Moments

Have a go at the following exam questions.

OCR, G481, JANUARY 2009

4 **(a)** Define *torque of a couple*.

.....

..... **[1]**

(b) Explain why *moment of a force* and *torque of a couple* have the same unit N m.

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..... **[1]**

(c) Fig. 4.1 shows an irregular shaped metal plate of constant thickness that can swing freely about point **P**.

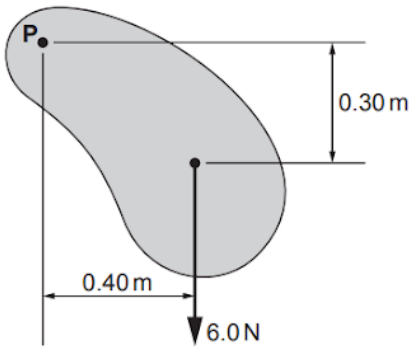

Fig. 4.1

(i) The weight of the plate is 6.0 N. With the plate in the position as shown in Fig. 4.1, calculate the clockwise moment of the weight of the plate about an axis through point **P**.

moment = ... N m **[1]**

(ii) Explain why the moment of the weight reduces to zero when the plate reaches the bottom of the swing.

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..... **[1]**

(d) Describe an experiment to determine the centre of gravity of the metal plate shown in Fig. 4.1.

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..... **[3]**

(e) Fig. 4.2 shows a section of the human forearm in equilibrium.

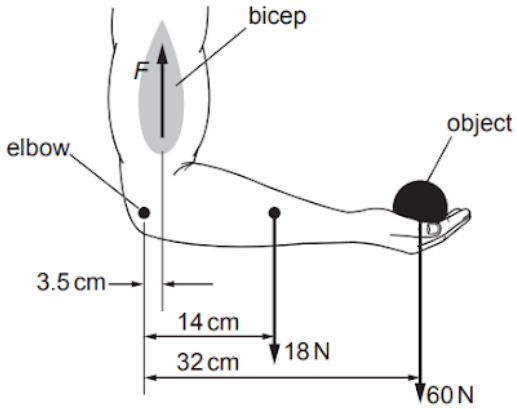

Fig. 4.2

The weight of the object in the hand is 60 N. The centre of gravity of this object is 32 cm from the elbow. The bicep provides an upward force of magnitude *F*. The distance between the line of action of this force and the elbow is 3.5 cm. The weight of the forearm is 18 N. The distance between the centre of gravity of the forearm and the elbow is 14 cm.

By taking moments about the elbow, determine the magnitude of the force *F* provided by the bicep.

F = ... N **[3]**

[Total: 10]

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6. *(a)* Explain, with the aid of a diagram, what is meant by the moment of a force about a point. [2]

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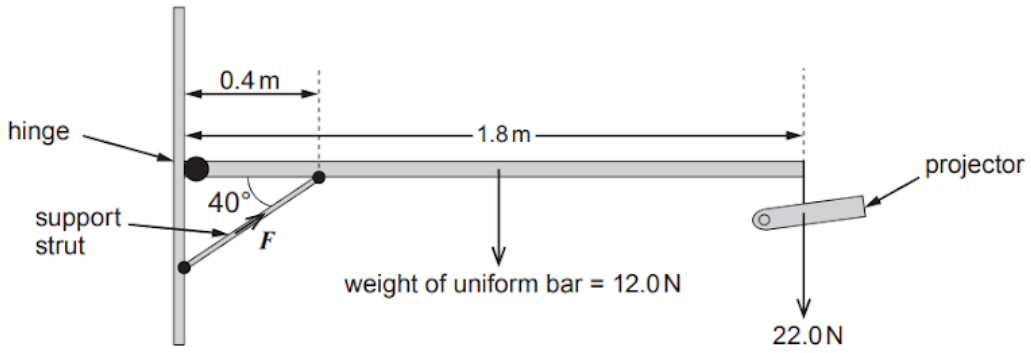
(b) A classroom projector is set up as shown.



