Moments Past Paper Questions

Jan 2002 to Jan 2009

3 (a) Define the moment of a force. **Q3 Jun 2004**

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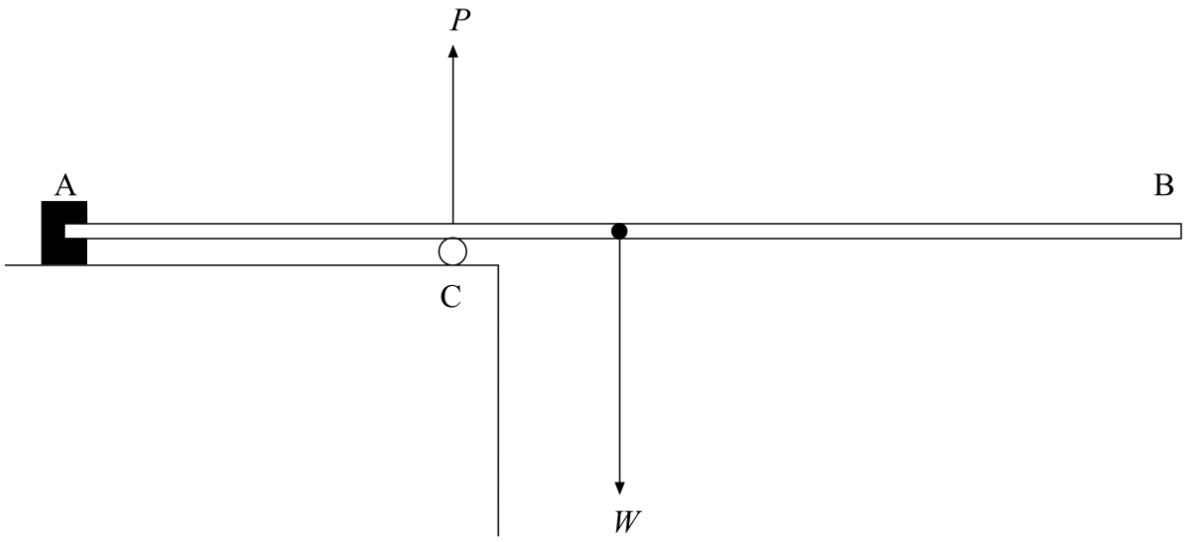
(2 marks)

(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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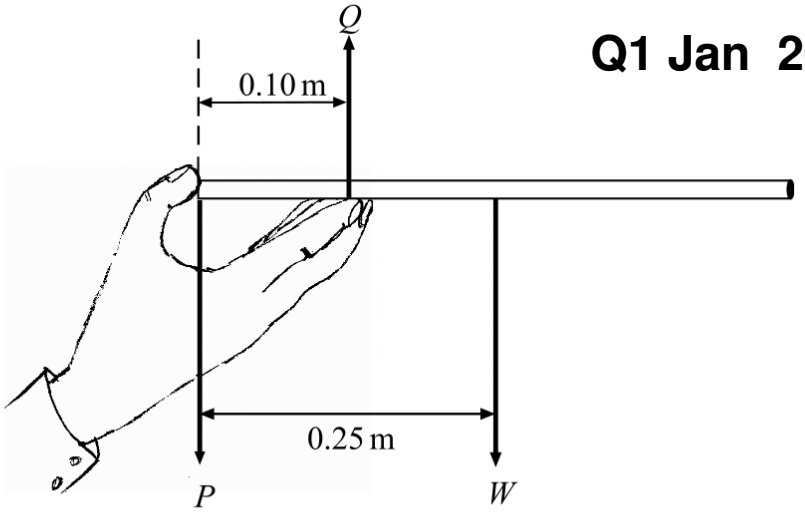
(4 marks)

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

Q1 Jan 2003



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 marks)

(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 marks)

4 (a) State the principle of moments.

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(3 marks)

(b) (i) Draw a labelled diagram of the apparatus you would use to verify the principle of moments.

