P.234 Uniform acceleration
a = constant. Dr. Bob

1.

$x_i = 0\,m$ $\quad t_i = 0\,s$ $\quad v_i = 0\,m/s$ $\quad a = ?$

$x_f = 402\,m$ $\quad t_f = 6\,s$ $\quad v_f = ?$

$$a = \frac{v_f - v_i}{t_f - t_i} \qquad x_f = x_i + \frac{1}{2}(v_i + v_f)\Delta t$$

$$x_f = \cancel{x_i}^{\,0} + \frac{1}{2}(\cancel{v_i}^{\,0} + v_f)\Delta t$$

$$2x_f = v_f \Delta t$$

$$v_f = \frac{2x_f}{\Delta t} = \frac{2(402\,m)}{6\,s - 0\,s}$$

$$\boxed{v_f = 134\ m/s}$$

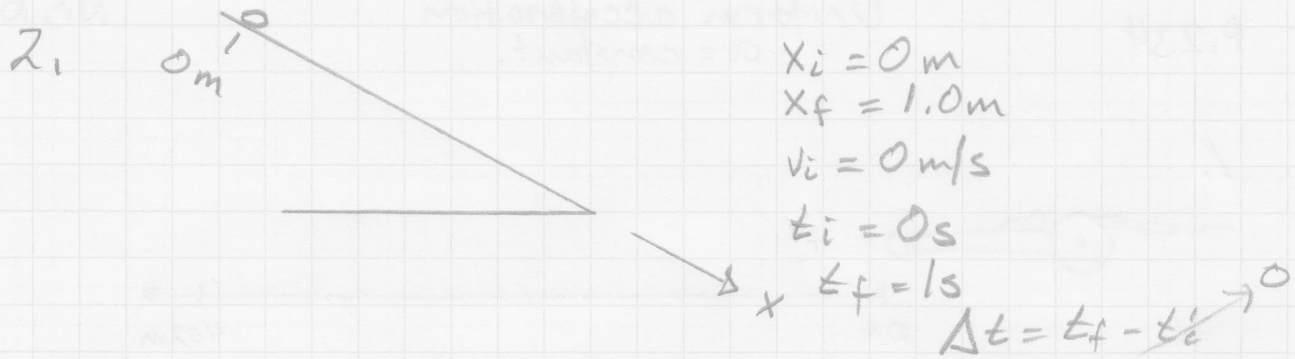
$$a = \frac{v_f - v_i}{t_f - t_i} = \frac{67\,m/s - 0\,m/s}{6\,s - 0\,s} = 11.2\,m/s^2$$

$$\boxed{a = 22.3\,m/s^2}$$

$$v_f = 134\,m/s\left(\frac{1\,km}{1000\,m}\right)\left(\frac{3600\,s}{h}\right)$$

$$\boxed{v_f = 482\,km/h}$$

2.



$x_i = 0\,m$
$x_f = 1.0\,m$
$v_i = 0\,m/s$
$t_i = 0\,s$
$t_f = 1\,s$
$\Delta t = t_f - t_i$
$\Delta t = t_f$

a) $a = ?$

$$x_f = x_i + v_i \Delta t + \tfrac{1}{2} a \Delta t^2$$

$$2x_f = a t_f^2$$

$$a = \frac{2x_f}{t_f^2} = \frac{2(1.0\,m)}{(1\,s)^2}$$

$$\boxed{a = 2\,m/s^2}$$

b) $x_i = 0\,m$ $\quad v_i = 0\,m/s$
$t_i = 0\,s$ $\quad a = 2\,m/s^2$
$t_f = 2.0\,s$
$x_f = ?$

$$x_f = x_i + v_i \Delta t + \tfrac{1}{2} a \Delta t^2$$

$$= \tfrac{1}{2}(2\,m/s^2)(2\,s)^2$$

$$\boxed{x_f = 4\,m}$$

P. 234

3.

