

A Level Mathematics B (MEI)

H640/01 MEI Pure Mathematics and Mechanics

Mechanics

Question Set 2

- 1 Fig. 1 shows a uniform beam of mass 4 kg and length 2.4 m resting on two supports P and Q. P is at one end of the beam and Q is 0.3 m from the other end. Determine whether a person of mass 50 kg can tip the beam by standing on it. [3]

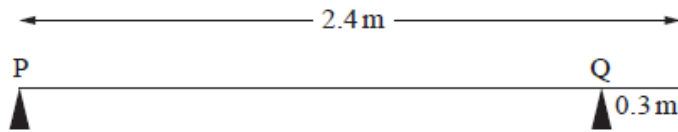


Fig. 1

- 2 A car of mass 1200 kg travels from rest along a straight horizontal road. The driving force is 4000 N and the total of all resistances to motion is 800 N. Calculate the velocity of the car after 9 seconds. [4]

- 3 The velocity $v \text{ ms}^{-1}$ of a particle at time t s is given by

$$v = 0.5t(7 - t).$$

Determine whether the speed of the particle is increasing or decreasing when $t = 8$. [4]

- 4 A cannonball is fired from a point on horizontal ground at 100 ms^{-1} at an angle of 25° above the horizontal. Ignoring air resistance, calculate

(a) the greatest height the cannonball reaches, [3]

(b) the range of the cannonball. [4]

- 5 In this question, the unit vector \mathbf{i} is horizontal and the unit vector \mathbf{j} is vertically upwards.

A particle of mass 0.8 kg moves under the action of its weight and two forces given by $(k\mathbf{i} + 5\mathbf{j})$ N and $(4\mathbf{i} + 3\mathbf{j})$ N. The acceleration of the particle is vertically upwards.

(a) Write down the value of k . [1]

Initially the velocity of the particle is $(4\mathbf{i} + 7\mathbf{j}) \text{ ms}^{-1}$.

(b) Find the velocity of the particle 10 seconds later. [4]

- 6 A 15 kg box is suspended in the air by a rope which makes an angle of 30° with the vertical. The box is held in place by a string which is horizontal.

(a) Draw a diagram showing the forces acting on the box. [1]

(b) Calculate the tension in the rope. [2]

(c) Calculate the tension in the string. [2]

7 A particle of mass 2 kg slides down a plane inclined at 20° to the horizontal. The particle has an initial velocity of 1.4 m s^{-1} down the plane. Two models for the particle's motion are proposed.

In model A the plane is taken to be smooth.

- (a) Calculate the time that model A predicts for the particle to slide the first 0.7 m. [5]
- (b) Explain why model A is likely to underestimate the time taken. [1]

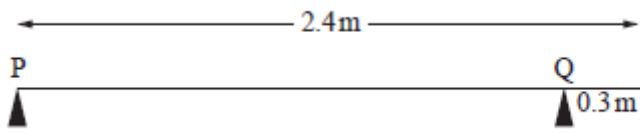
In model B the plane is taken to be rough, with a constant coefficient of friction between the particle and the plane.

- (c) Calculate the acceleration of the particle predicted by model B given that it takes 0.8 s to slide the first 0.7 m. [2]
- (d) Find the coefficient of friction predicted by model B, giving your answer correct to 3 significant figures. [6]

Total Marks for Question Set 2: 42

Resource Materials

Question Set No: 2 Diagram for answering Q1



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