

Ex. 6, p. 42, Physics 1 - Halliday & Resnick

auto going East - vel reduced from 45 mi/hr to 30 mi/hr in a distance of 264 ft.

a) Find a

$$a = \frac{v_2 - v_1}{t} = \frac{45 \text{ mi/hr} - 30 \text{ mi/hr}}{t} = \frac{15 \text{ mi/hr}}{t} \quad \text{Eq 1}$$

What is t?

We know $d = v_{\text{ave}} \cdot t$ assuming a is constant

$$v_{\text{ave}} = \frac{v_1 + v_2}{2}, \quad \text{So...}$$

$$264 \text{ ft} = \frac{v_1 + v_2}{2} t$$

$$528 \text{ ft} = (v_1 + v_2)t$$

$$t = \frac{528 \text{ ft}}{v_1 + v_2} = \frac{528 \text{ ft}}{45 \frac{\text{mi}}{\text{hr}} + 30 \frac{\text{mi}}{\text{hr}}} = \frac{528 \text{ ft}}{75 \text{ mi/hr}} \quad \text{Eq 2}$$

Insert Eq 2 into Eq 1.

$$a = \frac{15 \text{ mi/hr}}{t} = \frac{15 \text{ mi/hr}}{\frac{528 \text{ ft}}{75 \text{ mi/hr}}} = \frac{15}{\frac{528}{75}} \frac{(\text{mi/hr})^2}{\text{ft}}$$

$$= 2.1367 \frac{\text{mi}^2}{\text{hr}^2} \frac{1}{\text{ft}}$$

$$= 2.1367 (2.151 \frac{\text{ft}^2}{\text{s}^2}) \frac{1}{\text{ft}}$$

Aside

$$\frac{\text{mi}^2}{\text{hr}^2} = \frac{(5280 \text{ ft})^2}{(60 \cdot 60 \text{ s})^2}$$

$$= 2.151 \frac{\text{ft}^2}{\text{s}^2} \quad \text{Eq 3}$$

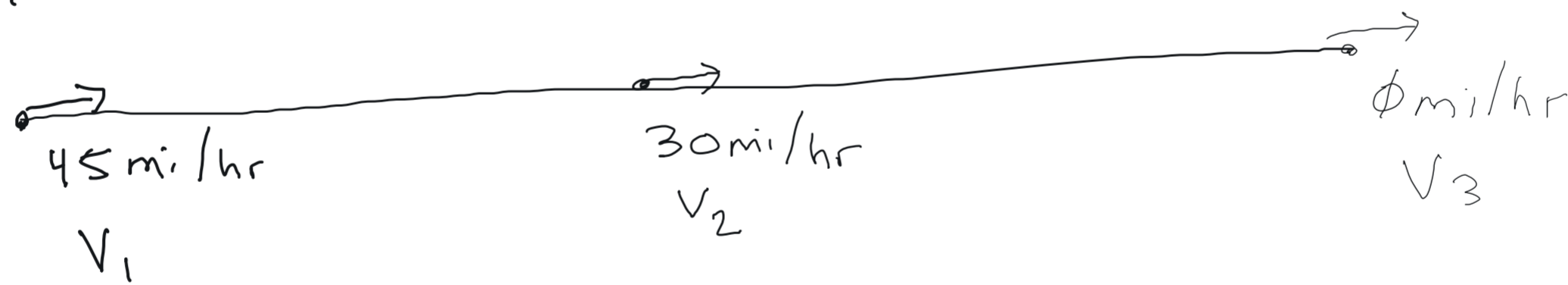
$$a = 4.583 \frac{\text{ft}}{\text{s}^2}$$

b) Find time to decelerate from 45 mi/hr to 30 mi/hr
time is obtained from Eq 2

$$t = \frac{528 \text{ ft}}{75 \text{ mi/hr}} = \frac{528 \text{ ft}}{75 \cdot \frac{5280 \text{ ft}}{60^2 \text{ s}}} = \frac{528 \cdot 60^2 \text{ s}}{75 \cdot 5280}$$

$$t = 4.8 \text{ s}$$

c) Determine time it takes to go from 45 mi/hr to ϕ mi/hr.



$$a = \frac{v_3 - v_2}{t} = \frac{\phi \text{ mi/hr} - 30 \text{ mi/hr}}{t}$$

$$-4.583 \frac{\text{ft}}{\text{s}^2} = \frac{-30 \frac{\text{mi}}{\text{hr}}}{t}$$

$$t = \frac{-30 \text{ mi/hr}}{-4.583 \frac{\text{ft}}{\text{s}^2}} = \frac{30 (5280 \text{ ft}) / 60^2 \text{ s}}{4.583 \text{ ft}}$$

$$= \frac{30 (5280) \text{ s}}{4.583 (60^2)} = 9.60 \text{ s}$$

$$t = 9.60 \text{ s}$$

$$t_{\text{total}} = 4.8 \text{ s} + 9.6 \text{ s} = 14.4 \text{ s}$$

d) Find total distance to come to rest.

$$d = \frac{1}{2} a t^2 \quad t = t_{\text{total}}$$

$$= \frac{1}{2} 4.58 \frac{\text{ft}}{\text{s}^2} (14.4 \text{ s})^2 = 475.2 \text{ ft}$$

$$d = 475.2 \text{ ft}$$