MX SP 11 a A particle is fired from the origin O with initial velocity 18 ms^{-1} at an angle 60° to the horizontal.

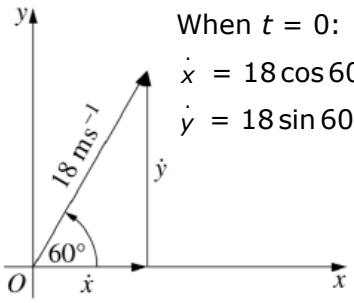
The equations of motion are $\frac{d^2x}{dt^2} = 0$ and $\frac{d^2y}{dt^2} = -10$

(i) Show that $x = 9t$. **1**

(ii) Show that $y = 9\sqrt{3}\,t - 5t^2$. **2**

(iii) Hence find the Cartesian equation for the trajectory of the particle. **1**

(i)



When $t = 0$:

$\dot{x} = 18\cos 60° = 9$

$\dot{y} = 18\sin 60° = 9\sqrt{3}$

$\ddot{x} = 0$

$\dot{x} = C_1$

Substitute $t = 0$, $\dot{x} = 9$:

$\therefore C_1 = 9$

$\therefore \dot{x} = 9$

$x = 9t + C_2$

Substitute $t = 0$, $x = 0$:

$\therefore C_2 = 0$

$x = 9t$

(ii) $\ddot{y} = -10$

$\dot{y} = -10t + C_3$

Substitute $t = 0$, $\dot{y} = 9\sqrt{3}$:

$C_3 = 9\sqrt{3}$

$\therefore \dot{y} = 9\sqrt{3} - 10t$

$y = 9\sqrt{3}\,t - 5t^2 + C_4$

Substitute $t = 0$, $y = 0$:

$\therefore C_4 = 0$

$\therefore y = 9\sqrt{3}\,t - 5t^2$ …. *

(iii) Substitute $t = \frac{x}{9}$ into *:

$y = 9\sqrt{3}\,t - 5t^2$

$= \sqrt{3}\,x - \frac{5x^2}{81}$