(ii) Describe the procedure that would be used and state what measurements are taken.

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

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Continued....

(iii) Explain how the results would be used to verify the principle of moments.

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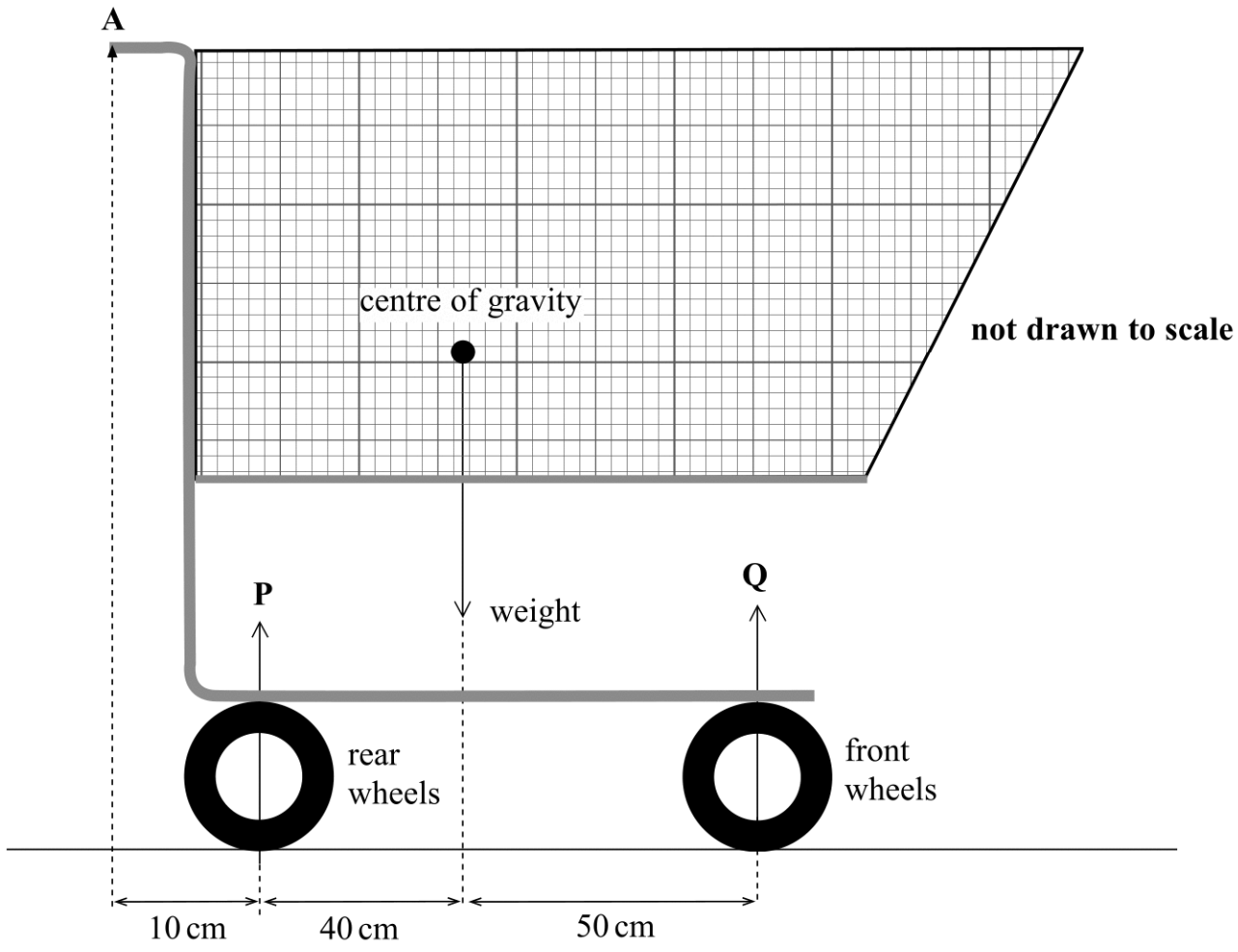
(7 marks)

3 **Figure 2** shows a supermarket trolley.

