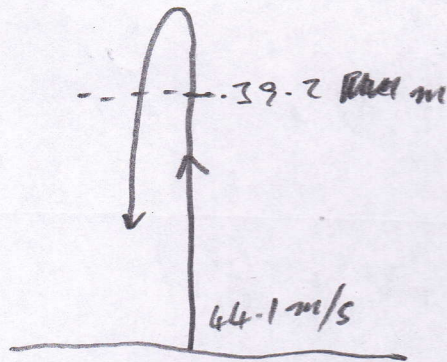


2013 Q1

(a)



$$u = 44.1 \text{ m/s}$$

$$S = 39.2 \text{ m}$$

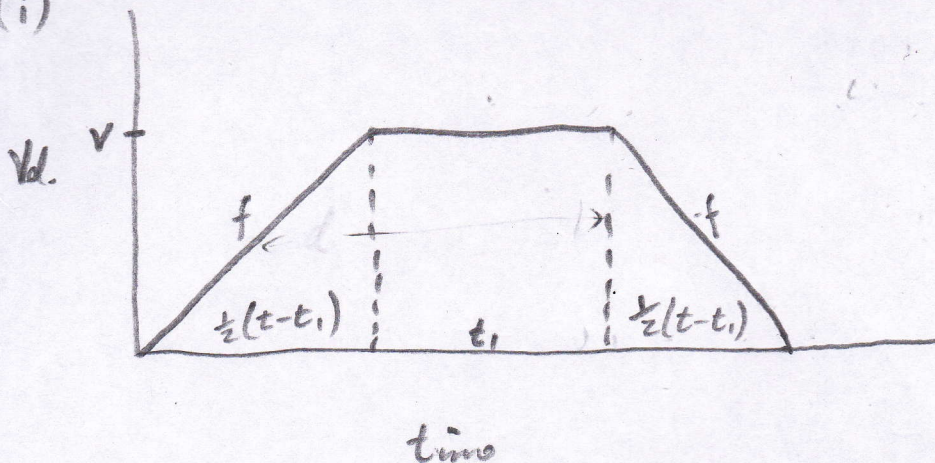
$$g = -9.8$$

$$t = ?$$

$$\begin{aligned} S &= ut + \frac{1}{2}gt^2 \Rightarrow 39.2 = 44.1t + \frac{1}{2}(-9.8)t^2 \\ &\Rightarrow 78.4 = 88.2t - 9.8t^2 \\ &\Rightarrow 0 = 9.8t^2 - 88.2t + 78.4 \\ &\Rightarrow 0 = 98t^2 - 882t + 784 \\ &\Rightarrow 0 = t^2 - 9t + 8 \\ &\Rightarrow 0 = (t - 8)(t - 1) \\ &\Rightarrow t = 8 \text{ or } 1 \text{ sec.} \end{aligned}$$

$$\Rightarrow \text{Time interval} = 8 - 1 = 7 \text{ sec.}$$

(b)(i)



$$(ii) \quad f = \frac{v}{\frac{1}{2}(t-t_1)} \Rightarrow v = \frac{1}{2}f(t-t_1)$$

(iii) $d = \text{Area under curve}$

$$= \frac{1}{2} \left(\frac{1}{2}(t-t_1) \right) v + t_1 v + \frac{1}{2} \left(\frac{1}{2}(t-t_1) \right) v$$

$$= \frac{1}{4}(t-t_1) v + t_1 v + \frac{1}{4}(t-t_1) v$$

$$= v \left(\frac{1}{2}(t-t_1) + t_1 \right)$$

$$= v \left(\frac{1}{2}t - \frac{1}{2}t_1 + t_1 \right)$$

$$= v \left(\frac{1}{2}t + \frac{1}{2}t_1 \right)$$

$$= \frac{1}{2} f(t-t_1) \frac{1}{2}(t+t_1)$$

$$= \frac{1}{4} f(t-t_1)(t+t_1)$$

$$= \frac{1}{4} f(t^2 - t_1^2)$$

$$\Rightarrow 4d = f(t^2 - t_1^2)$$

$$\Rightarrow \frac{4d}{f} = t^2 - t_1^2$$

$$\Rightarrow \frac{4d}{f} - t^2 = -t_1^2$$

$$\Rightarrow t^2 - \frac{4d}{f} = t_1^2$$

$$\Rightarrow \sqrt{t^2 - \frac{4d}{f}} = t_1$$