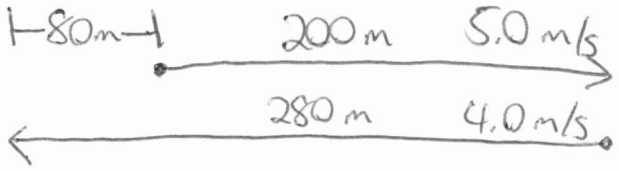
Recitation Week 2 Solutions

Ch.2 #4



a) Average speed s

t_1 = time spent running east = $\frac{200\text{ m}}{5.0\text{ m/s}} = 40\text{ s}$

t_2 = time spent running west = $\frac{280\text{ m}}{4.0\text{ m/s}} = 70\text{ s}$.

t = total time = $t_1 + t_2 = 40 + 70 = 110\text{ s}$.

$$s = \frac{s_1 t_1 + s_2 t_2}{t} = \frac{5.0(40) + 4.0(70)}{110} = \frac{480}{110} = \boxed{4.4\text{ m/s}}$$

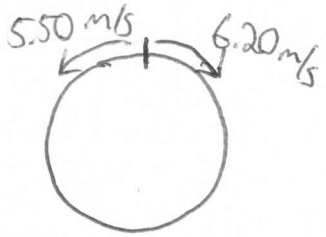
b) Average velocity $v = \frac{\Delta x}{\Delta t}$

$\Delta x = 200 - 280 = -80\text{ m}$.

$\Delta t = 110\text{ s}$.

$$v = \frac{\Delta x}{\Delta t} = -\frac{80}{110} = \boxed{-0.73\text{ m/s}}$$

Ch. 2 #5



a) time to meet = t

distance = 200 m. = $v_1 t + v_2 t$

$200\text{ m.} = (6.20 + 5.50)t = (11.70\text{ m/s})t$

$t = \frac{200\text{ m}}{11.70\text{ m/s}} = \boxed{17.09\text{ s}}$

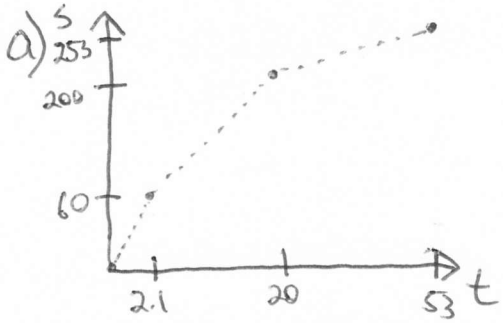
b) person 1

$d_1 = v_1 t = 6.20\text{ m/s}(17.09\text{ s}) = \boxed{105.98\text{ m}}$

$d_2 = v_2 t = 5.50\text{ m/s}(17.09\text{ s}) = \boxed{94.02\text{ m.}}$

Ch. 2 #13

a)



Not constant acceleration

b) $60\frac{\text{mi}}{\text{h}} \cdot \frac{0.45\text{ m/s}}{1\text{ mi/h}} = 27\text{ m/s}$ $\quad 200\frac{\text{mi}}{\text{h}} \cdot \frac{0.45\text{ m/s}}{1\text{ mi/h}} = 90\text{ m/s}$ $\quad 253\frac{\text{mi}}{\text{h}} \cdot \frac{0.45\text{ m/s}}{1\text{ mi/h}} = 113.9\frac{\text{m}}{\text{s}}$

i) $a = \frac{\Delta v}{\Delta t} = \frac{27\text{ m/s}}{2.1\text{ s}} = \boxed{12.9\text{ m/s}^2}$ between 0 and 2.1 seconds

ii) $a = \frac{\Delta v}{\Delta t} = \frac{(90-27)\text{ m/s}}{(20-2.1)\text{ s}} = \frac{63\text{ m/s}}{17.9\text{ s}} = \boxed{3.5\text{ m/s}^2}$ between 2.1 and 20 seconds

iii) $a = \frac{\Delta v}{\Delta t} = \frac{(113.9-90)\text{ m/s}}{(53-20)\text{ s}} = \frac{23.9\text{ m/s}}{33\text{ s}} = \boxed{0.72\text{ m/s}^2}$ between 20 and 53 seconds.

yes, acceleration (slope of line in velocity graph) decreases

Ch. 2 #25

$a_{max} = 250\ m/s^2$

$v_0 = 65\ \frac{mi}{h} = 65\ \frac{mi}{h} \cdot \frac{0.45\ m/s}{1\ mi/h} = 29.25\ m/s$

$v_f = 0$

$250\ m/s^2 = \frac{\Delta v}{\Delta t} = \frac{29.25\ m/s}{\Delta t}$

$\Delta t = \frac{29.25\ m/s}{250\ m/s^2} = 0.117\ s.$

$\Delta x = \frac{v_0 + v}{2} t = \frac{29.25\ m/s}{2} \cdot 0.117\ s = \boxed{1.7\ m}$

