Edexcel Maths M3

Topic Questions from Papers

Kinematics

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1. A particle P moves along the x-axis. At time $t = 0$, P passes through the origin O, moving in the positive x-direction. At time t seconds, the velocity of P is v m s^{-1} and $OP = x$ metres. The acceleration of P is $\frac{1}{12}(30 - x)$ m s^{-2}, measured in the positive x-direction.

(a) Give a reason why the maximum speed of P occurs when $x = 30$.

(1)

Given that the maximum speed of P is 10 m s^{-1},

(b) find an expression for v^2 in terms of x.

(5)

Leave blank

2. A particle P of mass 0.1 kg moves in a straight line on a smooth horizontal table. When P is a distance x metres from a fixed point O on the line, it experiences a force of magnitude $\frac{16}{5x^2}$ N away from O in the direction OP. Initially P is at a point 2 m from O and is moving towards O with speed 8 m s^{-1}.

Find the distance of P from O when P first comes to rest.

(8)

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6. A particle P of mass 0.5 kg moves along the positive x-axis. It moves away from the origin O under the action of a single force directed away from O. When $OP = x$ metres, the magnitude of the force is $\frac{3}{(x+1)^3}$ N and the speed of P is v m s^{-1}.

Initially P is at rest at O.

(a) Show that $v^2 = 6\left(1 - \frac{1}{(x+1)^2}\right)$.

(6)

(b) Show that the speed of P never reaches $\sqrt{6}$ m s^{-1}.

(1)

(c) Find x when P has been moving for 2 seconds.

(7)

Leave blank

Question 6 continued

Leave blank

1. A particle P of mass 3 kg is moving in a straight line. At time t seconds, $0 \leqslant t \leqslant 4$, the only force acting on P is a resistance to motion of magnitude $\left(9+\frac{15}{(t+1)^2}\right)$ N. At time t seconds the velocity of P is v m s^{-1}. When $t = 4$, $v = 0$.

Find the value of v when $t = 0$.

(7)

Leave blank

6. A cyclist and her bicycle have a combined mass of 100 kg. She is working at a constant rate of 80 W and is moving in a straight line on a horizontal road. The resistance to motion is proportional to the square of her speed. Her initial speed is 4 m s^{-1} and her maximum possible speed under these conditions is 20 m s^{-1}. When she is at a distance x m from a fixed point O on the road, she is moving with speed v m s^{-1} away from O.

(a) Show that

$$v\frac{dv}{dx} = \frac{8000 - v^3}{10000v} .$$

(5)

(b) Find the distance she travels as her speed increases from 4 m s^{-1} to 8 m s^{-1}.

(5)

(c) Use the trapezium rule, with 2 intervals, to estimate how long it takes for her speed to increase from 4 m s^{-1} to 8 m s^{-1}.

(4)

Leave blank

Question 6 continued

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1. A particle P of mass 0.5 kg is moving along the positive x-axis. At time t seconds, P is moving under the action of a single force of magnitude $\left[4+\cos(\pi t)\right]$ N, directed away from the origin. When $t=1$, the particle P is moving away from the origin with speed $6\,\text{m}\,\text{s}^{-1}$.

Find the speed of P when $t=1.5$, giving your answer to 3 significant figures.

(7)

Leave blank

6. At time $t = 0$, a particle P is at the origin O moving with speed $2\ \text{m s}^{-1}$ along the x-axis in the positive x-direction. At time t seconds ($t > 0$), the acceleration of P has magnitude $\frac{3}{(t+1)^2}\ \text{m s}^{-2}$ and is directed towards O.

(a) Show that at time t seconds the velocity of P is $\left(\frac{3}{t+1} - 1\right)\ \text{m s}^{-1}$.

(5)

(b) Find, to 3 significant figures, the distance of P from O when P is instantaneously at rest.

(7)

Leave blank

Question 6 continued

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1. A particle P moves on the positive x-axis. When the distance of P from the origin O is x metres, the acceleration of P is $(7 - 2x)$ m s^{-2}, measured in the positive x-direction. When $t = 0$, P is at O and is moving in the positive x-direction with speed 6 m s^{-1}. Find the distance of P from O when P first comes to instantaneous rest.

(6)

Leave blank

3. A particle P is moving in a straight line. At time t seconds, P is at a distance x metres from a fixed point O on the line and is moving away from O with speed $\frac{10}{x+6}$ m s^{-1}.

(a) Find the acceleration of P when $x = 14$

(4)

Given that $x = 2$ when $t = 1$,

(b) find the value of t when $x = 14$

(6)

Leave blank

Question 3 continued

Leave blank

1. A particle P is moving along the positive x-axis. At time $t = 0$, P is at the origin O. At time t seconds, P is x metres from O and has velocity $v = 2e^{-x}$ m s^{-1} in the direction of x increasing.

(a) Find the acceleration of P in terms of x.

(3)

(b) Find x in terms of t.

(6)

Leave blank

1. A particle P is moving along the positive x-axis. When the displacement of P from the origin is x metres, the velocity of P is v m s^{-1} and the acceleration of P is $9x$ m s^{-2}.

When $x = 2$, $v = 6$

Show that $v^2 = 9x^2$.

(4)

Leave blank

3. A particle P of mass 0.6 kg is moving along the x-axis in the positive direction. At time $t = 0$, P passes through the origin O with speed 15 m s^{-1}. At time t seconds the distance OP is x metres, the speed of P is v m s^{-1} and the resultant force acting on P has magnitude $\frac{12}{(t+2)^2}$ newtons. The resultant force is directed towards O.

(a) Show that $v = 5\left(\frac{4}{t+2} + 1\right)$.

(5)

(b) Find the value of x when $t = 5$

(5)

Leave blank

Question 3 continued

Leave blank

2. A particle of mass 4 kg is moving along the horizontal x-axis under the action of a single force which acts in the positive x-direction. At time t seconds the force has magnitude $\left(1 + 3t^{\frac{1}{2}}\right)$ N.

When $t = 0$ the particle has speed 2 m s^{-1} in the positive x-direction. Find the work done by the force in the interval $0 \leqslant t \leqslant 4$

(7)

Leave blank

4. A particle P is moving along the positive x-axis. At time t seconds, $t \geqslant 0$, P is x metres from the origin O and is moving away from O with velocity v m s^{-1}, where $v = \dfrac{4}{(x+2)}$. When $t = 0$, P is at O. Find

(a) the distance of P from O when $t = 2$

(5)

(b) the magnitude and direction of the acceleration of P when $t = 2$

(5)

Leave blank

Question 4 continued

Leave blank

2. A particle P of mass 0.5 kg is moving along the positive x-axis in the positive x-direction. The only force on P is a force of magnitude $\left(2t + \frac{1}{2}\right)$ N acting in the direction of x increasing, where t seconds is the time after P leaves the origin O. When $t = 0$, P is at rest at O.

(a) Find an expression, in terms of t, for the velocity of P at time t seconds.

(3)

The particle passes through the point A with speed 6 m s^{-1}.

(b) Find the distance OA.

(6)