

**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  $4 \text{ ms}^{-1}$ . 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  $6 \text{ ms}^{-1}$ . 4 seconds later it is travelling due north at  $8 \text{ ms}^{-1}$ .

- (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  $35 \text{ ms}^{-1}$  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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