Acceleration day 2

1) Moments after a stopwatch is started, a car starts travelling in the positive direction at $10\ \frac{m}{s}$. The driver steps on the gas, accelerating the car uniformly at $5\ \frac{m}{s^2}$. When the stopwatch reads 12 s, the car is travelling at a velocity of $30\ \frac{m}{s}$. What was the reading on the stopwatch when the driver stepped on the gas?

let positive be positive

$\Delta t = \frac{\Delta V}{a}$

$t_f - t_i = \frac{V_f - V_i}{a}$

$12s - t_i = \frac{30\ \frac{m}{s} - 10\ \frac{m}{s}}{5\ \frac{m}{s^2}}$

$12s - t_i = 4s$

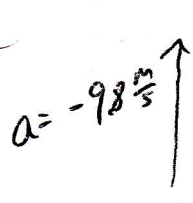
$-t = 4s - 12s$

$-t = -8s$

$t = 8s$

2) A ball is thrown straight up with a velocity of $40\ \frac{m}{s}$. How long does it take for the ball to reach its maximum height?

let up be positive



$\Delta t = \frac{\Delta V}{a}$

$t_f - t_i = \frac{V_f - V_i}{a}$

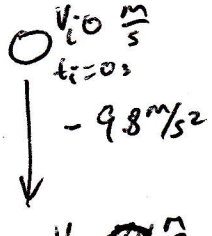
$t_f - 0s = \frac{0\ \frac{m}{s} - 40\ \frac{m}{s}}{-9.8\ \frac{m}{s^2}}$

$t_f = \frac{-40\ \frac{m}{s}}{-9.8\ \frac{m}{s^2}}$

$t_f = 4.08s$

3) ~~A rock is dropped from 11 m above the ground. How long does it take to reach the ground?~~

let up be positive



$\Delta V = a\,\Delta t$

$V_f - V_i = a(t_f - t_i)$

$V_f - 0\ \frac{m}{s} = -9.8\ \frac{m}{s^2}(7.2s - 0s)$

$V_f = -9.8\ \frac{m}{s^2} \times 7.2s$

$V_f = -70.56\ \frac{m}{s}$

4) A ball is rolling with a velocity of $5\frac{m}{s}$ in the negative direction. A strong wind applies a uniform acceleration on the ball until it has a velocity of $6\frac{m}{s}$ in the positive direction thirteen seconds later. What is the acceleration the ball was subjected to?

let negative be negative

$V_f = 6\frac{m}{s}$ → O a = ? O ← $V_i = -5\frac{m}{s}$

$\Delta t = 13s$

$a = \frac{\Delta V}{\Delta t}$

$a = \frac{V_f - V_i}{13s}$

$a = \frac{6\frac{m}{s} - (-5\frac{m}{s})}{13s}$

$= \frac{11\frac{m}{s}}{13s}$

$= 0.846\frac{m}{s^2}$

5) A group of people are attempting to calculate the terminal velocity for a human in a certain pose. 3s after a stopwatch is started, the body was falling at $4.95\frac{m}{s}$. What is the terminal velocity for a human in this posture if the body reached terminal velocity at 9s?

let up be positive

↓↓↓

$V_i = -4.95\frac{m}{s}$

$t_i = 3s$

$a = -9.8\frac{m}{s^2}$ ↓

$V_f = ?$

$t_f = 9s$

$\Delta V = a\Delta t$

$V_f - V_i = a(t_f - t_i)$

$V_f - (-4.95\frac{m}{s}) = -9.8\frac{m}{s^2}(9s - 3s)$

$V_f + 4.95\frac{m}{s} = -58.8\frac{m}{s}$

$-58.8\frac{m}{s}$

$V_f = -53.85\frac{m}{s} - 4.95$

6) Sometime after a stopwatch is started, a toy car starts accelerating with a constant acceleration of $0.5\frac{m}{s^2}$ in the negative direction. If it reaches a velocity of $3.10\frac{m}{s^2}$ in the negative direction when the stopwatch read 6s, what was its velocity when the stopwatch read 4s?

let negative be negative.

$a = -0.5\frac{m}{s^2}$ ←

t_f 6s

$V_f = -3.10\frac{m}{s}$

$t_i = 4s$

$V_i = ?$

$\Delta V = a\Delta t$

$V_f - V_i = a(t_f - t_i)$

$-3.10\frac{m}{s} - V_i = -0.5\frac{m}{s^2}(6s - 4s)$

$-3.10\frac{m}{s} - V_i = -1\frac{m}{s}$

$-V_i = -1\frac{m}{s} + 3.10\frac{m}{s}$

$-V_i = 2.10\frac{m}{s}$

$V_i = -2.10\frac{m}{s}$