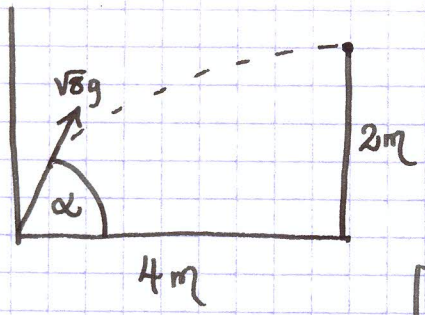
1998 Question 3.

a.



$u_x = u\cos\alpha$ $\quad$ $u_y = u\sin\alpha$

$\sqrt{8}g\cos\alpha$ $\quad$ $\sqrt{8}g\sin\alpha$

$s_x = \sqrt{8}g\cos\alpha\, t$ $\quad$ $s_y = \sqrt{8}g\sin\alpha\, t - \frac{1}{2}gt^2$

$4 = \sqrt{8}g\cos\alpha\, t$

$$\frac{4}{\sqrt{8}g\cos\alpha} = t$$ sub

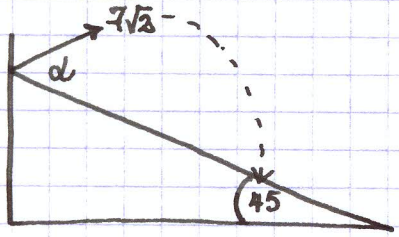
$$2 = \sqrt{8}g\sin\alpha\left(\frac{4}{\sqrt{8}g\cos\alpha}\right) - \frac{1}{2}g\left(\frac{4}{\sqrt{8}g\cos\alpha}\right)^2$$

$$2 = 4\tan\alpha - \frac{1}{8}(1+\tan^2\alpha)$$

$$\Rightarrow \tan^2\alpha - 4\tan\alpha + 3 = 0$$
$$(\tan\alpha - 1)(\tan\alpha - 3) = 0$$
$$\tan\alpha = 1 \text{ or } 3$$

$$\boxed{\alpha = 45^\circ \text{ or } 71^\circ 34'}$$

b.



$u_x = u\cos\alpha$ $\quad$ $u_y = u\sin\alpha$

$g_x = +g\sin 45$ $\quad$ $g_y = -g\cos 45$

$v_x = 7\sqrt{2}\cos\alpha + \frac{g}{\sqrt{2}}t$ $\quad$ $v_y = 7\sqrt{2}\sin\alpha - \frac{g}{\sqrt{2}}t$

$$s_y = 7\sqrt{2}\sin\alpha\, t - \frac{1}{2}g\frac{1}{\sqrt{2}}t^2$$

$$0 = 7\sqrt{2}\sin\alpha - \frac{g}{2\sqrt{2}}t$$

hits plane $\Rightarrow s_y = 0$

$$\boxed{\frac{28\sin\alpha}{g} = t}$$

i. value of α at $t = 2$ $\quad$ $\frac{28\sin\alpha}{9.8} = 2$

$$\sin\alpha = 0.7$$

$$\boxed{\alpha = 44^\circ 26'}$$

ii. $\tan\theta = -\frac{v_y}{v_x}$ $\quad$ $v_x = 7\sqrt{2}\cos\alpha + \frac{g}{\sqrt{2}}\left(\frac{28\sin\alpha}{g}\right)$ $\quad$ $v_y = 7\sqrt{2}\sin\alpha - \frac{g}{\sqrt{2}}\left(\frac{28\sin\alpha}{g}\right)$

$$v_x = \frac{14\cos\alpha + 28\sin\alpha}{\sqrt{2}} \qquad v_y = \frac{14\sin\alpha - 28\sin\alpha}{\sqrt{2}}$$

$$\frac{1}{3} = \frac{14\sin\alpha}{14\cos\alpha + 28\sin\alpha}$$

$$14\cos\alpha + 28\sin\alpha = 42\sin\alpha$$
$$14\cos\alpha = 14\sin\alpha$$
$$\cos\alpha = \sin\alpha$$

$$\Rightarrow \tan\alpha = 1$$

$$\boxed{\alpha = 45^\circ}$$