

PROB. 11-41

$$(v_A)_0 = \left(24 \frac{\text{mi}}{\text{h}}\right) \left(\frac{\text{h}}{3600\text{s}}\right) \left(\frac{5280\text{ ft}}{\text{mi}}\right) = 35.2 \frac{\text{ft}}{\text{s}},$$

$$(v_B)_0 = 36 \frac{\text{mi}}{\text{h}} = 52.8 \frac{\text{ft}}{\text{s}}, \quad (x_A)_0 = 0, \quad (x_B)_0 = 75 \text{ ft}$$

$$a_A = 1.8 \frac{\text{ft}}{\text{s}^2}, \quad a_B = -1.2 \frac{\text{ft}}{\text{s}^2}$$

FIND WHEN/WHERE  $x_A = x_B$ ,  $(v_A)_f$ ,  $(v_B)_f$

CAR A:

$$x_A = (x_A)_0 + (v_A)_0 \cdot t + \frac{1}{2} a_A \cdot t^2$$

$$x_A = (0) + (35.2)t + \frac{1}{2}(1.8)t^2 = 35.2t + 0.9t^2$$

CAR B:

$$x_B = (x_B)_0 + (v_B)_0 \cdot t + \frac{1}{2} a_B \cdot t^2$$

$$x_B = (75) + (52.8)t + \frac{1}{2}(-1.2)t^2$$

$$x_B = 75 + 52.8t - 0.6t^2$$

$x_A = x_B$  WHEN:

$$35.2t + 0.9t^2 = 75 + 52.8t - 0.6t^2$$

$$1.5t^2 - 17.6t - 75 = 0$$

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-17.6) \pm \sqrt{17.6^2 - 4(1.5)(-75)}}{2(1.5)}$$

$$t = 5.867 \pm 9.188 \quad \text{TAKE POSITIVE ROOT}$$

$$t = 15.05 \text{ s}$$

PROB. 11-41 CONT.

$$X_A = 35.2t + 0.9t^2 = 35.2(15.05) + 0.9(15.05)^2$$

$$X_A = 733.7 \text{ ft} = X_B$$

CAR A:

$$V_A = \sqrt{(V_A)_0^2 + 2a_A [X_A - (X_A)_0]}$$

$$V_A = \sqrt{(35.2)^2 + 2(1.8)[(733.7) - (0)]}$$

$$V_A = \left(62.28 \frac{\text{ft}}{\text{s}}\right) \left(\frac{\text{mi}}{5280 \text{ ft}}\right) \left(\frac{3600 \text{ s}}{\text{hr}}\right) = 42.47 \frac{\text{mi}}{\text{hr}}$$

CAR B:

$$V_B = \sqrt{(V_B)_0^2 + 2a_B [X_B - (X_B)_0]}$$

$$V_B = \sqrt{(52.8)^2 + 2(-1.2)[(733.7) - (75)]}$$

$$V_B = \left(34.74 \frac{\text{ft}}{\text{s}}\right) \left(\frac{3600 \text{ s}}{\text{hr}}\right) \left(\frac{\text{mi}}{5280 \text{ ft}}\right) = 23.69 \frac{\text{mi}}{\text{hr}}$$