Moments

Question paper 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Forces, Density & Pressure
Sub Topic	Moments
Paper Type	Theory
Booklet	Question paper 1

Time Allowed: **53 minutes**

Score: **/44**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 A rod PQ is attached at P to a vertical wall, as shown in Fig. 3.1.

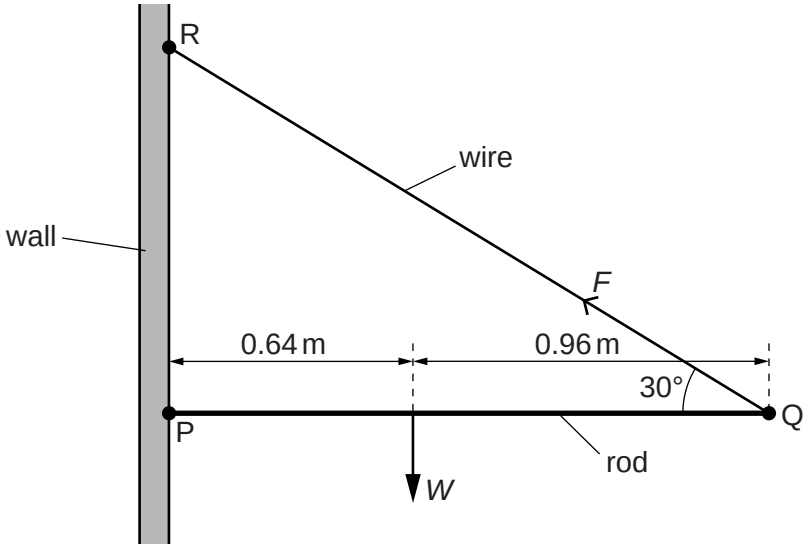

Fig. 3.1

The length of the rod is 1.60 m. The weight *W* of the rod acts 0.64 m from P. The rod is kept horizontal and in equilibrium by a wire attached to Q and to the wall at R. The wire provides a force *F* on the rod of 44 N at 30° to the horizontal.

(a) Determine

(i) the vertical component of *F*,

vertical component = ... N [1]

(ii) the horizontal component of *F*.

horizontal component = ... N [1]

(b) By taking moments about P, determine the weight *W* of the rod.

W = ... N [2]

(c) Explain why the wall must exert a force on the rod at P.

.....

.....

..... [1]

(d) On Fig. 3.1, draw an arrow to represent the force acting on the rod at P. Label your arrow with the letter S. [1]

2 **(a)** Define the *torque* of a couple.

.....

..... [2]

(b) A wheel is supported by a pin P at its centre of gravity, as shown in Fig. 4.1.

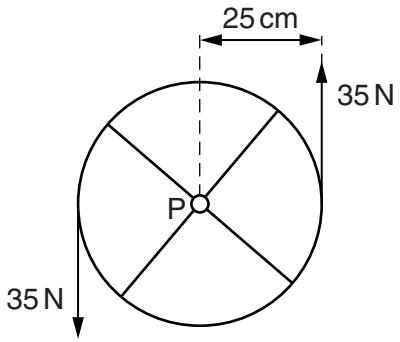

Fig. 4.1

The plane of the wheel is vertical. The wheel has radius 25 cm.
Two parallel forces each of 35 N act on the edge of the wheel in the vertical directions shown in Fig. 4.1. Friction between the pin and the wheel is negligible.

(i) List two other forces that act on the wheel. State the direction of these forces and where they act.

1. .....

2. .....
[2]

(ii) Calculate the torque of the couple acting on the wheel.

torque = ... N m [2]

(iii) The resultant force on the wheel is zero. Explain, by reference to the four forces acting on the wheel, how it is possible that the resultant force is zero.

.....

..... [1]

(iv) State and explain whether the wheel is in equilibrium.

..... [1]

3 **(a)** Define the *torque* of a couple.

.....

..... [2]

(b) A uniform rod of length 1.5 m and weight 2.4 N is shown in Fig. 2.1.

