Serway + Vuille (8th Edition)
Chapter 2 Homework

3) $v_1 = 80.0\ \text{Km/h}$, $t_1 = 30.0\ \text{min} = .500\ \text{h}$ $\Big\}$ $x_1 = v_1 t_1 = 80.0\ \frac{\text{Km}}{\text{h}}(.500\ \text{h}) = 40.0\ \text{Km}$

$v_2 = 100\ \text{Km/h}$, $t_2 = 12.0\ \text{min} = .200\ \text{h}$ $\Big\}$ $x_2 = v_2 t_2 = 20.0\ \text{Km}$

$v_3 = 40.0\ \text{Km/h}$, $t_3 = 45.0\ \text{min} = .750\ \text{h}$ $\Big\}$ $x_3 = v_3 t_3 = 30.0\ \text{Km}$

$v_4 = 0$, $t_4 = 15.0\ \text{min} = .250\ \text{h}$ $\Big\}$ $x_4 = 0$

a) $$\bar{v} = \frac{(x_1 + x_2 + x_3 + x_4)}{(t_1 + t_2 + t_3 + t_4)} = \frac{(40.0 + 20.0 + 30.0)\ \text{Km}}{(.500 + .200 + .750 + .250)\ \text{h}}$$

$$\bar{v} = \frac{90.0\ \text{Km}}{1.70\ \text{h}} = 52.9\ \text{Km/h}$$

b) $$x_{total} = 90.0\ \text{Km}$$

8) Graph on p. 49

Connect initial + final positions and then take the slope of the line $= \bar{v}$

a) $t = 0$ to $t = 1.0\ \text{s}$

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{(4-0)\ \text{m}}{(1-0)\ \text{s}} = 4.0\ \frac{\text{m}}{\text{s}}$$

b) $t = 0$ to $t = 4.0\ \text{s}$

$$\bar{v} = \frac{(-2-0)\ \text{m}}{(4-0)} = -.50\ \frac{\text{m}}{\text{s}}$$

c) $t = 1.0\ \text{s}$ to $5.0\ \text{s}$

$$\bar{v} = \frac{(0-4)\ \text{m}}{(5-1)\ \text{s}} = -1.0\ \frac{\text{m}}{\text{s}}$$

d) $\Delta x = 0 \Rightarrow \bar{v} = 0$

9) See graph on p. 49

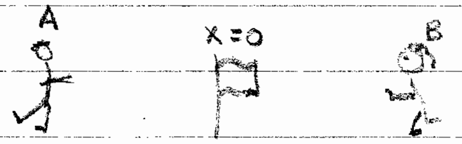
a) $V = 4.0\ m/s$ at $t = 0.50\,s$ (constant slope)

b) slope $= \dfrac{(-2-4)}{(2.5-1)}\dfrac{m}{s} = -4.0\dfrac{m}{s}$ slope of tangent line at $t = 2.0\,s$

c) $V = 0$ horizontal line

d) slope $= \dfrac{0-(-2)}{(5-4)}\dfrac{m}{s} = 2.0\dfrac{m}{s}$

19)



Note: East is +
West is −

$x_{o_A} = -4.0\,mi$ $\quad x_{o_B} = 3.0\,mi$

$V_A = 6.0\ mi/h$ $\quad V_B = -5.0\ mi/h$

The runners meet when $x_{f_A} = x_{f_B}$ (no acceleration)

$$x_{o_A} + v_A t = x_{o_B} + v_B t$$

$$-4.0\,mi + \left(6.0\frac{mi}{h}\right)t = (3.0\,mi) + \left(-5.0\frac{mi}{h}\right)t$$

$$\therefore\ t = \frac{7.0}{11}h = 0.64\,h$$

$$x_{f_A} = -4.0\,mi + \left(6.0\frac{mi}{h}\right)\left(\frac{7.0}{11}h\right) = -.18\,mi$$

