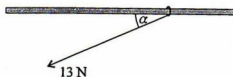


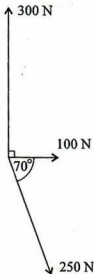
1



A ring of mass 1.1 kg is threaded on a fixed rough horizontal rod. A light string is attached to the ring and the string is pulled with a force of magnitude 13 N at an angle α below the horizontal, where $\tan \alpha = \frac{5}{12}$ (see diagram). The ring is in equilibrium.

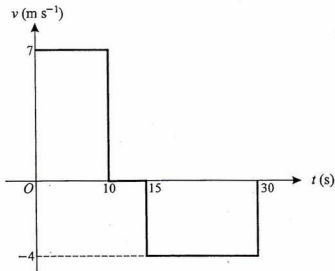
- (i) Find the frictional component of the contact force on the ring. [2]
- (ii) Find the normal component of the contact force on the ring. [2]
- (iii) Given that the equilibrium of the ring is limiting, find the coefficient of friction between the ring and the rod. [1]

2



Coplanar forces of magnitudes 250 N, 100 N and 300 N act at a point in the directions shown in the diagram. The resultant of the three forces has magnitude R N, and acts at an angle α° anticlockwise from the force of magnitude 100 N. Find R and α . [6]

3



A boy runs from a point A to a point C . He pauses at C and then walks back towards A until reaching the point B , where he stops. The diagram shows the graph of v against t , where $v \text{ m s}^{-1}$ is the boy's velocity at time t seconds after leaving A . The boy runs and walks in the same straight line throughout.

- (i) Find the distances AC and AB . [3]
- (ii) Sketch the graph of x against t , where x metres is the boy's displacement from A . Show clearly the values of t and x when the boy arrives at C , when he leaves C , and when he arrives at B . [3]
- 4 The top of an inclined plane is at a height of 0.7 m above the bottom. A block of mass 0.2 kg is released from rest at the top of the plane and slides a distance of 2.5 m to the bottom. Find the kinetic energy of the block when it reaches the bottom of the plane in each of the following cases:
- (i) the plane is smooth, [2]
- (ii) the coefficient of friction between the plane and the block is 0.15 . [5]
- 5 A particle P moves in a straight line that passes through the origin O . The velocity of P at time t seconds is $v \text{ m s}^{-1}$, where $v = 20t - t^3$. At time $t = 0$ the particle is at rest at a point whose displacement from O is -36 m .
- (i) Find an expression for the displacement of P from O in terms of t . [3]
- (ii) Find the displacement of P from O when $t = 4$. [1]
- (iii) Find the values of t for which the particle is at O . [3]

- 6 A car of mass 1200 kg travels along a horizontal straight road. The power of the car's engine is 20 kW. The resistance to the car's motion is 400 N.

(i) Find the speed of the car at an instant when its acceleration is 0.5 m s^{-2} . [4]

(ii) Show that the maximum possible speed of the car is 50 m s^{-1} . [2]

The work done by the car's engine as the car travels from a point *A* to a point *B* is 1500 kJ.

(iii) Given that the car is travelling at its maximum possible speed between *A* and *B*, find the time taken to travel from *A* to *B*. [2]

- 7 A particle P_1 is projected vertically upwards, from horizontal ground, with a speed of 30 m s^{-1} . At the same instant another particle P_2 is projected vertically upwards from the top of a tower of height 25 m, with a speed of 10 m s^{-1} . Find

(i) the time for which P_1 is higher than the top of the tower, [3]

(ii) the velocities of the particles at the instant when the particles are at the same height, [5]

(iii) the time for which P_1 is higher than P_2 and is moving upwards. [3]