HW 1

problem 1

$a = 1.5\ g's = 1.5 \times 9.81\ m/s^2 = 14.715\ m/s^2$

$m = 800\ kg$

$V_f = 60\ mph = 26.822\ m/s$

$t = ?$

$x = ?$

$V_i = 0$

using the kinematic equation

$$V_f = V_i + at$$

solving for t

$$t = \frac{V_f - V_i}{a} = \frac{26.822\ m/s}{14.715\ m/s^2}$$

$$\boxed{t = 1.822\ s}$$

~~problem 2~~

Now to find the distance we use the other kinematic equation

$$\Delta x = \cancel{V_i t^0} + \frac{1}{2} a t^2$$

$$\Delta x = \cancel{V_i^0} t + 1/2\ a t^2$$

$$\Delta x = \frac{1}{2} (14.715\ m/s^2)(1.822)^2$$

$$\boxed{\Delta x = 24.424}$$

problem 2

$v_i = 100 \text{ kph} = \frac{100 \times 1000}{60 \times 60} = 27.77 \text{ m/s}$

$a = -4 G's = -4 \times 9.81 \text{ m/s}^2 = -39.24 \text{ m/s}^2$

$v_f = 0$

using the kinematic equation

$$v_f = v_i + at$$

$$\frac{v_f - v_i}{a} = t$$

$$\frac{0 - 27.77}{-39.24} = t$$

$$\boxed{t = 0.708 \text{ s}}$$

Problem 3

$l = 600m$

$v_i = 40 mph = 17.8816 m/s$

exit velocity $= 17.8816 m/s$

$a_1 = 1.5 g's = 14.7185 m/s^2$

$a_2 = 4 g's = -39.24 m/s^2$

Since the starting and ending velocities are both ~~is~~ 40 mph we can say $\Delta K.E = 0$

W_1 = work done accelarating $= F_1 x_1$

W_2 = work done braking $= -F_2 x_2$

$F_1 = m a_1$

$F_2 = m a_2$

$W_1 + W_2 - \Delta K.E = 0$

$m a_1 (x_1) - m a_2 (x_2) = 0$

~~$a_1 x_1 = a_2 x_2$~~ $a_1 x_1 - a_2 x_2 = 0$

$14.715 m/s^2 x_1 - 39.24 x_2 = 0$

we also know $x_1 + x_2 = 600m$

$x_1 = 600 - x_2$

$14.715 (600 - x_2) - 39.24 x_2 = 0$

$8829 - 14.715x - 39.24 x_2 = 0$

$+53.955 x_2 = +8829$

$x_2 = 163.636m$

$x_1 = 600 - x_2 = 436.363m$

$x_1 = 436.363\,m$
$x_2 = 163.636$

Let's find final velocity at the end of accelaration using the Kinematic equation

$$V^2 = V_{oi}^2 + 2a\Delta x$$

$$V = \sqrt{V_{oi}^2 + 2a\Delta x}$$
$$= \sqrt{17.881^2 + 2(14.715)(436.363)}$$
$$= 114.72\ m/s \text{ or } 256.6\ mph$$

~~No w~~ Now we find time

$$V = V_i + a t_1$$
$$\frac{V - V_i}{a} = t_1$$
$$t_1 = \frac{114.72 - 17.881}{14.715} = 6.581\ s$$

~~$t_2 = V\ t_2 = V_i$~~
$$t_2 = \frac{V_f - V_i}{a} = \frac{114.72 - 17.8816}{39.24}$$
$$t_2 = 2.45\ s$$
$$t = t_1 + t_2 = 9.049\ s$$

The fastest possible time is **9.049 s**