(−) indicates west of flagpole

or

$$x_{f_B} = 3.0\,mi + \left(-5.0\frac{mi}{h}\right)\left(\frac{7.0}{11}\right)h = -.18\,mi$$

24) See graph on p. 50 $\quad \bar{a} = \text{slope} = \dfrac{\Delta v}{\Delta t}$

a) 0 to 5.0 s $\therefore \bar{a} = 0$

5.0 s to 15.0 s $\quad \bar{a} = 8\,m/s - (-8\,m/s) / 10\,s = 1.6\,m/s^2$

0 to 20 s $\quad \bar{a} = 8\,m/s - (-8\,m/s) / 20\,s = 0.80\,m/s^2$

b) slope of tangent line $\therefore a = 0$ at $t = 2.5\,s$ and $t = 18\,s$

$a = 1.6\,m/s^2$ at $t = 10\,s$

29) $\Delta x = 40.0m$ a) $V_o = ?$ $\bar{V} = \frac{40.0m}{8.50s} = 4.71 m/s$

$t = 8.50s$

$V_f = 2.80 m/s$ $\bar{V} = \frac{V_o + V_f}{2}$ $\therefore$ $4.71 m/s = \frac{V_o + 2.80 m/s}{2}$

$V_o = 6.61 m/s$

b) $a = ?$ $V_f = V_o + at$ $\therefore$ $2.80 m/s = 6.61 m/s + a(8.50s)$

$a = -0.448 m/s^2$

31) $x = 240m$

$V_o = 0$

$V_f = (120\ km/h)(1h/3600s)(10^3 m/km) = 33.3 m/s$

a) $V_f^2 = V_o^2 + 2ax$ $\therefore$ $a = (33.3 m/s)^2 / 2(240m) = 2.31 m/s^2$

b) $V_f = V_o + at$ $\therefore$ $33.3 m/s = (2.31 m/s^2)t$

$t = 14.4s$

32) $V_0 = 0$
$a_1 = 2.0\,m/s^2$
$V_f = 20\,m/s$
$\Delta t = 20s$, $V = cnst$
$\Delta t' = 5.0s$
$V_f' = 0$

a) $V_f = V_0 + a_1 t_1 \therefore t_1 = \frac{V_f - V_0}{a_1} = \frac{20\,m/s - 0}{2.0\,m/s^2} = 10s$

$\therefore t_{total} = 10s + 20s + 5.0s = 35s = t_T$

b) $x_1 = \frac{1}{2} a_1 t_1^2 = \frac{1}{2}(2.0\,m/s^2)(10s)^2 = 100m$

$x_2 = (20\,m/s)(20s) = 400m$

$x_3 = \left(\frac{20\,m/s + 0}{2}\right)\Delta t' = (10\,m/s)(5.0s) = 50m$

total displacement $= x_1 + x_2 + x_3 = 550m = x_T$

$\bar{V} = \frac{x_T}{t_T} = \frac{550m}{35s} = 15.7\,m/s \approx 16\,m/s$

39) $V_{0_1} = 0$
$t_1 = 5.0s$
$a_1 = 1.5\,m/s^2$
$t_2 = 3.0s$
$a_2 = -2.0\,m/s^2$

$V_{f_1} = V_{0_1} + a_1 t_1 = 0 + (1.5\,m/s^2)(5.0s) = 7.5\,m/s$

This becomes V_{0_2}.

$V_f = V_{0_2} + a_2 t_2 = 1.5\,m/s + (-2.0\,m/s^2)(3.0s)$
$= 1.5\,m/s$

$x_{total} = x_1 + x_2 = \left(V_{0_1} t_1 + \frac{1}{2} a_1 t_1^2\right) + \left(V_{0_2} t_2 + \frac{1}{2} a_2 t_2^2\right)$

$x_{total} = 0 + \frac{1}{2}(1.5\,m/s^2)(5.0s)^2 + (7.5\,m/s)(3.0s) + \frac{1}{2}(-2.0\,m/s^2)(3.0s)^2$
$= 32.3 \approx 32m$

