AP Physics Unit 1 Kinematics - Problem Set 1, 2, 3

Set 1:

① **Given:**

$\Delta t = 15 \text{ min} \left(\frac{1 \text{ hr}}{60 \text{ min}}\right) = .25 \text{ Hr}$

$\vec{V} = 12.5 \text{ km/hr South}$

$\Delta x = ?$

Soln:

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

$\Delta x = V \Delta t = \left(\frac{12.5 \text{ km}}{\text{hr}}\right)(.25 \text{ hr})$

$\boxed{\Delta x = 3.1 \text{ km South}}$

② **Given:**

$\vec{V} = 48.0 \text{ km/h East}$

$\Delta t = ?$

$\Delta x = 144 \text{ km}$

Soln:

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

$\Delta t = \frac{\Delta x}{V} = \frac{144 \text{ km}}{\left(48.0 \frac{\text{km}}{\text{hr}}\right)}$

$\boxed{\Delta t = 3.00 \text{ hr}}$

③ **Given:**

$\Delta x_1 = 280 \text{ km}$, $V_1 = 88 \text{ km/hr}$, $\Delta t_1 = ?$

.... Stop $\Delta t_2 = 24 \text{ min}$

$\Delta x_2 = 210 \text{ km}$, $\vec{V}_2 = 75 \text{ km/hr}$, $\Delta t_3 = ?$

$\Delta T_{\text{Total}} = ?$ $T_1 + T_2 + T_3$

$\Delta \vec{V}_{\text{Avg Total}} = ?$

Soln: $V = \frac{\Delta x}{\Delta t} \Rightarrow \Delta t = \frac{\Delta x}{V}$

$\Delta T_{\text{total}} = \Delta T_1 + \Delta T_2 + \Delta T_3$

$= \frac{280 \text{ km}}{88 \text{ km/hr}} + \left(\frac{24 \text{ min}}{1}\right)\left(\frac{1 \text{ hr}}{60 \text{ min}}\right) + \left(\frac{210 \text{ km}}{75 \frac{\text{km}}{\text{hr}}}\right) = 3.2 \text{ hr} + .40 \text{ hr} + 2.8 \text{ h}$

$\boxed{\Delta T_{\text{total}} = 6.4 \text{ hr}}$

$\vec{V}_{\text{avg}} = \frac{\Delta x_{\text{Total}}}{\Delta T_{\text{Total}}} = \frac{280 \text{ km} + 210 \text{ km}}{6.4 \text{ hr}} = \boxed{77 \text{ km/hr South}}$

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SET 2:

(1) Given:

$V_i = 15.0\ m/s$

$V_f = 0$ stop

$\Delta t = 2.50\ s$

$\Delta x = ?$

Soln:

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

$$\Delta x = \frac{1}{2}(15.0\ m/s)(2.50\ s)$$

$$\boxed{\Delta x = 18.8\ m}$$

(2) Given:

$\bar{V}_i = 21.8\ m/s$

$\Delta x = 101\ m$ ~~m~~ $99\ m$

$\Delta t = ?$

$V_f = 0$ stop

Soln:

$$\Delta x = \frac{1}{2}(V_i + V_f)\overset{?}{\Delta t}$$

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

$$= \frac{2(99\ m)}{21.8\ m/s}$$

$$\boxed{\Delta t = 9.1\ s}$$

(3) Given:

$\bar{V}_i = 6.4\ m/s$

$\Delta x = 3.2\ km \left(\frac{1000\ m}{1\ km}\right) = 3200\ m$

$\Delta t = 3.5\ min \left(\frac{60\ sec}{1\ min}\right) = 210\ sec$

$V_f = ?\ m/s$

Soln:

$$\Delta x = \frac{1}{2}(V_i + \overset{?}{V_f})\Delta t$$

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

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

$$V_f = \frac{2(3200\ m)}{210\ s} - 6.4\ m/s$$

$$\boxed{V_f = 24\ m/s}$$

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① Given:

$\bar{V}_i = 6.5\ m/s$

$\bar{a} = 0.92\ m/s^2$

$\Delta t = 3.6\ s$

$\bar{V}_f = ?$

$\Delta x = ?$

Soln:

$$V_f = V_i + a\Delta t$$
$$= 6.5\ m/s + (0.92\ m/s^2)(3.6\ s)$$
$$= 6.5\ m/s + 3.3\ m/s$$
$$\boxed{V_f = 9.8\ m/s}$$

$$\Delta x = x_0^{\,0} + V_i t + \frac{1}{2}at^2 \qquad \text{start @ } x_0 = 0$$
$$\Delta x = (6.9\ m/s)(3.6\ s) + \frac{1}{2}(0.92\ m/s^2)(3.6\ s)^2$$
$$= 23\ m + 6.0\ m$$
$$\boxed{\Delta x = 29\ m}$$

② Given:

$V_f = ?$

$V_i = 4.30\ m/s$

$a = 3.00\ m/s^2$

$\Delta x = ?$

$\Delta t = 5.00\ s$

Soln:

$$V_f = V_i + a\Delta t$$
$$= 4.30\ m/s + (3.00\ m/s^2)(5.00\ s)$$
$$= 4.30 + 15.0$$
$$\boxed{V_f = 19.3\ m/s}$$

$$x = x_0 + V_0 t + \frac{1}{2}at^2$$
$$\Delta x = x - x_0 \qquad \text{usually skip this}$$
$$\therefore \Delta x = V_i t + \frac{1}{2}at^2$$
$$= (4.30\ m/s)(5.00\ s) + \frac{1}{2}\left(3.00\ \frac{m}{s^2}\right)(5.00\ s)^2$$
$$= 21.5\ m + 37.5\ m$$
$$\boxed{\Delta x = 59.0\ m}$$

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(3) Given:

$V_i = 15.0\ m/s$

$a = -2.0\ m/s^2$

$V_f = 10.0\ m/s$

$\Delta t = ?$

$\Delta x = ?$

Soln: $V_f = V_i + a\Delta t$

$\Delta t = \dfrac{V_f - V_i}{a}$

$= \dfrac{10.0\ m/s - 15.0\ m/s}{-2.0\ m/s^2}$

$\boxed{\Delta t = 2.5\ s}$

$\Delta x = \cancel{x_0}^{\,0} + V_i \Delta t + \frac{1}{2} a \Delta t^2$

$= \left(\frac{15.0\ m}{s}\right)(2.5s) + \frac{1}{2}(-2.0\ m/s^2)(2.5s)^2$

$= 38\ m + -6.3\ m$

$\boxed{\Delta x = 32\ m}$