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3. A particle P of mass 0.4 kg moves under the action of a single constant force \mathbf{F} newtons. The acceleration of P is $(6\mathbf{i} + 8\mathbf{j})$ m s⁻² . Find

(a) the angle between the acceleration and \mathbf{i} , (2)

(b) the magnitude of \mathbf{F} . (3)

At time t seconds the velocity of P is \mathbf{v} m s⁻¹ . Given that when $t = 0$, $\mathbf{v} = 9\mathbf{i} - 10\mathbf{j}$,

(c) find the velocity of P when $t = 5$. (3)

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4. A car is moving along a straight horizontal road. The speed of the car as it passes the point A is 25 m s^{-1} and the car maintains this speed for 30 s. The car then decelerates uniformly to a speed of 10 m s^{-1} . The speed of 10 m s^{-1} is then maintained until the car passes the point B . The time taken to travel from A to B is 90 s and $AB = 1410 \text{ m}$.

(a) Sketch, in the space below, a speed-time graph to show the motion of the car from A to B .

(2)

(b) Calculate the deceleration of the car as it decelerates from 25 m s^{-1} to 10 m s^{-1} .

(7)



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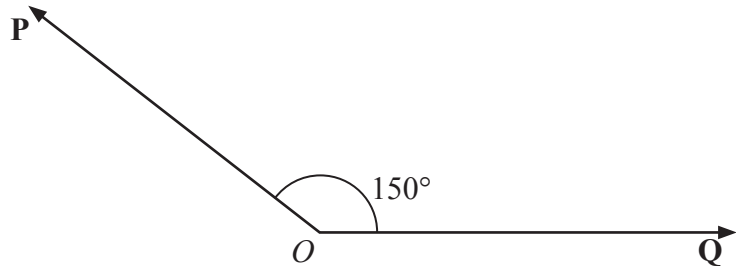


Figure 1

Two forces **P** and **Q** act on a particle at a point O . The force **P** has magnitude 15 N and the force **Q** has magnitude X newtons. The angle between **P** and **Q** is 150° , as shown in Figure 1. The resultant of **P** and **Q** is **R**.

Given that the angle between **R** and **Q** is 50° , find

- (a) the magnitude of **R**, (4)
- (b) the value of X . (5)



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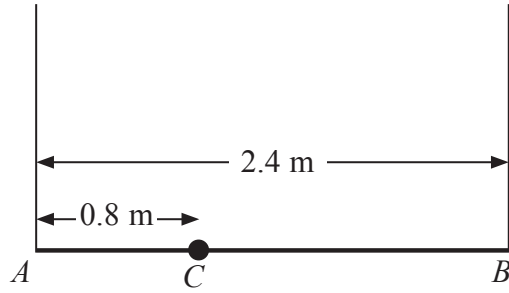


Figure 2

A plank AB has mass 12 kg and length 2.4 m . A load of mass 8 kg is attached to the plank at the point C , where $AC = 0.8\text{ m}$. The loaded plank is held in equilibrium, with AB horizontal, by two vertical ropes, one attached at A and the other attached at B , as shown in Figure 2. The plank is modelled as a uniform rod, the load as a particle and the ropes as light inextensible strings.

(a) Find the tension in the rope attached at B . (4)

The plank is now modelled as a non-uniform rod. With the new model, the tension in the rope attached at A is 10 N greater than the tension in the rope attached at B .

(b) Find the distance of the centre of mass of the plank from A . (6)



Question 6 continued

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Question 6 continued

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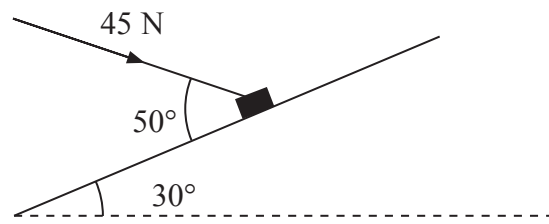


Figure 3

A package of mass 4 kg lies on a rough plane inclined at 30° to the horizontal. The package is held in equilibrium by a force of magnitude 45 N acting at an angle of 50° to the plane, as shown in Figure 3. The force is acting in a vertical plane through a line of greatest slope of the plane. The package is in equilibrium on the point of moving up the plane. The package is modelled as a particle. Find

- (a) the magnitude of the normal reaction of the plane on the package, (5)

- (b) the coefficient of friction between the plane and the package. (6)



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Question 7 continued

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Figure 4

Two particles P and Q , of mass 2 kg and 3 kg respectively, are joined by a light inextensible string. Initially the particles are at rest on a rough horizontal plane with the string taut. A constant force F of magnitude 30 N is applied to Q in the direction PQ , as shown in Figure 4. The force is applied for 3 s and during this time Q travels a distance of 6 m. The coefficient of friction between each particle and the plane is μ . Find

- (a) the acceleration of Q , (2)
- (b) the value of μ , (4)
- (c) the tension in the string. (4)
- (d) State how in your calculation you have used the information that the string is inextensible. (1)

When the particles have moved for 3 s, the force F is removed.

- (e) Find the time between the instant that the force is removed and the instant that Q comes to rest. (4)



Question 8 continued _____

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Question 8 continued

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