Ch. 2 #29

a) constant acceleration $a = \frac{\Delta v}{\Delta t} = \frac{-8\ cm/s}{6\ s} = \boxed{-\frac{4}{3}\ cm/s^2 \approx -1.33\ \frac{cm}{s^2}}$

$v(t) = v_0 + at$

$v(4) = 8\ \frac{cm}{s} + \left(-\frac{4}{3}\ \frac{cm}{s^2}\right)(4s) = \left(8 - \frac{16}{3}\right)\frac{cm}{s} = \boxed{\frac{8}{3}\ \frac{cm}{s} \approx 2.7\ \frac{cm}{s}}$

$v(7) = 8\ \frac{cm}{s} + \left(-\frac{4}{3}\ \frac{cm}{s^2}\right)(7s) = \left(8 - \frac{28}{3}\right)\frac{cm}{s} = \boxed{-\frac{4}{3}\ \frac{cm}{s} \approx -1.3\ \frac{cm}{s}}$

b) constant acceleration

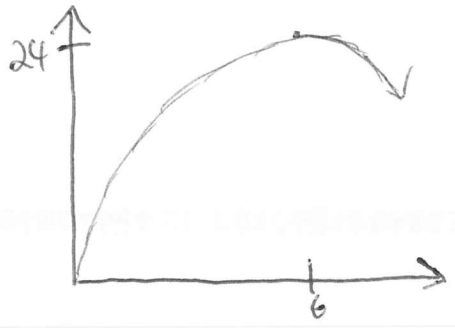
$\boxed{a = -\frac{4}{3}\ \frac{cm}{s^2} \approx -1.33\ \frac{cm}{s^2}}$

c) $\Delta x = \left(\frac{v_0 + v_x}{2}\right) t = \left(\frac{v_0 + v(4.5)}{2}\right) 4.5\ s = \left(\frac{v_0 + v_0 + at}{2}\right) 4.5\ s.$

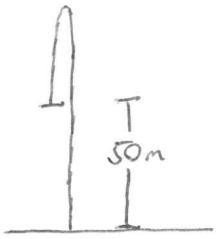
$= \left(\frac{8 + 8 + \left(-\frac{4}{3}\right)4.5}{2}\right) 4.5 = \boxed{22.5\ cm}$ in first 4.5s.

$\Delta x = \left(\frac{v_0 + v(7.5)}{2}\right) 7.5\ s = \left(\frac{8 + 8 + \left(-\frac{4}{3}\right)7.5}{2}\right) 7.5\ s = \boxed{22.5\ cm}$ in first 7.5s.

d)



Ch.2 #46



$\Delta y = y_0 + v_0 t + \frac{1}{2}at^2$ $\quad a = -9.8\ m/s^2$, $t = 5.0\ s$.

a) $\Delta y = v_0 t + \frac{1}{2}at^2$

$-50.0\ m = v_0(5.0) + \frac{1}{2}(-9.8)(5.0)^2$

$-50.0 = v_0(5.0) - 122.5$

$v_0(5.0) = 72.5$

$v_0 = \boxed{14.5\ m/s}$

b) time to top $= t$ $\quad v$ at top $= 0\ m/s$

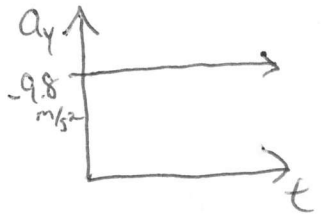
$\Delta v = at$

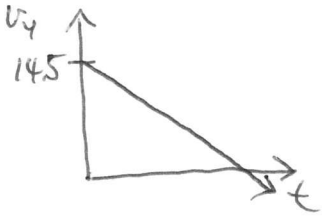
$t = \frac{\Delta v}{a} = \frac{-14.5\ m/s}{-9.8\ m/s} = \boxed{1.5\ s}$

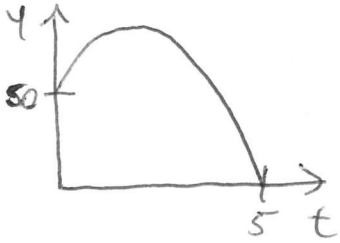
c) $|v|$ at top $= \boxed{0\ m/s}$

d) constant $a = -9.8\ m/s^2$ $\quad |\vec{a}| = \boxed{9.8\ m/s^2}$ $\quad \boxed{\text{direction is downward} \downarrow}$

e)







Ch. 2 #78

a) time to run to table t

$t = \frac{5.5\,m}{2.50\,m/s} = 2.2\,s.$ return trip $t_{tot} = 4.4\,s.$

So 2.2 seconds for ball to reach the top of its trajectory.

$\Delta v = at$ v at top $= 0$

$-v_0 = -9.8\,m/s\,(2.2\,s)$

$\boxed{v_0 = 21.56\,m/s}$

b) max height happens after 2.2 seconds.

$y = v_0 t + \frac{1}{2}at^2 = (21.56\,m/s)(2.2\,s) + \frac{1}{2}(-9.8\,m/s^2)(2.2\,s)^2$

$= 47.43\,m - 23.72\,m$

$= \boxed{23.71\,m}$