0m
20km/h

25m

$v_i = 20 km/h \left(\frac{1h}{3600s}\right)\left(\frac{1000m}{1km}\right)$

$v_i = 5.55\overline{5} m/s$

$v_f = 30 \frac{km}{h} = 8.33\overline{3} m/s$

$t_i = 0s$ $\quad x_i = 0m$

$x_f = 25m$

a) $a = ?$

$$v_f^2 = v_i^2 + 2a(x_f - x_i)$$

$$2a = \frac{v_f^2 - v_i^2}{x_f - x_i}$$

$$a = \frac{v_f^2 - v_i^2}{2(x_f - x_i)} = \frac{(8.33\overline{3} m/s)^2 - (5.55\overline{5} m/s)^2}{2(25m - 0m)}$$

$$\boxed{a = 0.77 m/s^2}$$

Units $\frac{m^2/s^2}{m}$

b. $\Delta t = ?$

$$x_f - \cancel{x_i}^{\,\to 0} = \frac{1}{2}(v_i + v_f)\,\Delta t^{\,t_f}$$

$$2x_f = (v_i + v_f)\,t_f$$

$$t_f = \frac{2x_f}{(v_i + v_f)} = \frac{2(25m)}{(8.33 m/s + 5.55 m/s)}$$

$$\boxed{t_f = 3.6 s}$$

Units $\frac{m}{m/s} = s$

4.

$$a = -4.00\ m/s^2$$

$x_i = 0m$ $\qquad$ $x_f = 25m$

$v_i = ?$ $\qquad$ $v_f = 0\ m/s$

$t_i = 0s$ $\qquad$ $t_f = ?$

$$v_f = v_i + a\Delta t \qquad v_f^2 - v_i^2 = 2a\Delta x$$

$$v_i^2 = v_f^{2\to 0} - 2a\Delta x$$

$$v_i^2 = -2(-4\ m/s^2)(25m - 0m)$$

$$v_i^2 = 200\ m^2/s^2$$

$$\boxed{v_i = 14.1\ m/s}$$

$$v_f = v_i + a\Delta t$$

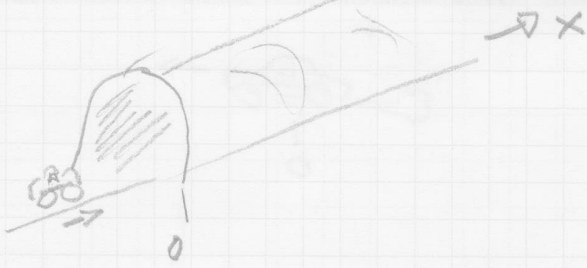
$$\Delta t = \frac{v_f - v_i}{a} = \frac{(0\ m/s - 14.1\ m/s)}{-4.00\ m/s^2}$$

$$\boxed{\Delta t = 3.54s}$$

$$v_i = (14.1\ m/s)\left(\frac{1km}{1000m}\right)\left(\frac{3600s}{1h}\right)$$

$$\boxed{v_i = 51.8\ km/h}$$

5.



$V_i = 24.0\ m/s$

$a = 2.0\ m/s^2$

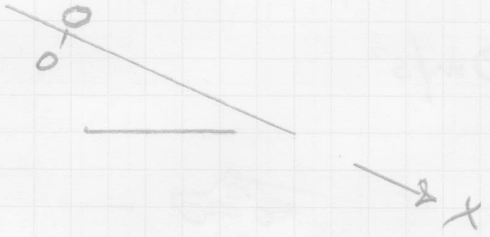
$\Delta t = 8\ s$

$$V_f = V_i + a\,\Delta t$$

$$= 24.0\ m/s + (2.0\ m/s^2)(8\ s)$$

$$\boxed{V_f = 40\ m/s}$$

6.



$x_i = 0\ m \qquad t_i = 0\ s$

$x_f = 6.0\ m \qquad t_f = 4.0\ s$

$V_i = 1\ m/s$

$V_f = ?$

$a = ?$

$$V_f = V_i + 2a\Delta x \qquad x_f = x_i + V_i\Delta t + \tfrac{1}{2}a\Delta t^2$$

$$x_f - x_i - V_i\Delta t = \frac{a\Delta t^2}{2}$$

$$a = \frac{2(x_f - x_i - V_i\Delta t)}{\Delta t^2} = \frac{2(6.0\ m - 0\ m - (1\ m/s)(4\ s))}{(4\ s)^2}$$

