Chapter 06 *(Bueche & Jerde)* ***Linear Momentum***

P03 $v = \sqrt{2gh}$, $p = mv = m\sqrt{2gh}$.

P05 $K = (½)mv^2$ & $p = mv$ $\Rightarrow$ $p^2 = 2mK$.

P08 m = (440,000)(4.45)/9.80 = 1.998×10^5 (kg), v_f = 240 km/s = 66.67m/s & Δx = 1750 m: $\underline{F} = \Delta p/\Delta t = mv_f/(2\Delta x)$ = 254 kN .

P10 Δx = 0.225 cm, v_i = 15.25 m/s & v_r = –10.7m/s: $\Delta x = v_i\Delta t_i/2 = v_r\Delta t_r/2 \Rightarrow \Delta t_i = 2.90\times10^{-4}$s & $\Delta t_r = 4.21\times10^{-4}$ s. So the total time $\Delta t = 7.11\times10^{-4}$ s. $\underline{F} = m(v_r - v_i)/\Delta t = -1.27\times10^4$ N.

P13 $\Delta m/\Delta t$ = 26 g/s & v = 2.10 m/s: (a) $I = \Delta P = (\Delta m/\Delta t)\, t\, v = 0.0546\, t$ N·s; (b) $F = I/t$ = 0.0546 N.

P17 $m(36) + m(-12) = 2mV$, V = 12 (m/s) .

P19 (a) $mv = mv_f + MV_f$, (0.0175)(55.60 + 12.60) = (8.45)V_f , V_f = 0.141 (m/s); (b) $0 - (½)mV_f^{\,2} = -f\,s$, $(1/2)(8.45)(0.141^2) = f(1.32)$, f = 0.064 (N) .

P22 (a) $v = \sqrt{2gh}$, $mv = (2m)V$, $V = \sqrt{gh/2}$; (b) $\Delta K = (½)mv^2 - (½)(2m)(v/2)^2 = mv^2/4$, $\Delta K/K_i = 1/2$.

P23 Constant of Energy: $v_i = \sqrt{2gh}$, $v_f = \sqrt{2g(h/6)}$. Conservation of Momentum: $m_1v_i = (m_1+m_2)\, v_f$ or $v_i/v_f = (m_1+m_2)/m_1$. Using v_i/v_f = 2.45 leads to $m_2 = 1.45m_1$.

P25 $m_\ell = 3.5m_r$, $v_\ell = (3.5-1)\, v_0/(3.5+1) = (5/9)\, v_0$, $v_r = (2\times3.5)/(3.5+1)\, v_0 = (14/9)\, v_0$.

P29 $m_2 = rm_1$, $V_{2f} = 2V_0/(1+r)$, $\Delta K_1/K_1 = K_{2f}/K_1 = (m_2V_{2f}^{\ 2})/(m_1V_0^{\ 2}) = 4r/(1+r)^2$. As r = 1, i.e., $m_1 = m_2$, $\Delta K_1/K_1$ is largest.

P31 Constant of Momentum: (7.2)(3.3) = (72)(v), v = 0.33m/s. $\Delta t = \Delta x/v$ = 21.5/0.33 = 65 (s) .

P38 Let θ_2 be the angle of the proton going o. with respect to the $-x$ axis. Px: $mv_0 - mv_0 = 0 = mv_1 \cos50° - mv_2 \cos\theta_2$. P_y: $mv_1 \sin50° = mv_2 \sin\theta_2$, so $\tan\theta_2 = \tan50°$ or $\theta_2 = 50°$, and $v_1 = v_2 = v_0$.

P39 (a) $\vec{v}_1$: $(-v_0, 0)$, $\vec{v}_2$: $(v_0/2, v_0/2)$; $\vec{v}_{1,f}$: $(0, v_0)$ & $\vec{v}_{2,f}$: $(v_{2,fx}, v_{2,fy})$. P_x: $-v_0 + v_0/2 = 0 + v_{2,fx} \Rightarrow v_{2,fx} = -v_0/2$. P_y: $0 + v_0/2 = v_0 + v_{2,fy} \Rightarrow v_{2,fy} = -v_0/2$; (b) Since there is no change in speed or kinetic energy, the collision is perfectly *elastic* .

P41 P_x: $m(-v) = m(-v/2)\cos40° + (m/5)V_x$, $V_x = -3.08v$. P_y: $0 = m(v/2)\sin40° + (m/5)V_y$, $V_y = -1.61v$. $V = 3.48\, v$, $\theta = \tan^{-1}(1.61/3.08)$ = 27.6° below $-x$ axis .

P42 P_x: $m(-v) = m(v/4)\cos40° + (m/5)V_x$, $V_x = -5.96v$. P_y: $0 = m(v/4)\sin 40° + (m/5)V_y$, $V_y = -0.803v$. $V = 6.01\, v$, $\theta = \tan^{-1}(0.803/5.96)$ = 7.7° below $-x$ axis .

P48 Constant of E: $\Delta K + \Delta U = 0$, $(½)(m+2m)V_1^{\,2} = (2m-m)gD$, $V_1 = \sqrt{2gD/3}$; Conservation of P: $(3m)V_1 = (4m)V_2$, $V_2 = (3/4)V_1 = \sqrt{3gD/8}$.

P49 (a) $(½)mV_1^{\,2} = mgL$, $V_1 = \sqrt{2gL}$; (b) $(m)V_1 = (4m)V_2$, $V_2 = V_1/4 = \sqrt{gL/8}$.

P50 The force on the table is due to the weight of that part of the chain on the table at any given time t plus the negative of the impulsive force needed to stop the chain from moving. $F_1 = (y/L)Mg = (vMg/L)\, t$ and $F_2 = v\Delta M/\Delta t$, where $\Delta M = (v\Delta t/L)M$. Thus $F_{net} = F_1 + F_2 = (Mv/L)(v + gt)$.