Chapter **3** (Benson)

E23 $x = 4 - 5t + 3t^2$ (a) At $t = 3\,\text{s}$, $v = -5 + 6t = 13\,(\text{m/s})$, $a = 6\,\text{m/s}^2$; (b) $v = 0$ at $t = 5/6 = 0.83\,(\text{s})$.

E25 (a) $t = 0$ or $3\,\text{s}$; (b) $t = 3\,\text{s}$; (c) $a = 2\,\text{m/s}^2$; (d) $a = 4\,\text{m/s}^2$.

E26 (a) $3 - 4\,\text{s}$; (b) 0 or $7\,\text{s}$; (c) $1 - 2\,\text{s}$, $5 - 6\,\text{s}$; (d) $4 - 5\,\text{s}$; (e) $6 - 7\,\text{s}$; (f) $0 - 1\,\text{s}$, $7 - 8\,\text{s}$; (g) $2 - 3\,\text{s}$.

E51 $H = 25\,\text{m}$ & $g' = g/6$. From $v_0^2 = 2gH$, $v_0 = 22.1\,\text{m/s}$. Then $H' = v_0^2/(2g') = 150\,\text{m}$.

E53 $H = 2.45\,\text{m/s}$, $v^2 = 2gH$, $v = 6.93\,\text{m/s}$.

E59 $v_0 = 20\,\text{m/s}$, $H = v_0^2/(2g) = 20.4\,\text{m}$. (a) $10.2 = 20\,t - 4.9\,t^2$, gives $t = 0.6\,\text{s}$, or $3.48\,\text{s}$; (b) $v = \pm 10\,\text{m/s}$ leads to $t = 1.02\,\text{s}$, or $3.06\,\text{s}$.

E65 $H = 280\,\text{km}$ & $g' = 1.5\,\text{m/s}^2$. $v_0 = \sqrt{2g'H} = 917\,\text{m/s}$. $v_y = 917 - 1.5\,t = 0$, so $t = 10\,\text{min}$.

P01 $v_m = 12.5\,\text{m/s}$, $a_c = (96\,\text{km/h})/4.6\,\text{s} = (26.7\,\text{m/s})/4.6\,\text{s} = 5.80\,\text{m/s}^2$. (a) $x = v_m t = a_c t^2/2$ gives $t = 4.31\,\text{s}$ & $x = 53.9\,\text{m}$; (b) $v_m = 12.5\,\text{m/s}$ & $v_c = 25\,\text{m/s}$.

P07 (a) $y_A = 100 + 5\,t - 4.9\,t^2$, $y_B = 100 - 20\,(t-2) - 4.9\,(t-2)^2$. Set $y_A = y_B$ to find $t = 3.78\,\text{s}$ & $y = 48.9\,\text{m}$; (b) $v_A = 5 - 9.8\,(3.78) = -32\,\text{m/s}$ & $v_B = -20 - 9.8\,(1.78) = -37.4\,(\text{m/s})$.

P16 (a) $y_A = H + 15\,t - 4.9\,t^2$, $y_B = H - 4.9\,(t-2)^2$. Set $y_A = y_B$ to find $t = 4.26\,\text{s}$ & $y = H - 25\,\text{m}$; (b) $v_A = 15 - 9.8\,(4.26) = -26.7\,\text{m/s}$ & $v_B = -9.8\,(2.26) = -22.1\,(\text{m/s})$.

P23 $t = 2.5\,\text{s}$: (a) $H = g\,t^2/2 = 30.6\,\text{m}$; (b) Let t_1 be the time to fall and t_2 be the time for the sound to travel. $H = 4.9\,t_1^2$ & $H/330 = t_2$, where $t_1 + t_2 = 2.5$. From $330\,(2.5 - t_1) = 4.9\,t_1^2$, we obtain $t_1 = 2.41\,\text{s}$ & $H = 28.5\,\text{m}$. (Teacher: Jyh-Shinn Yang, 89.10.11)