Chapter **9** (Benson)

E07 P_x: $0 = -3V_1 \cos 60^0 + 2V_2 \sin 25^0$; P_y: $-(3)(6) = -3V_1 \sin 60^0 - 2V_2 \cos 25^0$. Solve to find $V_1 = 3.1\,\mathrm{m/s}$ & $V_2 = 5.5\,\mathrm{m/s}$.

E14 $m_1 = 1\,\mathrm{kg}$, $m_2 = 2\,\mathrm{kg}$, $v_2 = 0$ & $v_2' = 10\,\mathrm{m/s}$;
P_x: $m_1 v_1 = m_1 v_1' \cos 30^0 + m_2 v_2' \cos 45^0$. P_y: $0 = m_1 v_1' \sin 30^0 - m_2 v_2' \sin 45^0$, so $v_1' = 2.83\, v_2 = 2.83\,\mathrm{m/s}$. Substitute v_1' into P_x to find $v_1 = 38.6\,\mathrm{m/s}$.

E28 (a) $mu = (M+m)v$ & $v^2 = gh$, so $H = [mu/(M+m)]^2/2g = 81.6\,\mathrm{cm}$; (b) $K_i = 90\,\mathrm{J}$, $K_f = 12\,\mathrm{J}$, so $\Delta K = -78\,\mathrm{J}$.

E29 P_x: $(0.01)(400) = (0.01)(100) + (2.5)\,v$, so $v = 1.2\,\mathrm{m/s}$. (a) $H = v^2/(2g) = 7.3\,\mathrm{cm}$; (b) $W = -\Delta K = m\,(v_f^2 - v_i^2)/2 = 750\,\mathrm{J}$.

E30 $m = 0.25\,\mathrm{kg}$, $M = 1.75\,\mathrm{kg}$ & $v = 24\,\mathrm{m/s}$; P_x: $mv = (m+M)V$, so $V = 3\,\mathrm{m/s}$. $\Delta E = W_{nc}$: $kA^2/2 - (m+M)V^2/2 = -fA$, where $k = 40\,\mathrm{N/m}$ and $A = 0.5\,\mathrm{m}$, thus $f = 8\,\mathrm{N}$.

E36 Let $r = m_2/m_1$, we know $v_1' = u\,(1-r)/(1+r)$. (a) $(1-r)/(1+r) = -1/3$, so $m_2 = 2m_1$; (b) $(1-r)/(1+r) = 1/2$, so $m_2 = m_1/3$.

E41 $F = (0.01)(100-400)/(0.01) = -300\,(\mathrm{N})$.

E42 $\vec{F}_{av} = \Delta\vec{P}/\Delta t$ & $\Delta t = 1\,\mathrm{ms}$: (a) $(0.15)(-30\,\hat{\imath} - 30\,\hat{\imath})/10^{-3} = -9\,\hat{\imath}\,(\mathrm{kN})$; (b) $(0.15)(40\,\hat{\jmath} - 30\,\hat{\imath})/10^{-3} = (-4.5\,\hat{\imath} + 6\,\hat{\jmath})\,(\mathrm{kN})$.

E51 $m = 0.06\mathrm{kg}$, $v_1 = 25\mathrm{m/s}$, $\theta_1 = 40^0$, $v_2 = 30\mathrm{m/s}$ & $\theta_2 = 30^0$: $\Delta P_x = m\,(v_2 \cos\theta_2 - v_1 \cos\theta_1) = -0.11$, $\Delta P_y = m\,(v_2 \sin\theta_2 + v_1 \sin\theta_1) = 1.56$. (a) $\vec{I} = (-0.11\,\hat{\imath} + 1.56\hat{\jmath})\,\mathrm{kg{\cdot}m/s}$; (b) $\Delta t = 0.005\,\mathrm{s}$, $\vec{F} = \vec{I}/\Delta t = (-22\,\hat{\imath} + 312\hat{\jmath})\,\mathrm{N}$.

E56 $v_1 = 8/\sqrt{3}\,\mathrm{m/s}$, $v_2 = 16/\sqrt{3}\,\mathrm{m/s}$, $\theta_2 = 30^0$ below the x axis.

E59 $\cos\theta_1 = 2/3$ or $\theta_1 = 48.1^0$ and $\cos\theta_2 = \sqrt{5}/3$ or $\theta_2 = 41.8^0$.

E70 Let $m_1 (=40\,\mathrm{kg})$, $m_2 (=2\,\mathrm{kg})$, and $m_3 (=10\,\mathrm{kg})$ be the mass of the child, ball, and platform & $v_3 = 4\,\mathrm{m/s}$. (a) P_x: $(m_1 + m_2 + m_3)\,v_3 = m_2 v_2' + (m_1 + m_3)\,v$, where $v_2' = 8\,\mathrm{m/s}$, so $v = 3.84\,\mathrm{m/s}$; (b) P_x: $(m_1 + m_2 + m_3)\,v_3 = -m_2 v_2' + (m_1 + m_3)\,v$, where $v_2' = 8\,\mathrm{m/s}$, so $v = 4.48\,\mathrm{m/s}$. (Teacher: Jyh-Shinn Yang, 89.11.30)

E74 $v = v_0 + v_{ex} \ln(M_0/M)$, $v = 2.5{\times}10^3 + 2.9{\times}10^3 \ln(1/0.8) = 3.15\,(\mathrm{km/s})$.

P03 P_x: $m_1 u_1 - m_2 u_2 = (m_1 + m_2)V$; $\Delta K = (m_1 u_1^2 + m_2 u_2^2)/2 - (m_1 + m_2)V^2/2 = m_1 m_2 (u_1 + u_2)^2/[2(m_1 + m_2)]$.

P04 Let u be the speed of the block relative to the wedge. P_x: $MV - m\,(u\cos\theta - V) = 0$, thus $u\cos\theta = (m+M)V/m$. Constant of E: $mgh = MV^2/2 + m\,[(u\cos\theta - V)^2 + (u\sin\theta)^2]/2$. Substitute for u to find $V = [2m^2 gh \cos^2\theta/(M+m)(M + m\sin^2\theta)]^{1/2}$.

P09 $v_1' = (-u - 4u)/3 = -5u/3$ & $v_2' = (2u - u)/3 = u/3$, where $u^2 = 2gH$, thus, $H_1 =$

$v_1'^2/2g = 25H/9$ & $H_2 = H/9$.

P13 First M collides with $4M$ on right: $V_1 = -3u/5$, $V_4 = 2u/5$. Second M collides with $4M$ on left: $V_1' = 9u/25$, $V_4' = -6u/25$. Since $V_1' < V_4$, M cannot catch the $4M$ on the right.

P14 First collision: $V_1 = u/5$, $V_2 = 6u/5$, $V_3 = 0$. Second collision: $V_1' = V_1 = u/5$, $V_2' = -6u/25$ & $V_3' = 24u/25$.

P18 (a) As the maximum compression occurs, two masses move with the same velocity. $(2)(8) = (2+4)V$, $V = 8/3\,\mathrm{m/s}$; $E_i = K_i = 64\,\mathrm{J}$, $E_f = K_f + U_f$, $E_f = 64/3 + 200A^2$. Set $E_f = E_i$ to find $A = 0.462\,\mathrm{m}$; (b) P_x: $16 = 2V_1' + 4V_2'$, $V_2' - V_1' = V_1 - V_2 = 8$. Find $V_1' = -8/3\,\mathrm{m/s}$ & $V_2' = 16/3\,\mathrm{m/s}$.

(Teacher: Jyh-Shinn Yang, 89.11.30)