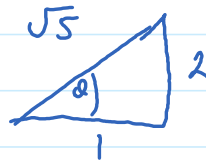


2011

22 April 2013  
09:333(a)  
ii

$$\begin{aligned}\tan \theta &= \frac{2}{1} \\ \sin \theta &= \frac{2}{\sqrt{5}} \\ \cos \theta &= \frac{1}{\sqrt{5}}\end{aligned}$$

$$s_x: 35 \cos \theta t = x$$

$$t = \frac{x}{35 \left(\frac{1}{\sqrt{5}}\right)} \Rightarrow t = \frac{x}{7\sqrt{5}}$$

SM

$$s_y: 35 \sin \theta t - \frac{1}{2} g t^2 = 50$$

$$35 \left(\frac{2}{\sqrt{5}}\right) t - 4.9 t^2 = 50$$

SM

$$\text{If } t = \frac{x}{7\sqrt{5}} \Rightarrow 14\sqrt{5} \left(\frac{x}{7\sqrt{5}}\right) - 4.9 \left(\frac{x^2}{49(5)}\right) = 50$$

$$2x - \frac{x^2}{50} = 50$$

$$x^2 - 100x + 2500 = 0$$

$$x = 50$$

SM

iii

$$35 \cos \theta t = 50$$

$$t = \frac{50}{35 \cos \theta} = \frac{10}{7 \cos \theta}$$

$$35 \sin \theta t - 4.9 t^2 = 50$$

$$\overset{5}{35} \sin \theta \left(\frac{10}{7 \cos \theta}\right) - 4.9 \left(\frac{100}{49 \cos^2 \theta}\right) = 50$$

$$\rightarrow 10 \left(\frac{1}{\cos^2 \theta}\right)$$

$$50 \tan \theta - 10(1 + \tan^2 \theta) = 50$$

SM

$$\tan^2 \theta - 5 \tan \theta + 6 = 0$$

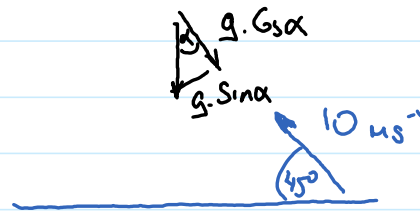
$$(\tan \theta - 2)(\tan \theta - 3) = 0.$$

$$\begin{aligned} \tan \theta &= 3 \\ \theta &= 71.6^\circ \end{aligned}$$

SM

25

(b)



$$s_y = 0 = 10 \cdot \sin 45 \cdot t - \frac{1}{2} g \cos \alpha \cdot t^2$$

$$t = \frac{10\sqrt{2}}{g \cos \alpha}$$

SM

$$v_x = 10 \cdot \cos 45 + g \sin \alpha \left( \frac{10\sqrt{2}}{g \cos \alpha} \right)$$

SM

$$= 5\sqrt{2} + 10\sqrt{2} \tan \alpha$$

$$v_y = 10 \cdot \sin 45 - g \cos \alpha \left( \frac{10\sqrt{2}}{g \cos \alpha} \right)$$

SM

$$v_y = -5\sqrt{2}$$

$$\tan \theta = \frac{-v_y}{v_x}$$

$$\frac{1}{4} = \frac{5\sqrt{2}}{5\sqrt{2} + 10\sqrt{2} \tan \alpha}$$

$$\frac{1}{4} = \frac{1}{1 + 2 \tan \alpha}$$

$$1 + 2 \tan \alpha = 4$$

$$\tan \alpha = \frac{3}{2}$$

$$\alpha = 56.3^\circ$$

SM

$$\text{ii) } v_z = 20\sqrt{2}$$

$$v_z = 5e\sqrt{2}$$

$$\Rightarrow 5\sqrt{33} = \sqrt{(20\sqrt{2})^2 + (5e\sqrt{2})^2}$$

$$\Rightarrow e = \frac{1}{\sqrt{2}}$$

SM

25