

Q. 11. $s_x = 12t$

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

$$s_x = 30 \text{ when } s_y = 9.375$$

$$\Rightarrow 12t = 30$$

$$\Rightarrow t = \frac{5}{2}$$

$$\text{when } kt - 4.9t^2 = 9.375$$

$$\Rightarrow k\left(\frac{5}{2}\right) - 4.9\left(\frac{5}{2}\right)^2 = 9.375$$

$$\Rightarrow \frac{5k}{2} - \frac{245}{8} = \frac{75}{8}$$

$$\Rightarrow 20k - 245 = 75$$

$$\Rightarrow 20k = 320 \Rightarrow k = 16$$

Q. 12. $u_x = u \cos \alpha$ $u_y = u \sin \alpha$

$$v_x = u \cos \alpha$$

$$v_y = u \sin \alpha - gt$$

$$s_x = ut \cos \alpha$$

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

(i) Greatest height: s_y when $v_y = 0$

$$v_y = 0$$

$$\Rightarrow u \sin \alpha - gt = 0$$

$$\Rightarrow t = \frac{u \sin \alpha}{g}$$

$$\Rightarrow \text{Greatest height} = u\left(\frac{u \sin \alpha}{g}\right) \sin \alpha - \frac{1}{2}g\left(\frac{u \sin \alpha}{g}\right)^2$$

$$\Rightarrow \text{Greatest height} = \frac{u^2 \sin^2 \alpha}{g} - \frac{u^2 \sin^2 \alpha}{2g}$$

$$\Rightarrow \text{Greatest height} = \frac{2u^2 \sin^2 \alpha - u^2 \sin^2 \alpha}{2g}$$

$$\Rightarrow \text{Greatest height} = \frac{u^2 \sin^2 \alpha}{2g}$$

OR

$$v_y^2 = u_y^2 + 2a_y s_y$$

$$0 = (u \sin \alpha)^2 + 2(-g)H$$

$$\therefore H = \frac{u^2 \sin^2 \alpha}{2g}$$

(ii) Range: s_x when $s_y = 0$

$$s_y = 0$$

$$\Rightarrow ut \sin \alpha - \frac{1}{2}gt^2 = 0$$

$$\Rightarrow 2ut \sin \alpha - gt^2 = 0$$

$$\Rightarrow t(2u \sin \alpha - gt) = 0$$

$$\Rightarrow \underbrace{t = 0}_{\text{Point of Projection}} \quad \quad \quad \underbrace{t = \frac{2u \sin \alpha}{g}}_{\text{Time of Flight}}$$

$$\Rightarrow \text{Range} = u\left(\frac{2u \sin \alpha}{g}\right) \cos \alpha$$

$$\Rightarrow \text{Range} = \frac{2u^2 \sin \alpha \cos \alpha}{g}$$

(iii) $u = 70$ and Greatest height = 125

$$\Rightarrow \frac{4,900 \sin^2 \alpha}{2g} = 125$$

$$\Rightarrow 250 \sin^2 \alpha = 125$$

$$\Rightarrow \sin^2 \alpha = \frac{1}{2}$$

$$\Rightarrow \sin \alpha = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \alpha = 45^\circ$$

$$\Rightarrow \text{Range} = \frac{9,800 \left(\frac{1}{\sqrt{2}}\right) \left(\frac{1}{\sqrt{2}}\right)}{9.8}$$

$$= 500 \text{ m}$$