AP Physics - Unit 1 Kinematics

WKST - Linear & Free Fall Problems

1) Given: $\Delta t = 45.0\ s$, $a = 2.99\ m/s^2$, $V_i = 0\ m/s$ Find: $V_f = ?\ m/s$

Soln: $V_f = \cancel{V_i}^{0} + at$ $V_i = 0$

$V_f = at$

$= (2.99\ m/s^2)(45.0\ s)$

$\boxed{V_f = 135\ m/s}$

2) A) Given: $V_i = 0$, $V_f = 1090\ Km/hr$, $\Delta x = 2.0 \times 10^4\ m$, $\Delta t = ?\ s$

Soln: $V_f = \left(\frac{1090\ Km}{hr}\right)\left(\frac{1000\ m}{1\ Km}\right)\left(\frac{1\ hr}{60\ min}\right)\left(\frac{1\ min}{60\ s}\right) = 303\ m/s$

$\Delta x = \frac{\cancel{V_i}^{0} + V_f}{2}\ \Delta t^{?} =$

$\Delta x = \frac{V_f}{2}\Delta t$

$\Delta t = \frac{2\Delta x}{V_f} = \frac{2(2.0 \times 10^4\ m)}{303\ m/s}$

$\boxed{\Delta t = 132\ sec}$

B) Given: $V_i = 1090\ Km/hr = 303\ m/s$, $V_f = 0$, $\Delta x = 5.00 \times 10^3\ m$, $\Delta t_2 = ?\ sec$

$\Delta x = \frac{V_i + \cancel{V_f}^{0}}{2}\Delta t_2$

$\Delta t_2 = \frac{2\Delta x}{V_i} = \frac{2(5.00 \times 10^3\ m)}{303\ m/s}$

$\boxed{\Delta t_2 = 33.0\ sec}$

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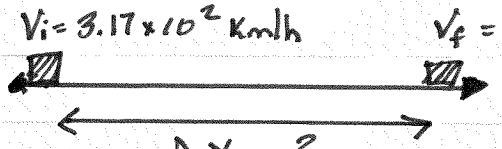
3) Given:



$a = ?$

Soln:

$$\left(\frac{3.17\times10^2\ km}{hr}\right)\left(\frac{1000\ m}{km}\right)\left(\frac{1\ hr}{60\ min}\right)\left(\frac{1\ min}{60\ sec}\right) = 88.1\ m/s = V_i$$

$$\left(\frac{2.00\times10^2\ km}{hr}\right)\left(\frac{1000\ m}{km}\right)\left(\frac{1\ hr}{60\ min}\right)\left(\frac{1\ min}{60\ sec}\right) = 55.6\ m/s = V_f$$

$$\Delta x = \frac{1}{2}(V_i + V_f)\Delta t = \frac{1}{2}(88.1\ m/s + 55.6\ m/s)(8.0\ sec)$$

$$\boxed{\Delta X = 570\ m}$$

$$V_f = V_i + \overset{?}{a}\,\Delta t$$

$$a = \frac{V_f - V_i}{\Delta t} = \frac{55.6\ m/s - 88.1\ m/s}{8.0\ s}$$

$$\boxed{a = -4.1\ m/s^2}$$

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4) Given:

$V_i = ?$ m/s → $V_f = 0$

$\Delta x = 9.60\ km \left(\frac{1000\ m}{1\ km}\right) = 9600\ m$

$a = -2.00\ m/s^2$

Soln:

Need eqn w/ V, a, x & No t

$V_f^2 = V_i^2 + 2a\Delta x$

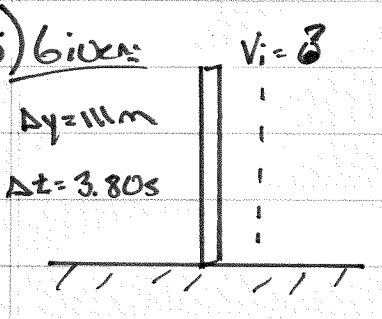
$V_i^2 = -2a\Delta x$

$= -2(-2.00\ m/s^2)(9600\ m)$

$V_i^2 = 38400\ m^2/s^2$

$\boxed{V_i = 196\ m/s}$

5) Given:



$g = a = 9.8\ m/s^2$

Soln:

① choose $x = 0$ at V_i ... $x = 0, v_i$?

$\therefore \Delta y = -111\ m$, V_i is in negative direction

and $V \uparrow \therefore -a$

$x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$, can be used in y

$y_f = y_i + v_{y0}t + \frac{1}{2}g t^2$, $y_f - y_i = \Delta y$

$\left(\Delta y = v_{yi}t + \frac{1}{2}g t^2\right)\frac{1}{t}$

$\frac{\Delta y}{t} = v_{yi} + \frac{gt}{2}$

$v_{yi} = \frac{\Delta y}{t} - \frac{gt}{2}$

$= \frac{-111\ m}{3.80\ s} - \frac{(-9.8\ m/s^2)(3.80\ s)}{2}$

$= -29.2\ m/s - (-18.6\ m/s)$

$\boxed{v_{yi} = -10.6\ m/s \text{ or } 10.6\ m/s \text{ down}}$

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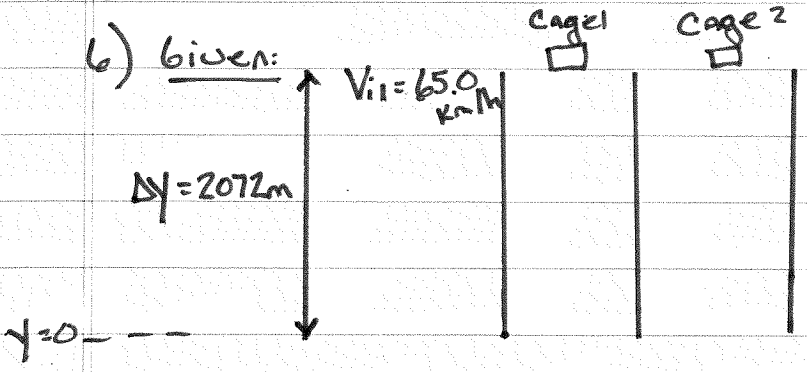
6) Given:



Find: $\Delta t_1 = ?$

$\Delta t_2 = ?$

Soln: $V_{i1} = \left(\frac{65.0 Km}{h}\right)\left(\frac{1000 m}{1 Km}\right)\left(\frac{1 h}{3600 s}\right) = 18.1 m/s$

Cage 1

$V = \frac{\Delta x}{\Delta t_1} =$

$\Delta t_1 = \frac{\Delta x}{V} = \frac{2072 m}{18.1 m/s}$

$\boxed{\Delta t_1 = 114 s}$

Cage 2

Know $V_i, a, \Delta y$ t?

$y = y_0 + V_i t^{?0} + \frac{1}{2} a t_2^2$ $\Delta y = y - y_0$

$\Delta y = \frac{1}{2} a t_2^2$

$t_2^2 = \frac{2\Delta y}{a}$

$t_2 = \sqrt{\frac{2(2072 m)}{4.00 \times 10^{-2} m/s}}$

$\boxed{t_2 = 322 s}$

* Cage 1 Reaches Bottom 1st