Q3 Jan 2006

Figure 2



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 marks)

Continued....

(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 marks)

(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 marks)

(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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(3 marks)

Q4 Jan 2002

4 (a) State the principle of moments.

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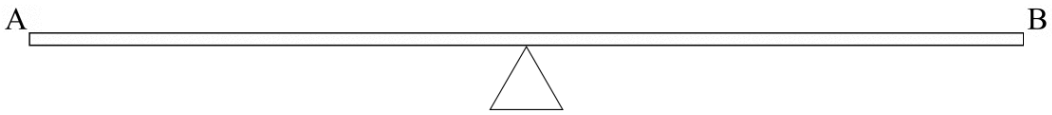
(2 marks)

(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 mark)

(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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(5 marks)

Q6 Jan 2005

6 (a) Define the moment of a force about a point.

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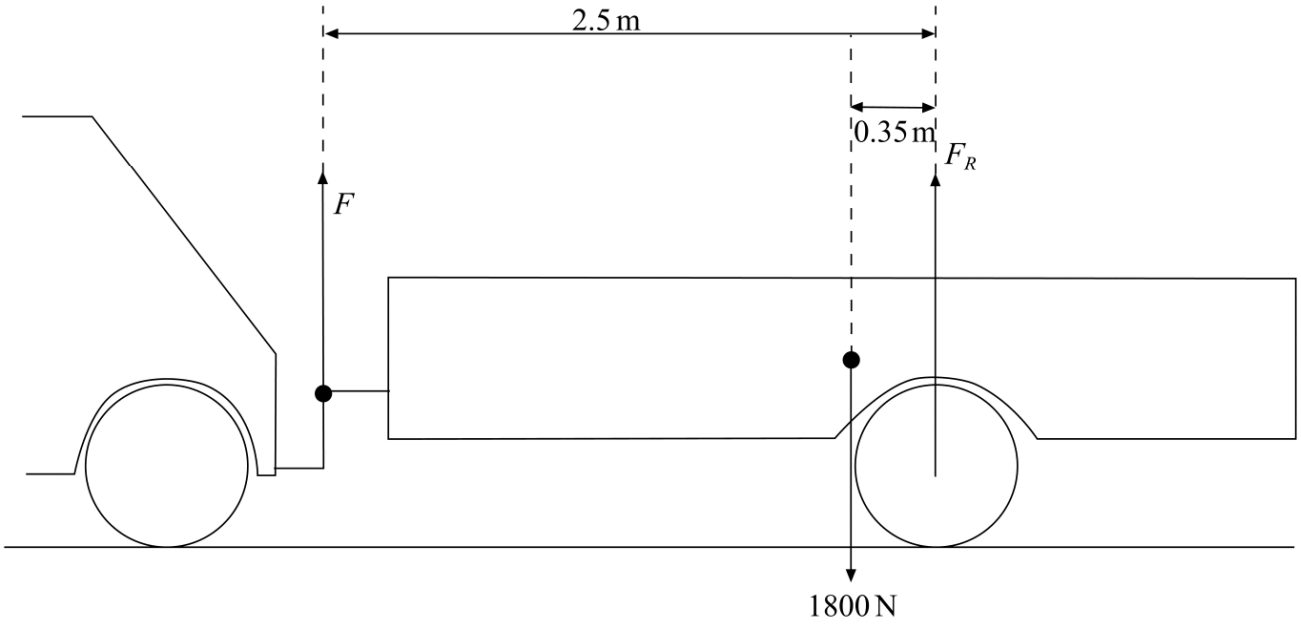
(2 marks)

(b) The diagram shows a trailer attached to the towbar of a stationary car. The weight of the trailer is 1800 N and is shown acting through its *centre of gravity*.
F is the force exerted by the towbar on the trailer. F_R is the **total** normal reaction force experienced by the trailer. When stationary all forces acting on the trailer are vertical.