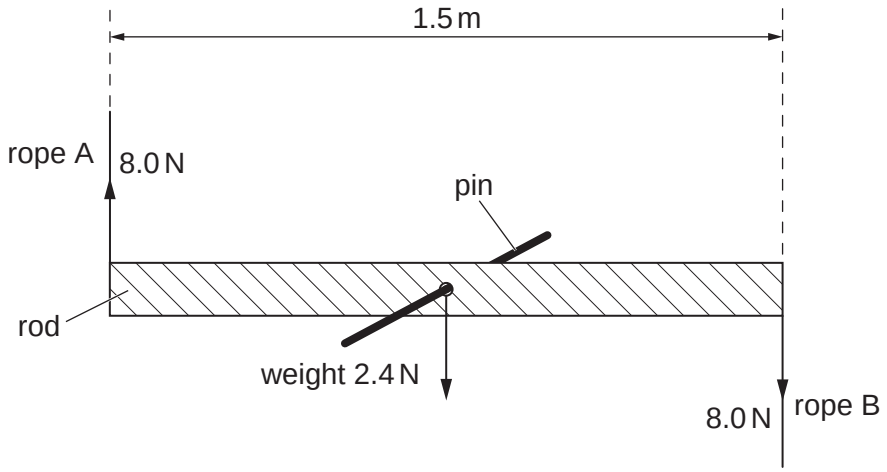

Fig. 2.1

The rod is supported on a pin passing through a hole in its centre. Ropes A and B provide equal and opposite forces of 8.0 N.

(i) Calculate the torque on the rod produced by ropes A and B.

torque = ... N m [1]

(ii) Discuss, briefly, whether the rod is in equilibrium.

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.....

.....

..... [2]

(c) The rod in **(b)** is removed from the pin and supported by ropes A and B, as shown in Fig. 2.2.

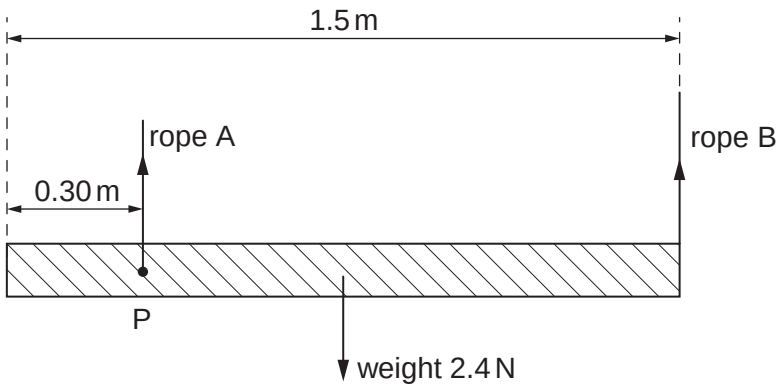

Fig. 2.2

Rope A is now at point P 0.30 m from one end of the rod and rope B is at the other end.

(i) Calculate the tension in rope B.

tension in B = ... N [2]

(ii) Calculate the tension in rope A.

tension in A = ... N [1]

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

.....

..... [2]

(b) Define *moment* of a force.

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..... [1]

(c) A student is being weighed. The student, of weight *W*, stands 0.30 m from end A of a uniform plank AB, as shown in Fig. 3.1.

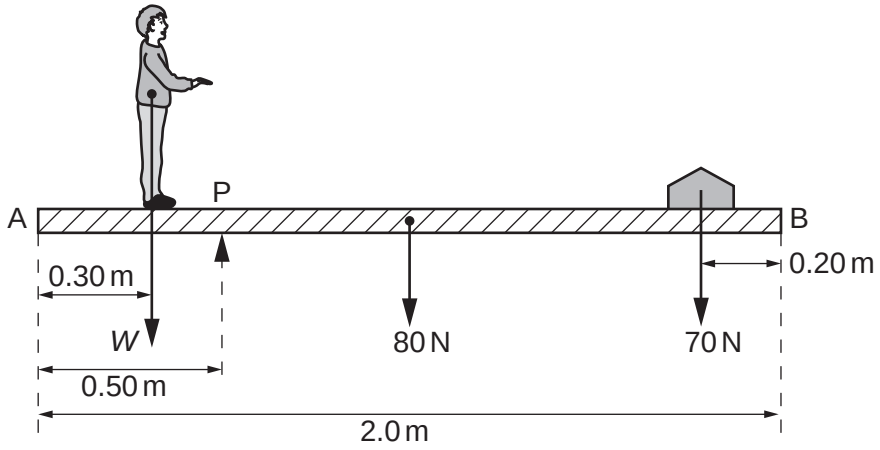

Fig. 3.1 (not to scale)

The plank has weight 80 N and length 2.0 m. A pivot P supports the plank and is 0.50 m from end A.
A weight of 70 N is moved to balance the weight of the student. The plank is in equilibrium when the weight is 0.20 m from end B.

