Chapter **03** (Bueche & Jerde) *Newton's Laws of Motion*

P09. v = 80.0 km/h = 22.22 m/s, $F = ma$ = (1060)(22.22/9.4) = 2.5 (kN).

P16. (a) F = 6.8 N, m_1 = 3.2 kg & m_2 = 4.1 kg. $F_{12} = F_{21}$, $F - F_{12} = m_1 a$ & $F_{21} = m_2 a$ $\Rightarrow$ $a = F/(m_1+m_2)$ = 0.93 m/s^2, $F_{12} = m_2F/(m_1+m_2)$ = 3.8 N; (b) The acceleration is of same magnitude but in opposite direction. $F_{12} = m_1F/(m_1+m_2)$ = 3.0 N .

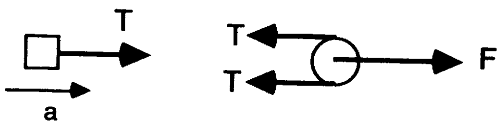
P21. W_e = 960 N & g_m = 1.63 m/s^2: (a) $W_e = mg_e$ & $W_m = mg_m$ $\Rightarrow$ $W_m = W_e g_m / g_e$ = 160 N; (b) $m = W_e/g_e$ = 98.0 kg .

P29. v_f = 20.7 m/s & μ = 0.620. $F = \mu mg = ma$, $a = \mu g$. $m_1^2 = 2a S$, $S = v_f^2/(2\mu g)$ = 35.3 m .

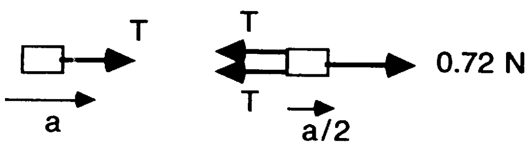
P34. m = 9.1 g, v_i = 165 m/s, v_f = 92 m/s & S = 2.3 cm. $v_f^2 = v_i^2 + 2\underline{a}S$ $\Rightarrow$ $\underline{a}$ = -4.08×10^5 m/s^2 & $\underline{F} = m\,\underline{a}$ = –3.7 kN .

P37. μ = 0.240 & v_0 = 22.5 m/s. $F = -\mu F_N = -\mu mg = ma$, $a = -\mu g$. Using $v_f^2 = v_0^2 + 2aS$, $S = v_0^2/(-2a) = v_0^2/(2\mu g)$ = 107 m .

P44. In the absence of friction, $F = 2T$, where T is the tension in the cord. $T = ma$, $a = F/(2m)$. In the presnece of friction, $F = 2T$ and $T - f = ma$, so $a = (F-2f)/(2m)$.



P45. m_1 = 0.375 kg, m_2 = 0.275 kg, F = 0.720 N & $a_2 = 2a_1$. $F - 2T = m_1 a_1 = m_1 a_2/2$ & $T = m_2 a_2$. We have $F = (2m_2+m_1/2)\,a$ or $a = F/(2m_2+m_1/2)$ = 0.976 m/s^2 & T = 0.268 N .



P46. m_1 (top) = 0.200 kg, m_2 (bottom) = 0.700 kg, F = 1.90 N & a = 1.35 m/s^2. $T - m_1 g\mu_k = m_1 a$ & $F - T - (m_1+m_2)g\mu_k - m_1 g\mu_k = m_2 a$. We have $F - (3m_1+m_2)\,g\mu_k = (m_1+m_2)\,a$. So μ_k = 0.0530 .

P48. m_1 (ramp) = 3.65 kg, m_2 = 6.30 kg, θ = 35° & μ = 0 (a) or 0.250 (b) between m_1 and the ramp. (a) $T - m_1 g\sin\theta = m_1 a$ & $m_2 g - T = m_2 a$ $\Rightarrow$ $a = g(m_2 - m_1\sin\theta)/(m_1+m_2)$ = 4.14 m/s^2 & $T = m_1m_2(1+\sin\theta)\,g/(m_1+m_2)$ = 35.6 N; (b) $T - m_1 g\sin\theta - (m_1 g\cos\theta)\,\mu = m_1 a$ & $m_2 g - T = m_2 a$ $\Rightarrow$ $a = g[m_2 - m_1(\sin\theta+\mu\cos\theta)]/(m_1+m_2)$ = 3.41 m/s^2 & $T = m_1m_2\,(1+\sin\theta+\mu\cos\theta)\,g/(m_1+m_2)$ = 40.3 N .

P49. Let subscripts 1 and 2 refer to M and m. $F_{12} = F_{21}$, $F - F_{12} = Ma$ & $F_{21} = ma$ $\Rightarrow$ $F = (m+M)\,a$ & $F_{12} = mF/(m+M)$. $mg = f_s \le \mu F_{12}$. So $F \ge (m+M)\,g/\mu$.

P51. m = 2.85 kg, F = 50 N, θ = 22.5° & μ_k = 0.77. (a) $F\cos\theta - (mg - F\sin\theta)\,\mu_k = ma$, a = 13.8 m/s^2; (b) $F\cos\theta - (mg+F\sin\theta)\,\mu_k = ma$, a = 3.49 m/s^2.

P61. m = 4.00 kg, μ_s = 0.80, μ_k = 0.600, F = 50.0 N & θ = 30°: (a) $F_N = mg - F\sin\theta$ = 14.2 N; (b) $F\cos\theta - \mu_s F_N = ma$, a = 7.99 m/s^2, just after the box starts to move. After sliding, $F\cos\theta - \mu_k F_N = ma$, a = 8.70 m/s^2; (c) $F_N = mg + F\sin\theta$ = 64.2 N; (d) $f_s = \mu_s F_N$ = 51.4 N > $F\cos\theta$ (= 43.3 N). Therefore the box will not have any acceleration and will not start moving .

P62. μ_s = 0.650. $F_N = F$, $m\,g = f_s \le \mu_s F_N = \mu_s F$, $F \ge mg/\mu_s$ = 1.54 mg .