43) $V_0 = 25.0\,m/s$
$a = -9.8\,m/s^2$

a) peak $\Rightarrow V_f = 0$

$V_f^2 = V_0^2 + 2ax$
$0 = (25\,m/s)^2 + 2(-9.8\,m/s^2)(x)$
$x = 31.9m$

b) $V_f = V_0 + at$
$0 = 25.0\,m/s - 9.8\,m/s^2\, t$
$t = 2.55s$

c) By symmetry: $t_{up} = t_{Down} = 2.55s$

d) symmetry in $|\vec{V}|$ $\therefore$
$V = -25.0\,m/s$ downward

50) $v_0 = -1.50\,m/s$ a) $v_f = v_0 + at$
$t = 2.00\,s$ $= -1.50\,m/s - 9.80\,m/s^2(2.00\,s)$
$a = -9.80\,m/s^2$ $= -21.1\,m/s$

b) $v_{helicopter} = cnst = -1.50\,m/s$

$\therefore$ in $\Delta t = 2.00\,s$ the helicopter moves down

$$\Delta y = -1.50\,m/s\,(2.00\,s) = -3.00\,m$$

The mailbag has the following displacement in 2.00s:

$$\Delta y = \bar{v}\,\Delta t = \left(\frac{v_0 + v_f}{2}\right)\Delta t = \left(\frac{-1.50\,m/s + (-21.1\,m/s)}{2}\right)2.00\,s$$

$$\Delta y = -22.6\,m$$

$\therefore$ the mailbag is $22.6\,m - 3.00\,m = 19.6\,m$ below the helicopter

54) $v_0 = -10\,m/s$ a) $y = v_0 t + \frac{1}{2}at^2$
$y = -50\,m$ $-50\,m = (-10\,m/s)t + \frac{1}{2}(-9.8\,m/s^2)t^2$
$a = -9.8\,m/s^2$ $4.9t^2 + 10t - 50 = 0$ Solve Quadratic

$$t = -10 \pm \sqrt{10^2 - 4(4.9)(-50)}\Big/2(4.9) = -10 \pm \sqrt{1080}\Big/9.8$$

$\therefore$ $t = 2.3\,s$ (+ root)

b) $v_f = v_0 + at$
$= -10\,m/s - 9.8\,m/s^2(2.3\,s)$
$= -33\,m/s$

65) $h_{balcony} = 19.6\,m$ above street

$V_{1_0} = -14.7\,m/s$

$V_{2_0} = 14.7\,m/s$

The Δy (displacement) of both balls is the same since they start at the balcony ($y_0 = 0$) + end on the ground $\therefore \Delta y = -19.6\,m$

a) ball #2 is in the air a longer time because it goes upward and then falls back to the level of the balcony, both balls would take the same time to travel from the balcony to the group. Symmetry in $|\vec{v}|$

extra time : $V_f = V_0 + at$

$-14.7\,m/s = 14.7\,m/s - (9.80\,m/s^2)t$

$t = 3.00\,s$

b)

$V_f^2 = V_0^2 + 2a(\Delta y)$

$V_f^2 = (-14.7\,m/s)^2 + 2(-9.80\,m/s^2)(-19.6\,m)$

$V_f^2 = 216 + 384 = 600\,m^2/s^2$

$\therefore V_f = 24.5\,m/s$

c) At $t = 0.800\,s$, how far apart are the balls?

ball #1 $y_f = -14.7\,m/s(.800\,s) + \frac{1}{2}(-9.80\,m/s^2)(.800\,s)^2$

$= -14.9\,m$ $\therefore$ it is 14.9 m below balcony

ball #2 $y_f = 14.7\,m/s(.800\,s) + \frac{1}{2}(-9.80\,m/s^2)(.800\,s)^2$

$= +8.62\,m$ $\therefore$ it is 8.62 m above balcony

They are $8.62 + 14.9 = 23.5\,m$ apart