(i) By taking moments about the hinge, show that the force, F, exerted by the support strut on the uniform bar is approximately 200 N. [3]

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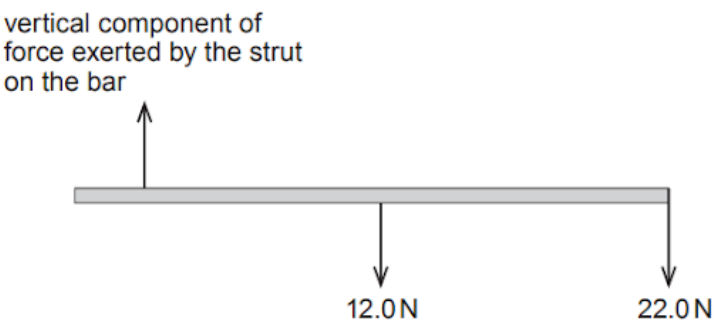
(ii) The free body diagram below shows **some of the vertical forces** acting on the uniform bar.



(I) Calculate the value of the **vertical component** of the force exerted by the strut on the bar. [1]

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(II) Indicate, with an arrow **on the diagram**, the direction of the vertical force on the bar due to the hinge. [1]

(III) Calculate the size of the vertical force on the bar due to the hinge. [1]

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6 **(a)** Fig. 6.1 shows two equal but opposite forces acting on an object.

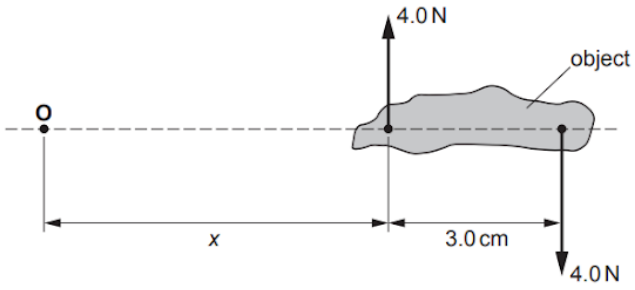

Fig. 6.1

The point **O** is at a distance *x* from the nearer of the two forces.

(i) The separation between the two parallel forces is 3.0 cm. Determine the torque of the couple exerted on the object.

torque = ... N m **[2]**

(ii) Calculate the total moment of the forces about the point **O** and state the significance of this value.

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..... **[3]**

(b) State two conditions necessary for an object to be in equilibrium.

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.....

..... **[2]**

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(c) A concrete paving slab has mass 45 kg and dimensions 0.600 m × 0.600 m × 0.050 m.

(i) Calculate the density of the concrete.

density = ... kg m^{-3} **[2]**

(ii) Fig. 6.2 shows the concrete paving slab in equilibrium.

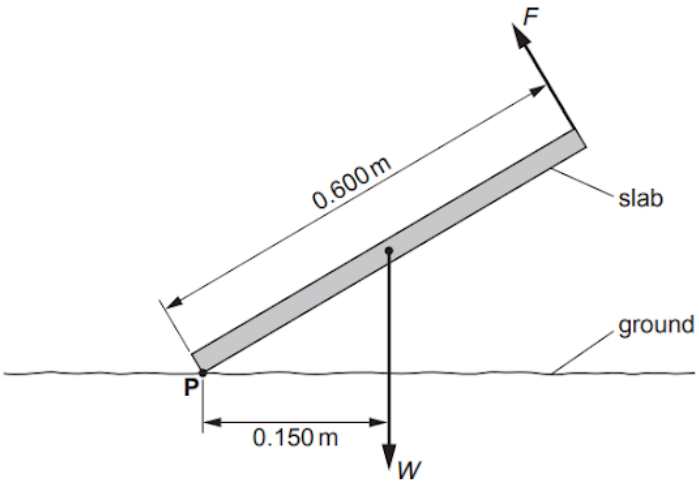

Fig. 6.2

Two forces acting on the slab are shown. The weight of the slab is *W*. The force *F* is applied at right angles to the end of the slab. By taking moments about **P**, determine the size of the force *F*.

F = ... N **[3]**

[Total: 12]

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