Hmwk #1 Physics 107

Conceptual: Ch3: 6, 28, 32

Problems: Ch 3: 2, 6, 10, 16

Conceptual

6. To verify experimentally the law of inertia requires the ability to measure time and distance. This is because the law of inertia states that objects in motion tend to stay in motion and objects at rest tend to stay at rest, and, to test this, you need to be able to measure the position of an object over a certain period of time to determine if there is any change in its motion.

28. $V_1 = 0\ km/hr$ $\Delta t: 10s$

Car: $V_2 = 100\ km/hr$

$$a_{car} = \frac{\Delta V}{\Delta t} = \frac{V_2 - V_1}{\Delta t} = \frac{100km/hr - 0km/hr}{10s} \quad \frac{100km/hr}{10s} = \underline{10 km/hr/s}$$

$$= \frac{100km/hr}{10\cancel{s}}\left(\frac{60\ \cancel{sec}}{1\ \cancel{min}}\right)\left(\frac{60\ \cancel{min}}{1\ hr}\right) = \frac{36000\cancel{0}}{\cancel{10}}\left(\frac{km/hr}{hr}\right)$$

$$= \underline{36{,}000\ km/hr^2} = \frac{36000km}{hr^2}\left(\frac{1hr}{60min} \times \frac{1min}{60sec}\right)^2$$

$$= \underline{2.78\ m/s^2}$$

drag racer: $V_1 = 0km/hr$, $V_2 = 400km/hr$, $\Delta t = 5s$

$$a_{dr} = \frac{\Delta V}{\Delta t} = \frac{V_2 - V_1}{\Delta t} = \frac{400km/hr - 0\ km/hr}{5sec} = \frac{400km/hr}{5s} = \underline{80km/hr/s}$$

$$= \frac{400km/hr}{5\cancel{s}}\left(\frac{60\cancel{s}}{1\cancel{min}} \times \frac{60\cancel{min}}{1hr}\right) = \frac{1.44 \times 10^6}{5}\left(\frac{km/hr}{hr}\right)$$

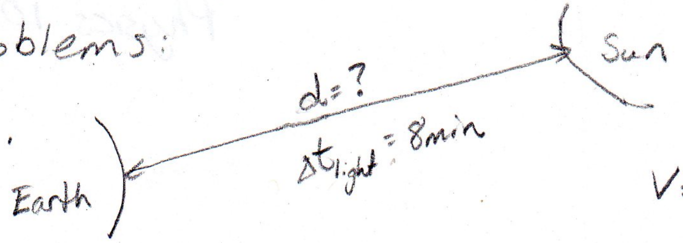
$$= \underline{2.88 \times 10^5\ km/hr^2} = \underline{22.22\ m/s^2}$$

32. By looking at the picture, we can see at A the ball travels small distances between each flash while at B, the ball travels much farther between flashes. Since the ball is traveling a larger distance in the same amount of time, it must have a higher velocity at B than at A.

Acceleration is the change in velocity with time. Since the time between each flash is equal, we can see the change in the velocity by looking at how much more distance the ball moves between flashes. Between each flash, the ball moves one more unit than it did between the last, from the begining to the end. Since this indicates a constant increase in the velocity, the acceleration is constant.

Problems:

2.



$V = 300{,}000\ km/s$ $\quad d = ?$

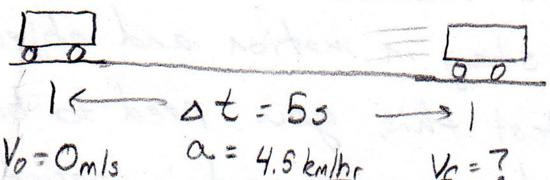
$\Delta t = 8min$

$$V = \frac{d}{\Delta t} \Rightarrow d = V\Delta t = \left(\frac{300{,}000km}{s}\right)\frac{8min}{1}\left(\frac{60s}{1min}\right)$$

$$= (300{,}000\ km/s)(4800\ s)$$

$$\underline{d = 1.44\times10^{9}\ km}$$

6.



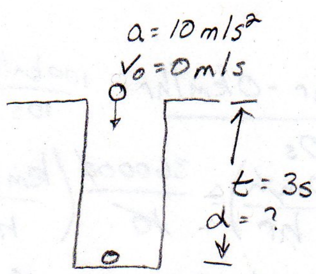
$$a = \frac{\Delta V}{\Delta t} = \frac{V_f - V_0}{\Delta t}$$

$$V_f - V_0 = a\Delta t$$

$$V_f = a\Delta t + V_0 = (4.5\ km/hr/s)(5s) + 0\ m/s$$

$$\underline{V_f = 22.5\ km/hr}$$

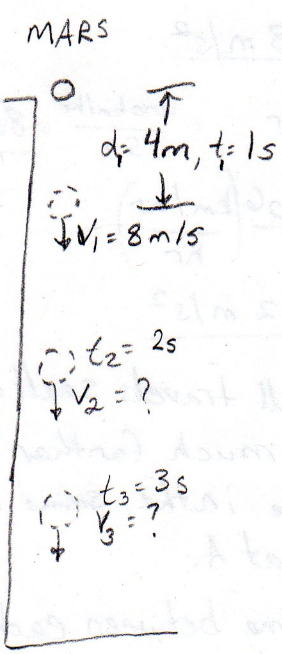
10.



$$d = \frac{1}{2}at^2 = \frac{1}{2}(10m/s^2)(3s)^2 = 5\frac{m}{s^2}\times 9s^2$$

$$\underline{d = 45m\ deep}$$

16.



Looking to find change in velocity with time ⇒ acceleration!

$$d_1 = \tfrac{1}{2}at_1^2 \Rightarrow 2d_1 = at_1^2 \Rightarrow a = \frac{2d_1}{t_1^2} = \frac{2(4m)}{(1s)^2} = 8m/s^2 = a$$

solve for V_2

$$a = \frac{\Delta V}{\Delta t} = \frac{V_f - V_i}{t_f - t_i} \Rightarrow a = \frac{\boxed{V_2} - V_1}{t_2 - t_1} \qquad a(t_2 - t_1) = V_2 - V_1$$

$$V_2 = a(t_2 - t_1) + V_1 \quad \leftarrow \text{we know all of these numbers}$$

$$= (8m/s^2)(2s - 1s) + 8m/s = 8m/s^2(1s) + 8m/s = \underline{16\ m/s = V_2}$$

do the same to find V_3:

$$V_3 = a(t_3 - t_1) + V_1$$

$$= (8m/s^2)(3s - 1s) + 8m/s = 8m/s^2(2s) + 8m/s = 16m/s + 8m/s = \underline{24m/s = V_3}$$