(i) Explain what is meant by centre of gravity.

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(ii) Calculate the force, F, exerted by the towbar on the trailer.

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(3 marks)

(iii) Calculate F_R.

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(2 marks)

Continued....

(c) The car starts to move forwards. State and explain what happens to the magnitude and direction of force, *F*.

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

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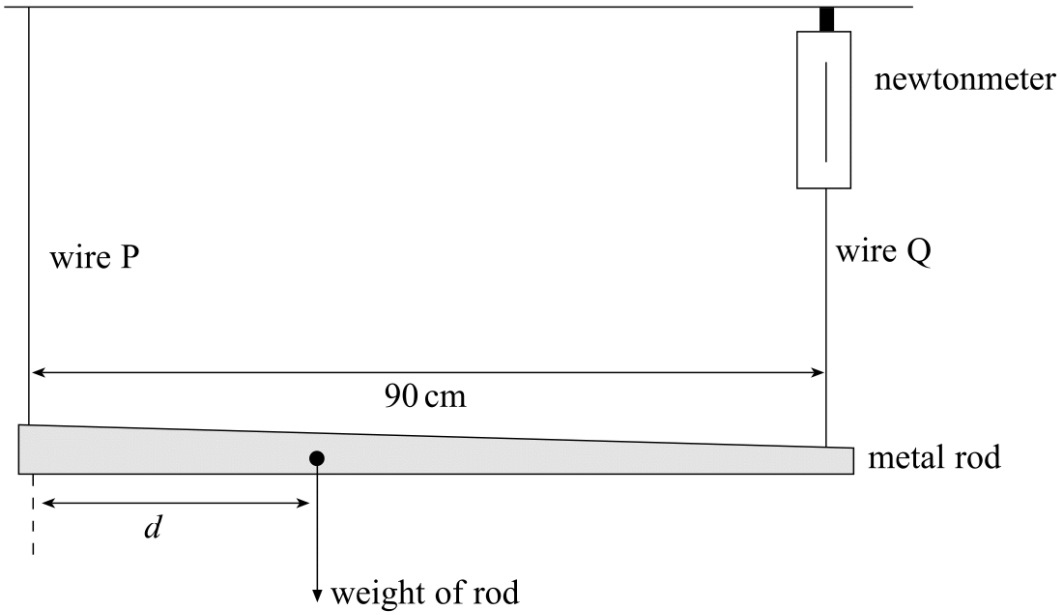
(3 marks)

3 **Figure 2** shows an apparatus used to locate the centre of gravity of a non-uniform metal rod.

Figure 2 **Q3 Jun 2006**



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 marks)

(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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(3 marks)

Q5 Jan 2007

5 (a) Define the moment of a force.

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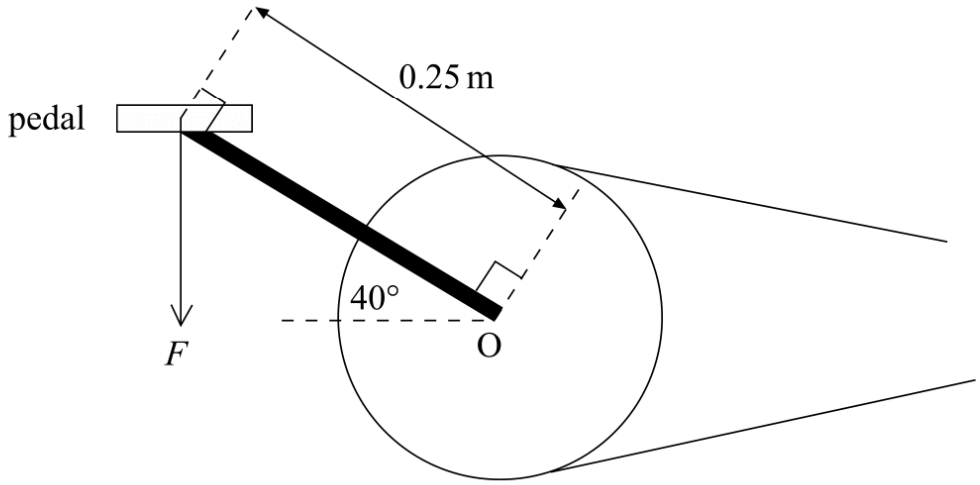
(2 marks)

(b) **Figure 2** shows the force, *F*, acting on a bicycle pedal.

