

AS Level Mathematics A

H230/02 Pure Mathematics and Mechanics

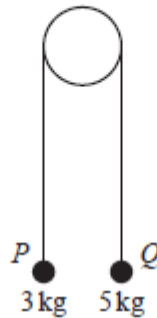
Question Set 2

- 1 In this question the horizontal unit vectors \mathbf{i} and \mathbf{j} are in the directions east and north respectively.

A model ship of mass 2 kg is moving so that its acceleration vector $\mathbf{a}\text{ m s}^{-2}$ at time t seconds is given by $\mathbf{a} = 3(2t - 5)\mathbf{i} + 4\mathbf{j}$. When $t = T$, the magnitude of the horizontal force acting on the ship is 10 N .

Find the possible values of T . [4]

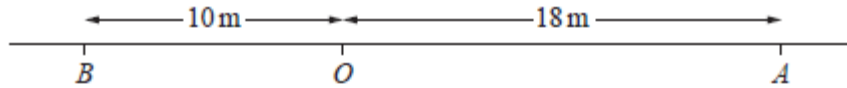
- 2 Particles P and Q , of masses 3 kg and 5 kg respectively, are attached to the ends of a light inextensible string. The string passes over a smooth fixed pulley. The system is held at rest with the string taut. The hanging parts of the string are vertical and P and Q are above a horizontal plane (see diagram).



- (a) Find the tension in the string immediately after the particles are released. [4]

After descending 2.5 m , Q strikes the plane and is immediately brought to rest. It is given that P does not reach the pulley in the subsequent motion.

- (b) Find the distance travelled by P between the instant when Q strikes the plane and the instant when the string becomes taut again. [4]



A particle P is moving along a straight line with constant acceleration. Initially the particle is at O . After 9 s, P is at a point A , where $OA = 18$ m (see diagram) and the velocity of P at A is 8 m s^{-1} in the direction \overrightarrow{OA} .

(a) (i) Show that the initial speed of P is 4 m s^{-1} . [2]

(ii) Find the acceleration of P . [2]

B is a point on the line such that $OB = 10$ m, as shown in the diagram.

(b) Show that P is never at point B . [4]

A second particle Q moves along the same straight line, but has variable acceleration. Initially Q is at O , and the displacement of Q from O at time t seconds is given by

$$x = at^3 + bt^2 + ct,$$

where a , b and c are constants.

It is given that

- the velocity and acceleration of Q at the point O are the same as those of P at O ,
- Q reaches the point A when $t = 6$.

(c) Find the velocity of Q at A . [5]

Total Marks for Question Set 2: 25

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