Q) Once it leaves the hose, the water moves in projectile motion. The firemen adjust the angle of elevation of the hose until the water takes 3 s to reach the building 45 m away.

You can ignore air resistance and assume that the end of the hose is at the ground level.

(i) Find the angle of elevation.

(ii) Find the speed and acceleration of water at the highest point of its trajectory.

(iii) How high above the ground does the water strike the building?

And how fast is it moving just before it hits the building?

Answer:

a)α= 53.13°

b)The velocity at the highest point = 15 m/s

The acceleration at the highest point = 9.8m/s^2

c)h=15 m

V=18.02 m/s

Explanation:

Speed of water ,u= 25 m/s

So the horizontal component of speed u = u cos α

Given that horizontal distance cover by water in 3 s is 45 m.

So We know that in projectile motion horizontal acceleration is zero.

In horizontal direction

Distance = Velocity x time

45 = u cos α x 3

u cos α = 45

45 = 25 cos α x 3

cos α = 45/75

α= 53.13°

So the velocity at the highest point = u cos α

The velocity at the highest point = 15 m/s

The acceleration at the highest point = 9.8m/s^2

Now the velocity along vertical direction(Vo) = u sin α

Vo= 25 sin 53.13°

Vo =20 m/s

$$h = V_o.t - \frac{1}{2}gt^2$$

$$h = 20 \times 3 - \frac{1}{2} \times 10 \times 3^2$$

h=15 m

So at 15 m above the ground water will strike .

The y-component of velocity after 3 sec

Vy= Vo - g t

Vy = 20 - 10 x 3

Vy= -10 m/s

The horizontal component of velocity will remain 15 m/s.

The resultant velocity

$$V = \sqrt{10^2 + 15^2}\ m/s$$

V=18.02 m/s