(i) State the two conditions necessary for the plank to be in equilibrium.

1. .....

.....

2. .....

.....
[2]

(ii) Determine the weight *W* of the student.

W = ... N [3]

(iii) If only the 70 N weight is moved, there is a maximum weight of student that can be determined using the arrangement shown in Fig. 3.1. State and explain **one** change that can be made to increase this maximum weight.

.....

.....

..... [2]

5 **(a)** Define the *torque* of a couple.

.....

.....

..... [2]

(b) A torque wrench is a type of spanner for tightening a nut and bolt to a particular torque, as illustrated in Fig. 3.1.

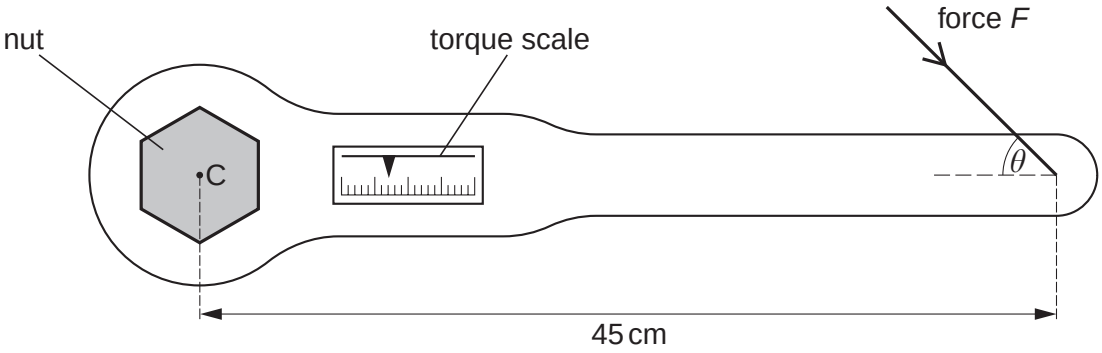

Fig. 3.1

The wrench is put on the nut and a force is applied to the handle. A scale indicates the torque applied.

The wheel nuts on a particular car must be tightened to a torque of 130 N m. This is achieved by applying a force *F* to the wrench at a distance of 45 cm from its centre of rotation C. This force *F* may be applied at any angle θ to the axis of the handle, as shown in Fig. 3.1.

For the minimum value of *F* to achieve this torque,

(i) state the magnitude of the angle θ that should be used,

θ = ... ° [1]

(ii) calculate the magnitude of *F*.

F = ... N [2]

6 **(a)** Distinguish between the moment of a force and the torque of a couple.

moment of a force .....

.....

.....

torque of a couple .....

.....

.....

[4]

(b) One type of weighing machine, known as a steelyard, is illustrated in Fig. 3.1.

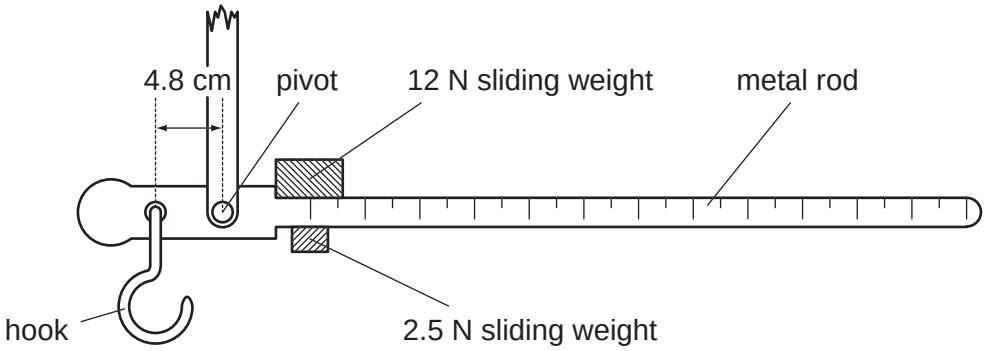

Fig. 3.1

The two sliding weights can be moved independently along the rod.

With no load on the hook and the sliding weights at the zero mark on the metal rod, the metal rod is horizontal. The hook is 4.8 cm from the pivot.

A sack of flour is suspended from the hook. In order to return the metal rod to the horizontal position, the 12 N sliding weight is moved 84 cm along the rod and the 2.5 N weight is moved 72 cm.

(i) Calculate the weight of the sack of flour.

weight = ……N [2]

(ii) Suggest why this steelyard would be imprecise when weighing objects with a weight of about 25 N.

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.....[1]