

Specimen M1 paper A

Time $1\frac{1}{2}$ hours

1. Two particles A and B of masses 3 kg and 5 kg respectively, are connected by a light inextensible string which is initially slack. The particles are resting on a smooth horizontal surface. A is projected directly away from B with speed 4 ms^{-1} . When the string jerks tight, find
- (a) the common speed of the particles, (4)
 - (b) the impulse in the string. (3)
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2. (In this question the unit vectors \mathbf{i} and \mathbf{j} are directed due east and due north respectively).

A particle moving with constant acceleration is initially travelling due east at 6 ms^{-1} . 4 seconds later it is travelling due north at 8 ms^{-1} .

- (a) Write down the initial velocity of the particle as a vector. (1)
 - (b) Find the acceleration of the particle in the form $(a\mathbf{i} + b\mathbf{j}) \text{ ms}^{-2}$. (3)
 - (c) Given that the particle starts at the origin, find its position vector after 4 seconds. (3)
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3. A distress flare is fired vertically upwards, with a speed of 35 ms^{-1} from a small boat which is at rest. Assuming that the flare is fired from a height of 2 m above the sea, find

- (a) the maximum height of the flare above the sea, (3)
 - (b) the time during which the flare is more than 32 m above the sea. (5)
 - (c) State one modelling assumption you have used in your calculation. (1)
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4. A non-uniform plank AB , of mass 20 kg and length 4 m, is supported horizontally on two supports at C and D , where $AC = 1 \text{ m}$ and $BD = 1.5 \text{ m}$.

When a boy of mass 30 kg stands on the plank 1 m from B , the plank is on the point of tilting about D .

- (a) Find the distance of the centre of mass of the plank from A . (5)

The boy then stands at a point 2 m from A .

- (b) Find the magnitude of the reactions at C and D . (5)
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