

16.5



Given: $\mu_s = 0.80$
 Find: (a) Assume
 (a) Four-wheel drive
 (b) Rear-wheel drive
 (c) Front-wheel drive

(a) Four-wheel drive:



$$+ \uparrow \Sigma F_y = 0: N_A + N_B - W = 0 \quad N_A + N_B = W = mg$$

$$\text{Thus: } F_A + F_B = \mu_s N_A + \mu_s N_B = \mu_s (N_A + N_B) = \mu_s W = 0.80 mg$$

$$\pm \Sigma F_x = \Sigma (F_x)_{\text{eff}}: F_A + F_B = ma \quad 0.80 mg = ma$$

$$a = 0.80g = 0.80(32.2 \text{ ft/s}^2) \quad a = 25.8 \text{ ft/s}^2 \rightarrow$$

(b) Rear-wheel drive:



$$+ \uparrow \Sigma M_G = \Sigma (M_G)_{\text{eff}}: (100 \text{ in})N_B - (100 \text{ in})N_A = -(20 \text{ in})ma$$

$$N_B = 0.4W + 0.2ma$$

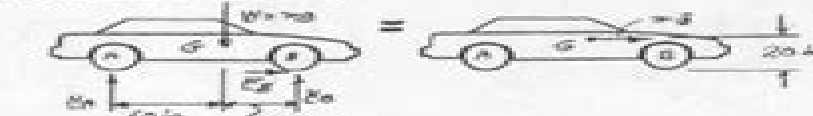
$$\text{Thus: } F_B = \mu_s N_B = 0.80(0.4W + 0.2ma) = 0.32mg + 0.16ma$$

$$\pm \Sigma F_x = \Sigma (F_x)_{\text{eff}}: F_B = ma \quad 0.32mg + 0.16ma = ma$$

$$0.32g = 0.84a \quad 0.32g = 0.84a$$

$$a = \frac{0.32}{0.84}(32.2 \text{ ft/s}^2) \quad a = 12.27 \text{ ft/s}^2 \rightarrow$$

(c) Front-wheel drive:



$$+ \uparrow \Sigma M_B = \Sigma (M_B)_{\text{eff}}: (100 \text{ in})N_B - (60 \text{ in})W = -(20 \text{ in})ma$$

$$N_B = 0.6W - 0.2ma$$

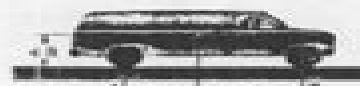
$$\text{Thus: } F_A = \mu_s N_B = 0.80(0.6W - 0.2ma) = 0.48mg - 0.16ma$$

$$\pm \Sigma F_x = \Sigma (F_x)_{\text{eff}}: F_A = ma \quad 0.48mg - 0.16ma = ma$$

$$0.48g = 1.16a \quad 0.48g = 1.16a$$

$$a = \frac{0.48}{1.16}(32.2 \text{ ft/s}^2) \quad a = 13.32 \text{ ft/s}^2 \rightarrow$$

16.6



Given: $v_0 = 30 \text{ ft/s}$
 From Sample Problem 16.1
 $\mu_s = 0.677$
 Find: Distance required to stop if
 (a) Rear-wheel brake fail to operate
 (b) Front-wheel brake fail to operate

(a) If rear-wheel brake fail to operate



$$+ \uparrow \Sigma M_A = \Sigma (M_A)_{\text{eff}}: N_B(50 \text{ in}) - W(50 \text{ in}) = -ma(4 \text{ ft})$$

$$N_B = \frac{5}{12}W + \frac{1}{3}\frac{W}{g}a$$

$$\pm \Sigma F_x = \Sigma (F_x)_{\text{eff}}: F_A = -ma \quad \mu_s N_B = \frac{W}{3}a$$

$$0.677\left(\frac{5}{12}W + \frac{1}{3}\frac{W}{g}a\right) = \frac{W}{3}a$$

$$a = \frac{0.677\left(\frac{5}{12}\right)(32.2 \text{ ft/s}^2)}{1 - 0.723} \quad a = 12.27 \text{ ft/s}^2 \rightarrow$$

$$\text{UNIFORMLY ACCELERATED MOTION} \quad v^2 = v_0^2 + 2ax \quad 0 = (30 \text{ ft/s})^2 - 2(12.27 \text{ ft/s}^2)x$$

$$x = 36.9 \text{ ft}$$

(b) If front-wheel brake fail to operate



$$+ \uparrow \Sigma M_B = \Sigma (M_B)_{\text{eff}}: W(70 \text{ in}) - N_A(120 \text{ in}) = -a(20 \text{ in})$$

$$N_A = \frac{7}{12}W - \frac{1}{3}\frac{W}{g}a$$

$$\pm \Sigma F_x = \Sigma (F_x)_{\text{eff}}: F_B = -ma \quad \mu_s N_A = \frac{W}{3}a$$

$$0.677\left(\frac{7}{12}W - \frac{1}{3}\frac{W}{g}a\right) = \frac{W}{3}a$$

$$a = \frac{0.677\left(\frac{7}{12}\right)(32.2 \text{ ft/s}^2)}{1 + 0.723} \quad a = 10.648 \text{ ft/s}^2 \rightarrow$$

$$\text{UNIFORMLY ACCELERATED MOTION} \quad v^2 = v_0^2 + 2ax \quad 0 = (30 \text{ ft/s})^2 - 2(10.648 \text{ ft/s}^2)x$$

$$x = 42.3 \text{ ft}$$

Vector Mechanics For Engineers Dynamics 9th Chapter 16 Solutions

**Ferdinand Pierre Beer, Elwood Russell
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