Figure 2



(i) The moment of the force about O is 46 N m in the position shown. Calculate the value of the force, *F*.

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(2 marks)

(ii) Force, *F*, is constant in magnitude and direction while the pedal is moving downwards. State and explain how the moment of *F* changes as the pedal moves through 80°, from the position shown.

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(2 marks)

6 (a) State the principle of moments.

Q6 Jun 2007

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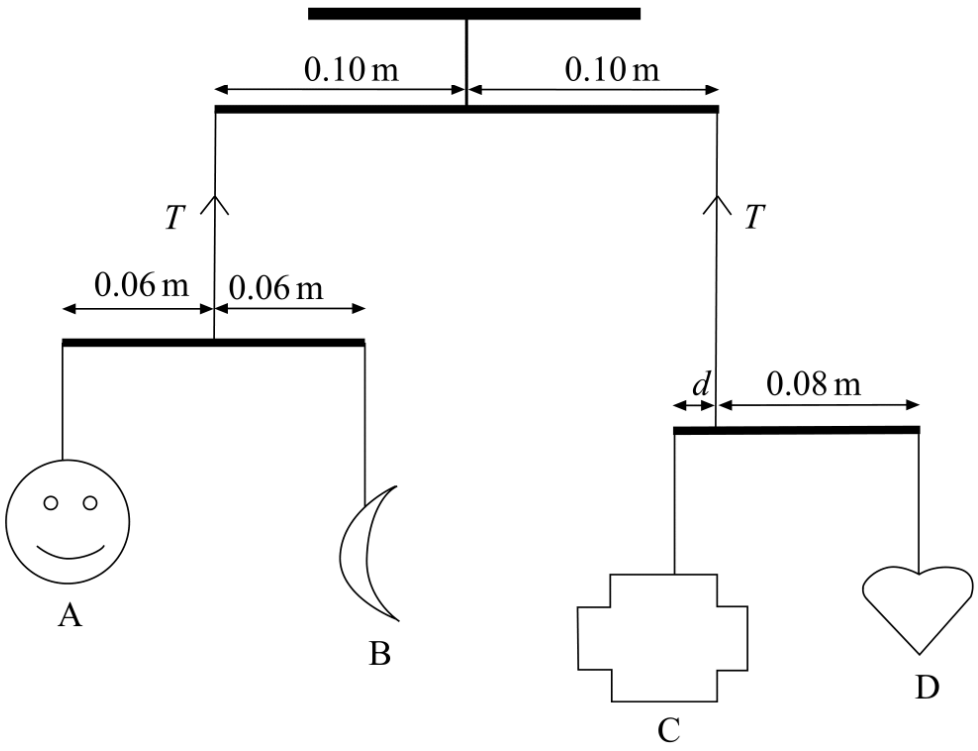
(2 marks)

Figure 2 shows a child's mobile in equilibrium.

Figure 2



A piece of cotton thread is attached to the rod supporting objects A and B and another piece of cotton thread supports the rod holding objects C and D. The tension in the cotton threads is *T* and all the rods are horizontal.

(b) (i) Complete the following table assuming the weights of the rods are negligible.

weight of object A /N	weight of object B /N	weight of object C /N	weight of object D /N
0.40			0.10

Continued....

(ii) Calculate the distance, *d*.

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(iii) Calculate the magnitude of *T*.

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(5 marks)

(c) Object A becomes detached and falls to the ground. State and explain the initial effect on

(i) the rod holding objects A and B,

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(ii) the rod holding objects C and D,

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(iii) the rod closest to the top of the mobile.

