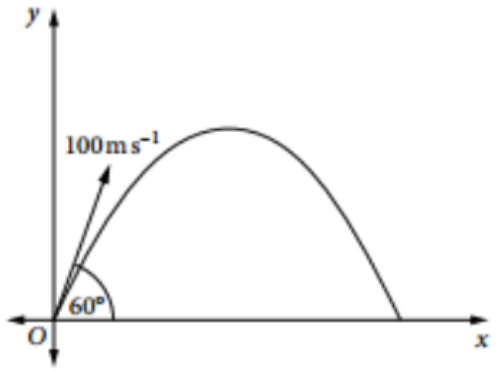
PROJECTILE MOTION

1 A particle is projected with a speed of 100 metres per second from a horizontal plane at an angle of 60°.

Given $\underline{v}(t) = 100\cos 60°\underline{i} + (100\sin 60° - 10t)\underline{j}$, find:

(a) when the particle reaches its greatest height
(b) its position vector $\underline{r}(t)$
(c) the greatest height reached
(d) the time of flight
(e) the horizontal range
(f) the equation of the trajectory.



2 A particle is projected with a speed of $80\,\text{m s}^{-1}$ from a horizontal plane at an angle of 30°.

(a) Write the vector for $\underset{\sim}{v}(0)$.

(b) Given that $\underset{\sim}{v}(t) = |\underset{\sim}{v}(0)|\cos\alpha\,\underset{\sim}{i} + (|\underset{\sim}{v}(0)|\sin\alpha - g\,t)\,\underset{\sim}{j}$, find $\underset{\sim}{r}(t)$, using $g = 10\,\text{m s}^{-2}$.

(c) Hence find the time of flight and the range of the projectile.

(d) Find the maximum height reached by the projectile.

(e) Show that the equation of the trajectory is $y = \frac{x}{\sqrt{3}} - \frac{x^2}{960}$.

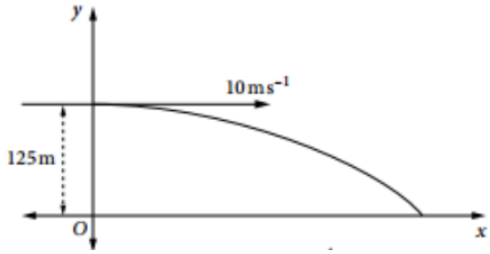
PROJECTILE MOTION

3 An object is projected horizontally from the top of a building 125 m high at a speed of $10\,\text{m s}^{-1}$. Using $g = 10\,\text{m s}^{-2}$, find:

(a) $\underset{\sim}{v}(t)$ and $\underset{\sim}{r}(t)$

(b) the time when the object hits the ground and its distance from the base of the building

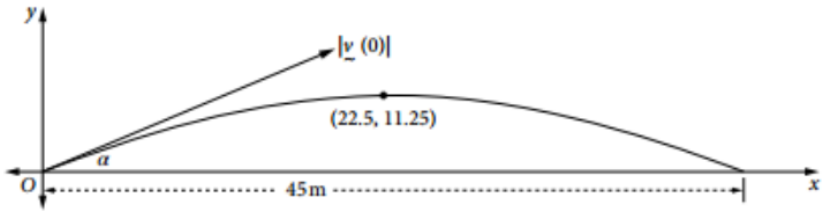
(c) the maximum height reached by the object.



8 A ball is projected so that its horizontal range is 45 metres. It passes through a point 11.25 metres vertically above and 22.5 metres horizontally from the point of projection.

(a) If $|\underset{\sim}{v}(0)|$ is the initial velocity and α the angle of projection, find expressions for $\underset{\sim}{v}(t)$ and $\underset{\sim}{r}(t)$.

(b) Given $g = 10\,\text{m}\,\text{s}^{-2}$, find the angle of projection and the speed of projection.



10 A ball is thrown horizontally with speed $v\,\mathrm{m\,s^{-1}}$ from a point h metres above the ground and lands at a horizontal distance d metres from the point of release. Use $g = 10\,\mathrm{m\,s^{-2}}$.

(a) Find expressions for $\underset{\sim}{v}(t)$ and $\underset{\sim}{r}(t)$.

(b) Find v given $d = 3$ and $h = 1.25$.

(c) Find h given $v = 10$ and $d = 20$.

16 A particle is projected to just clear two walls that are each 7 m tall, and 7 m and 14 m respectively away from the point of projection. It is given that $\underset{\sim}{r}(t) = Vt\cos\alpha\underset{\sim}{i} + \left(Vt\sin\alpha - 5t^2\right)\underset{\sim}{j}$.

(a) If α is the angle of projection, prove that $\tan\alpha = 1.5$.

(b) Show that if the walls are h metres high and are respectively b metres and c metres distant from the point of projection, then $\tan\alpha = \dfrac{h(b+c)}{bc}$.