$$\boxed{a = \frac{1}{4}\ m/s^2}$$

$$V_f = V_i + a\,\Delta t = 1\ m/s + \left(\frac{1}{4}\ m/s\right)(4\ s)$$

$$\boxed{V_f = 2\ m/s}$$

7. $a = 6.0\ m/s^2$

$X_i = 0\ m$

$V_i = 0\ m/s$

$t_i = 0\ s$

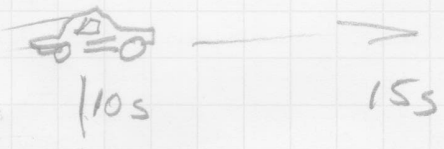
$\Delta X = ?$

Part I What is velocity @ $t = 10s$

$$V_f = V_i + at = 0\ m/s + (6.0\ m/s^2)(10\ s)$$

$$V_f = 60\ m/s$$

Part II



$X_i = 0m$ $\quad V_i = 60\ m/s$

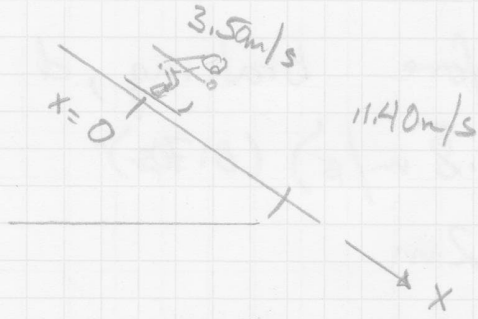
$a = 6.0 m/s^2$ $\quad t_i = 10s$, $t_f = 15s$

$$\Delta X = X_f - X_i = V_i \Delta t + \tfrac{1}{2} a \Delta t^2$$

$$\Delta X = (60\ m/s)(15s - 10s) + \tfrac{1}{2}(6.0\ m/s^2)(15s - 10s)^2$$

$$\boxed{\Delta X = 375\ m}$$

8. Dr. Bob



$x_i = 0m$

$t_i = 0s$

$t_f = 4.20s$

$V_i = 3.50\ m/s$

$V_f = 11.40 m/s$

a) $\Delta x = ?$

$\Delta x = x_f - x_i = \frac{1}{2}(V_i + V_f)\Delta t$

$= 1/2\,(3.50m/s + 11.4m/s)(4.20s)$

$\boxed{\Delta x = 31.3\ m}$

b) $V_{avg} = \frac{\Delta x}{\Delta t} = \frac{31.3m}{4.20s}$

$\boxed{V_{avg} = 7.45\ m/s}$

9. Reaction = 0.70 s

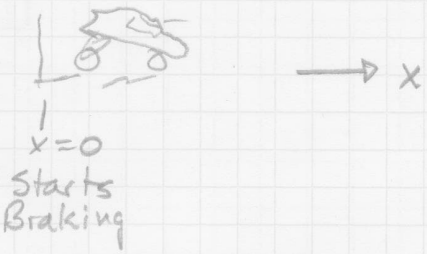
$V_i = 50km/h = 13.\bar{8}\ m/s$

Stopping time.

$\Delta t = ?$ $t_i = 0s$

$x_i = 0\ m$ $a = -7.50 m/s^2$

$V_f = 0\ m/s$



a) $V_f = V_i + a\Delta t$

$\Delta t = \frac{V_f - V_i}{a} = \frac{(0m/s - 13.\bar{8}\ m/s)}{-7.50 m/s^2}$

$\Delta t = 1.85s$

Total time t = Reaction t + stopping Δt

Total $t = 0.70s + 1.85s$

$\boxed{t = 2.55s}$

b) Distance before braking, d

$$d = (13.\overline{8}\ m/s)(0.70s)$$

$$d = 9.72m$$

Distance while braking

$$\Delta X = V_i \Delta t + \tfrac{1}{2} a \Delta t^2$$

$$= (13.\overline{8}\ m/s)(1.85s) + \tfrac{1}{2}(-7.50 m/s^2)(1.85s)^2$$

$$\Delta X = 12.86\ m$$

Total distance = Distance before (d) + distance while braking (ΔX)

$$\text{Total } d = 9.72\ m + 12.86\ m$$

$$\boxed{\text{Total } d = 22.6\ m}$$