Q. 10. (i) Let initial velocity = u and let the angle of projection be θ

$u_x = u\cos\theta \qquad u_y = u\sin\theta$

$s_x = ut\cos\theta$

$s_y = ut\sin\theta - \frac{1}{2}gt^2$

$s_x = 27$ and $s_y = 0$ when $t = 3$

$\Rightarrow 3u\cos\theta = 27$ and $3u\sin\theta - 44.1 = 0$

$\Rightarrow u\cos\theta = 9$ **Equation 1** $\Rightarrow u\sin\theta = 14.7$ **Equation 2**

$\Rightarrow$ Horizontal component of initial velocity = 9

Vertical component of initial velocity = 14.7

(ii) Need to find s_y when $s_x = 5.4$

$\Rightarrow 9t = 5.4$

$\Rightarrow t = 0.6$

$s_y = 14.7t - 4.9t^2$ ... let $t = 0.6$

$\Rightarrow s_y = 14.7(0.6) - 4.9(0.6)^2$

$= 7.056$ m ... height of wall

(iii) Need to find v_x and v_y when $t = 0.6$

$v_x = 9$

$v_y = 14.7 - gt$

$= 14.7 - 9.8(0.6)$

$= 8.82$

$\vec{v} = 9\vec{i} + 8.82\vec{j}$

Speed $= |\vec{v}|$

$= \sqrt{9^2 + 8.82^2}$

$= 12.6$ m/s

Q. 11. (i) $s_x = ut$

$s_y = -\frac{1}{2}gt^2$

$s_y = -0.1$ when $s_x = 2$

$ut = 2$

$\Rightarrow t = \frac{2}{u}$

$-\frac{1}{2}gt^2 = -0.1$ ... let $t = \frac{2}{u}$

$\Rightarrow \frac{1}{2}g\left(\frac{4}{u^2}\right) = 0.1$

$\Rightarrow \frac{2g}{u^2} = 0.1$

$\Rightarrow u^2 = 20g$

$\Rightarrow u = \sqrt{20g}$ m/s

$t = \frac{2}{u}$

$= \frac{2}{\sqrt{20g}}$

$= \frac{1}{7}$ s

(ii) $u = \sqrt{20g}$

$= 14$ m/s

(iii) $v_x = 14$

$v_y = -gt$

$= -9.8\left(\frac{1}{7}\right)$

$= -1.4$

$\vec{v} = 14\vec{i} - 1.4\vec{j}$

Speed $= |\vec{v}| = \sqrt{14^2 + (-1.4)^2}$

$= 14.07$ m/s