Q. 5. (a) $\sin^2 A + \cos^2 A = 1 \; [\div \cos^2 A]$

$\Rightarrow \tan^2 A + 1 = \sec^2 A$

(b) $\vec{u} = 35\sqrt{5}\cos\alpha\vec{i} + 35\sqrt{5}\sin\alpha\vec{j}$

$s_x = 35\sqrt{5}\cos\alpha t = 350$

$\Rightarrow t = \dfrac{350}{35\sqrt{5}\cos\alpha}$

$= \dfrac{10}{\sqrt{5}\cos\alpha}$

At $t = \dfrac{10}{\sqrt{5}\cos\alpha}$

$s_y = 35\sqrt{5}\sin\alpha t - 4.9t^2$

$= 210$

$\Rightarrow 35\sqrt{5}\sin\alpha\left(\dfrac{10}{\sqrt{5}\cos\alpha}\right) - 4.9\left(\dfrac{100}{5\cos^2\alpha}\right) = 210$

$\Rightarrow 350\tan\alpha - 98\sec^2\alpha = 210$

$\Rightarrow 25\tan\alpha - 7\sec^2\alpha = 15$

$\Rightarrow 25\tan\alpha - 7(\tan^2\alpha + 1) = 15$

$\Rightarrow 25T - 7T^2 - 7 = 15$ (where $T = \tan\alpha$)

$\Rightarrow 7T^2 - 25T + 22 = 0$

$\Rightarrow (7T - 11)(T - 2) = 0$

$\Rightarrow \tan\alpha = \dfrac{11}{7}$ **OR** 2

$\left(\Rightarrow \cos\alpha = \dfrac{7}{\sqrt{170}}\right.$ **OR** $\left.\dfrac{1}{\sqrt{5}}\right)$

Now $t = \dfrac{10}{\sqrt{5}\cos\alpha}$

$= \dfrac{10}{7}\sqrt{34}$ s **OR** 10 s

Q. 6. **Bullet**

Angle of projection is α where $\tan\alpha = \dfrac{1}{2}$

$\Rightarrow \cos\alpha = \dfrac{2}{\sqrt{5}}$ and $\sin\alpha = \dfrac{1}{\sqrt{5}}$

$u_x = 70\sqrt{5}\cos\alpha$

$= 70\sqrt{5}\left(\dfrac{2}{\sqrt{5}}\right)$

$= 140$

$u_y = 70\sqrt{5}\sin\alpha$

$= 70\sqrt{5}\left(\dfrac{1}{\sqrt{5}}\right)$

$= 70$

$v_x = 140$

$v_y = 70 - gt$

$s_x = 140t$

$s_y = 70t - \dfrac{1}{2}gt^2$

Bullet will strike fighter when bullet has travelled 210 m vertically, i.e. when $s_y = 210$.

$70t - \dfrac{1}{2}gt^2 = 210$

$\Rightarrow 4.9t^2 - 70t + 210 = 0$ … divide by 0.7

$\Rightarrow 7t^2 - 100t + 300 = 0$

$\Rightarrow (7t - 30)(t - 10) = 0$

$\Rightarrow t = \dfrac{30}{7}, \; t = 10$ … bullet will strike fighter on the way up

$\Rightarrow t = \dfrac{30}{7}$ s