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(3 marks)

Q2 Jan 2008

2 (a) State the principle of moments for a body in equilibrium.

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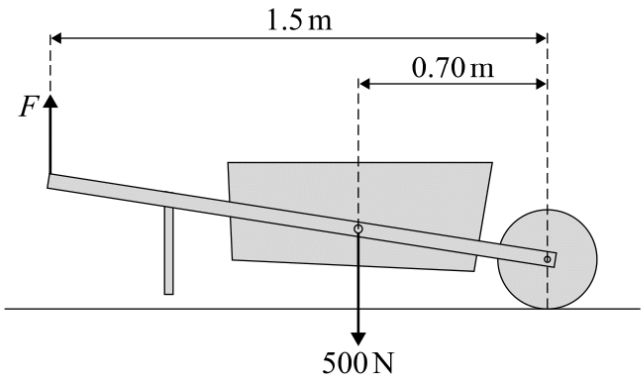
(2 marks)

(b) **Figure 1** shows a vertical force, *F*, being applied to raise a wheelbarrow which has a total weight of 500 N.

Figure 1



(i) On **Figure 1** draw an arrow to represent the position and direction of the force, *R*, exerted by the ground on the wheel.

(ii) Calculate the minimum value of the vertical force, *F*, needed to raise the legs of the wheelbarrow off the ground.

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(iii) Calculate the magnitude of *R* when the legs of the wheelbarrow have just left the ground.

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(5 marks)

Q1 Jun 2008

1 (a) (i) State **two** conditions necessary for an object to be in equilibrium.

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1 (a) (ii) For each condition state the consequence if the condition is not met.

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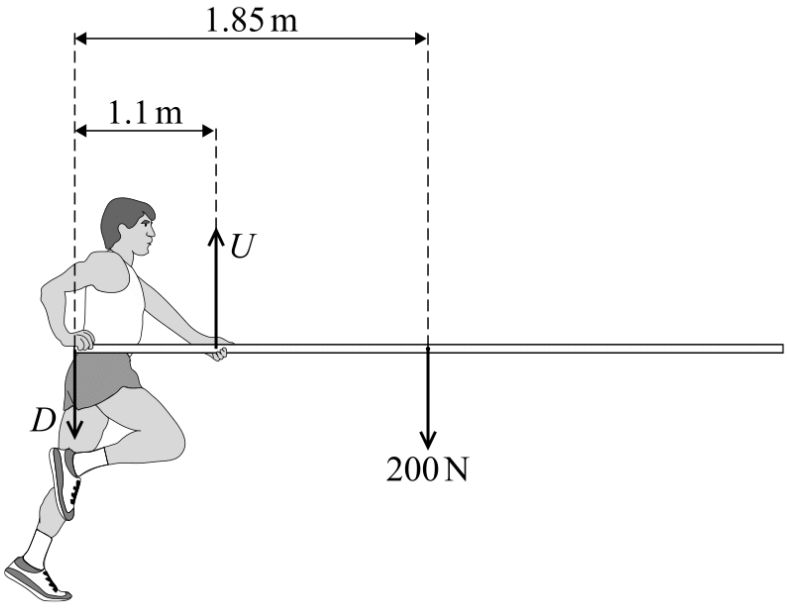
(4 marks)

Figure 1 shows a pole vaulter holding a uniform pole horizontally. He keeps the pole in equilibrium by exerting an upward force, *U*, with his leading hand, and a downward force, *D*, with his trailing hand.

Figure 1



weight of pole = 200 N
length of pole = 3.7 m

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1 (b) Calculate for the situation shown in **Figure 1**,

1 (b) (i) the force, *U*,

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1 (b) (ii) the force, *D*.

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(3 marks)

1 (c) Explain the effect on the magnitudes of *U* and *D* if the vaulter moves his leading hand closer to the centre of gravity of the pole and the pole is still in equilibrium.

You may be awarded additional marks to those shown in brackets for the quality of written communication in your answer.

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(3 marks)