Exercise 3B

Q. 1. (i) $\cos\alpha = \frac{2}{\sqrt{5}}, \sin\alpha = \frac{1}{\sqrt{5}}$

$\vec{u} = 7\sqrt{5}\cos\alpha\vec{i} + 7\sqrt{5}\sin\alpha\vec{j}$

$= 14\vec{i} + 7\vec{j}$

(ii) $s_y = 0$

$\Rightarrow 7t - 4.9t^2 = 0$

$\Rightarrow t = 0$ **OR** $t = \frac{7}{4.9}$

$= \left(\frac{10}{7}\right)$

At $t = \frac{10}{7}$, $s_x = 14t$

$= 14\left(\frac{10}{7}\right)$

$= 20$ m

Q. 2. $\vec{u} = 35\cos\theta\vec{i} + 35\sin\theta\vec{j}$

$= 35\left(\frac{4}{5}\right)\vec{i} + 35\left(\frac{3}{5}\right)\vec{j}$

$= 28\vec{i} + 21\vec{j}$

$s_y = 10$

$\Rightarrow 21t - 4.9t^2 = 10$

$\Rightarrow 49t^2 - 210t + 100 = 0$

$\Rightarrow t = 0.546$ (**OR** 3.740)

At $t = 0.546$,

$v_x = 28$ and $v_y = 21 - 9.8t$

$= 21 - 9.8(0.546)$

$= 15.65$

$\therefore \vec{v} = 28\vec{i} + 15.65\vec{j}$

$\Rightarrow |\vec{v}| = \sqrt{28^2 + (15.65)^2}$

$= 32.08$ m/s

Q. 3. $s_y = 0$

$\Rightarrow 7t - 4.9t^2 = 0$

$\Rightarrow t = 0$ **OR** $t = \frac{7}{4.9} = \frac{10}{7}$

At $t = \frac{10}{7}$, $s_x = 10t$

$= 10\left(\frac{10}{7}\right)$

$= \frac{100}{7}$ m

$= R$, the range

$\frac{3}{4}R = \frac{75}{7}$ m

$s_x = \frac{75}{7}$

$\Rightarrow t = \frac{75}{70}$

$= \frac{15}{14}$

At $t = \frac{15}{14}$, $s_y = 7\left(\frac{15}{14}\right) - 4.9\left(\frac{225}{196}\right)$

$= 7.5 - 5.625$

$= 1.875$ m

Q. 4. $s_y = 0$

$\Rightarrow 4t - 4.9t^2 = 0$

$\Rightarrow t = 0$ **OR** $t = \frac{4}{4.9} = \frac{40}{49}$

At $t = \frac{40}{49}$, $s_x = 3t$

$= 3\left(\frac{40}{49}\right)$

$= \frac{120}{49} = R$, the range

$\therefore \frac{1}{5}R = \frac{24}{49}$ m

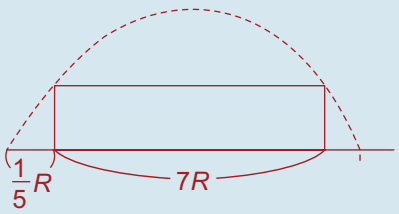
When is $s_x = \frac{24}{49}$? When $3t = \frac{24}{49}$

$\Rightarrow t = \frac{8}{49}$

At $t = \frac{8}{49}$, $s_y = 4\left(\frac{8}{49}\right) - 4.9\left(\frac{64}{2,401}\right)$

$= \frac{32}{49} - \frac{64}{490}$

$= \frac{128}{245}$



By symmetry, it will reach the same height when $s_x = \frac{4}{5}R$. The time will be $\frac{4}{5}$ of the time of flight $= \frac{4}{5}\left(\frac{40}{49}\right) = \frac{32}{49}$ s

Q. 5. (a) $(7t + 50)(t - 10)$

(b) $s_y = -350$

$\Rightarrow 14t - 4.9t^2 = -350$

$\Rightarrow 7t^2 - 20t - 50 = 0$

$\Rightarrow (7t + 50)(t - 10) = 0$

$\Rightarrow t = 10$ ($t = -\frac{50}{7}$ is rejected)