire exerts on the rod can be measured. The reading on the newtonmeter is 2.0 N and the weight of the rod is 5.0 N. Calculate

(i) the force that wire P exerts on the rod,

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(ii) the distance  $d$ .

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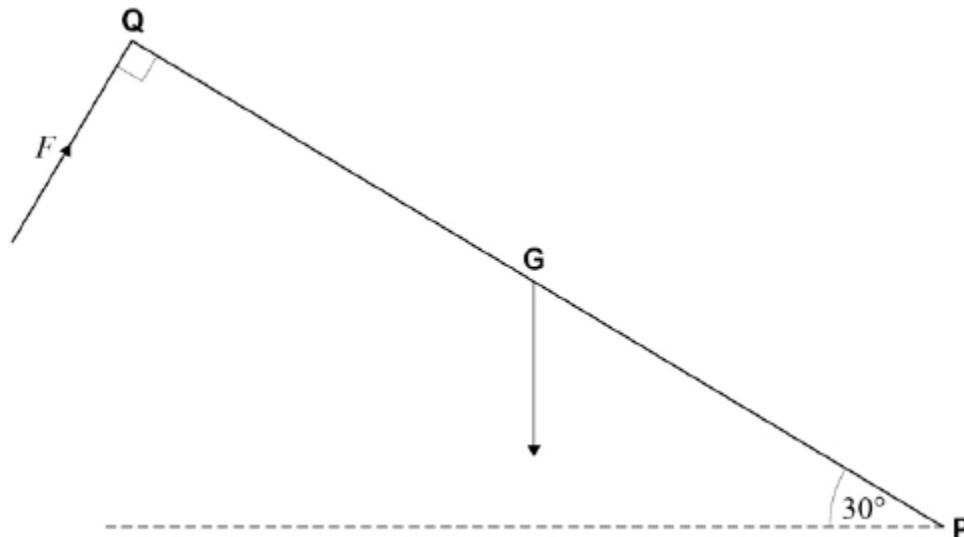
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(3)

(Total 5 marks)

7

A car bonnet, represented by **QP**, of mass 12 kg is pivoted at **P**. Its weight acts at **G** where **QG = GP = 1.0 m**.



What force,  $F$ , acting perpendicular to **QP** as shown, is required to hold the bonnet at  $30^\circ$  to the horizontal?

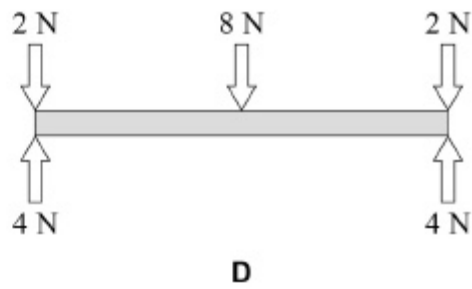
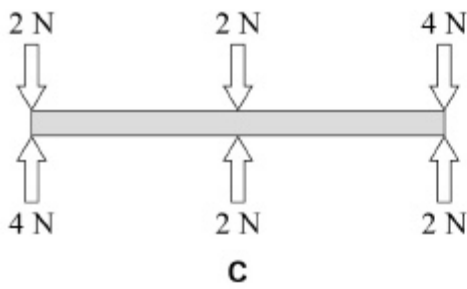
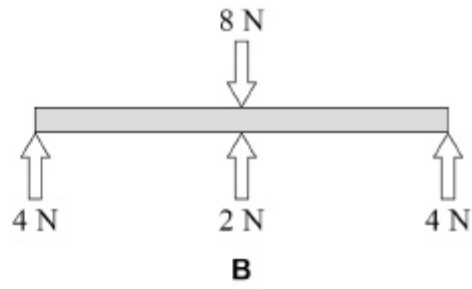
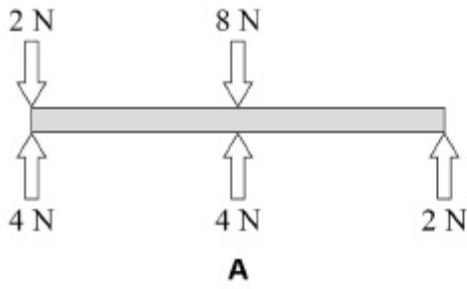
- A 29 N
- B 51 N
- C 59 N
- D 136 N

(Total 1 mark)

8

A light uniform rigid bar is pivoted at its centre. Forces act on the bar at its ends and at the centre.

Which diagram shows the bar in equilibrium?



A

B

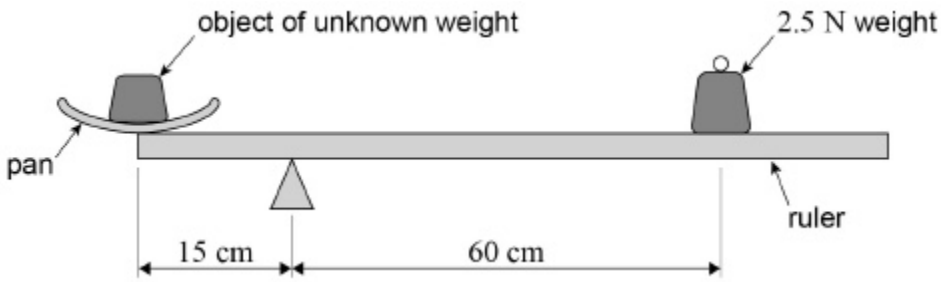
C

D

(Total 1 mark)

9

The diagram shows a uniform metre ruler of weight 1.5 N pivoted 15 cm from one end for use as a simple balance.



A scale pan of weight 0.5 N is placed at the end of the ruler and an object of unknown weight is placed in the pan. The ruler moves to a steady horizontal position when a weight of 2.5 N is added at a distance of 60 cm from the pivot as shown.

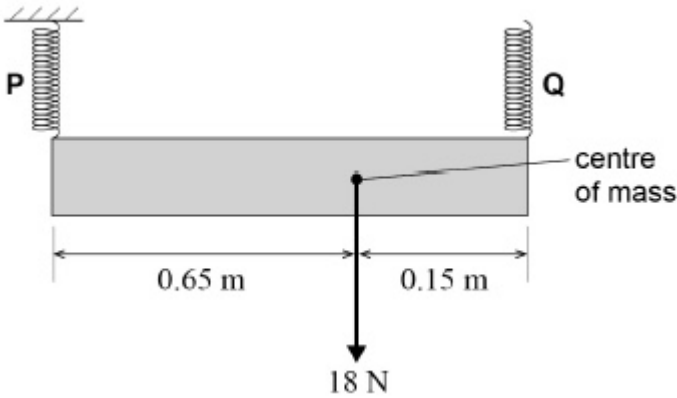
What is the weight of the object?

- A 9.5 N
- B 10.0 N
- C 13.0 N
- D 13.5 N

(Total 1 mark)

10

A non-uniform sign is 0.80 m long and has a weight of 18 N. It is suspended from two vertical springs **P** and **Q**. The springs obey Hooke's law and the spring constant of each spring is  $240 \text{ N m}^{-1}$ .



The top end of spring **P** is fixed and the top end of spring **Q** is adjusted until the sign is horizontal and in equilibrium.

What is the extension of spring **Q**?

**A** 0.014 m

**B** 0.038 m

**C** 0.049 m

**D** 0.061 m

**(Total 1 mark)**