

$$\begin{aligned} \text{(ii) } v_y &= 10.5 \\ \Rightarrow 35 - 9.8t &= 10.5 \\ \Rightarrow t &= \frac{24.5}{9.8} \\ &= \frac{5}{2} \end{aligned}$$

$$\begin{aligned} \text{(iii) } v_y &= -10.5 \\ \Rightarrow 35 - 9.8t &= -10.5 \\ \Rightarrow t &= \frac{45.5}{9.8} \\ &= \frac{65}{14} \end{aligned}$$

(iv) Midway between (ii) and (iii) is

$$\frac{\frac{5}{2} + \frac{65}{14}}{2} = \frac{25}{7} = \text{(i) QED}$$

$$\begin{aligned} \text{Q. 9. } s_y &= -490 \\ \Rightarrow -4.9t^2 &= -490 \\ \Rightarrow t &= 10 \end{aligned}$$

$$\begin{aligned} \text{At } t = 10, s_x &= 200t \\ &= 200(10) \\ &= 2,000 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Q. 10. (i) } v_y &= 0 \\ \Rightarrow 98 - 9.8t &= 0 \\ \Rightarrow t &= 10 \end{aligned}$$

$$\begin{aligned} \text{(ii) At } t = 10, s_x &= 10t \\ &= 10(10) \\ &= 100 \text{ m} \\ s_y &= 98t - 4.9t^2 \\ &= 98(10) - 4.9(100) \\ &= 490 \text{ m} \\ \therefore \vec{r} &= 100\vec{i} + 490\vec{j} \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Q. 11. } v_x &= 100 \\ v_y &= 98 - gt \\ s_x &= 100t \\ s_y &= 98t - \frac{1}{2}gt^2 \end{aligned}$$

$$\begin{aligned} \text{(i) Need to find } t \text{ when } s_y &= 470.4 \\ \Rightarrow 98t - \frac{1}{2}gt^2 &= 470.4 \\ \Rightarrow 98t - 4.9t^2 &= 470.4 \\ \Rightarrow 4.9t^2 - 98t + 470.4 &= 0 \\ \Rightarrow t^2 - 20t + 96 &= 0 \\ \Rightarrow (t - 8)(t - 12) &= 0 \\ \Rightarrow t = 8, t = 12 \end{aligned}$$

(ii) Find  $v_x$  and  $v_y$  when  $t = 8$

$$\begin{aligned} v_x &= 100 \\ v_y &= 98 - g(8) \\ &= 19.6 \\ \Rightarrow \vec{v} &= 100\vec{i} + 19.6\vec{j} \\ \Rightarrow \text{Speed} &= \sqrt{100^2 + 19.6^2} \\ &= 102 \text{ m/s} \end{aligned}$$

Find  $v_x$  and  $v_y$  when  $t = 12$

$$\begin{aligned} v_x &= 100 \\ v_y &= 98 - g(12) \\ &= -19.6 \\ \Rightarrow \vec{v} &= 100\vec{i} - 19.6\vec{j} \\ \Rightarrow \text{Speed} &= \sqrt{100^2 + (-19.6)^2} \\ &= 102 \text{ m/s} \end{aligned}$$

$$\begin{aligned} \text{Q. 12. } v_x &= 8 \\ v_y &= 28 - gt \\ \sqrt{8^2 + (28 - gt)^2} &= 10 \\ \Rightarrow 64 + (784 - 56gt + g^2t^2) &= 100 \\ \Rightarrow g^2t^2 - 56gt + 748 &= 0 \\ \Rightarrow \frac{2,401}{25}t^2 - \frac{2,744}{5}t + 748 &= 0 \\ \Rightarrow 2,401t^2 - 13,720t + 18,700 &= 0 \end{aligned}$$

$$t = \frac{13,720 \pm \sqrt{13,720^2 - 4(2,401)(18,700)}}{2(2,401)}$$

$$t_1 = \frac{110}{49} \text{ s} \quad t_2 = \frac{170}{49} \text{ s}$$