Ph105 Sum12
Hw1

1. a) $\Delta x_{tot} = \Delta x_1 + \Delta x_2$? walk, ? run $\qquad \Delta t_{tot} = \Delta t_1 + \Delta t_2$ [HRW 2.2]

$$\bar{v} = \frac{\Delta x_{tot}}{\Delta t_{tot}}$$

$\Delta x_1 = v_1 \Delta t_1$, $\Delta x_2 = v_2 \Delta t_2$ $\Rightarrow$ $\Delta t_1 = \frac{\Delta x_1}{v_1}$, $\Delta t_2 = \frac{\Delta x_2}{v_2}$ $\Rightarrow$ $\Delta t_t = \frac{\Delta x_1}{v_1} + \frac{\Delta x_2}{v_2}$

$$\bar{v} = \frac{\Delta x_1 + \Delta x_2}{\frac{\Delta x_1}{v_1} + \frac{\Delta x_2}{v_2}}$$

given $\Delta x_1 = \Delta x_2$, all Δx's cancel

$$\boxed{\bar{v} = \frac{2 v_1 v_2}{v_1 + v_2}} \simeq 1.74 \frac{m}{s}$$

indep. of Δx! since same $\Delta x_1 = \Delta x_2$

note $\Delta t_1 \simeq 60s$, $\Delta t_2 \simeq 24s$, $\Delta t_t \simeq 84s$

b) know Δt's, not Δx's!

$\Delta x_1 = v_1 \Delta t_1$ $\quad \Delta x_2 = v_2 \Delta t_2$ $\quad \Delta x_1 = 73.2m$ $\quad \Delta x_2 = 183m$

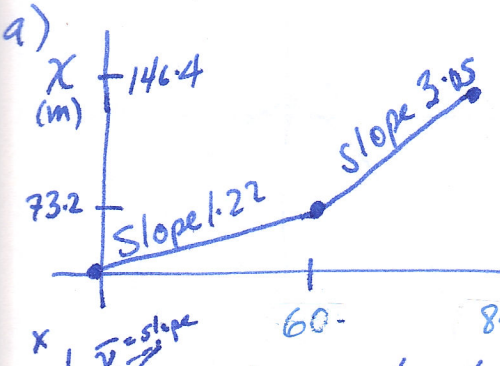
$$\bar{v} = \frac{v_1 \Delta t_1 + v_2 \Delta t_2}{\Delta t_1 + \Delta t_2}$$

given $\Delta t_1 = \Delta t_2$, all Δt's cancel

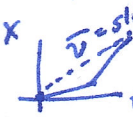
$$\boxed{\bar{v} = \frac{v_1 + v_2}{2}} \simeq 2.14 \frac{m}{s}$$

indep of Δt! Since same... $\Delta t_1 = \Delta t_2$

a)



b)



Avg velocity $\bar{v}$ is slope of line connecting 1st and last points

2. bird flies at 60km/h as long as trains take to collide! [HRW 2.7]

- trains @ same speed, so each cover half sep = 30km

$$\Delta t = \frac{\Delta x}{v} = \frac{30\text{km}}{30\text{km/h}} = 1\text{h}$$

- or, 2 trains close gap at $30+30 = 60\frac{\text{m}}{\text{s}}$!

$$\Delta t = \frac{60\text{km}}{60\text{km/h}} = 1\text{h}$$

bird flies at 60km/h for 1h $\Rightarrow \Delta x = v\Delta t = \left(60\frac{\text{km}}{\text{h}}\right)(1\text{h}) = \underline{60\text{km}}$

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3. $x(t) = 4 - 6t^2$ [HRW 2.16]

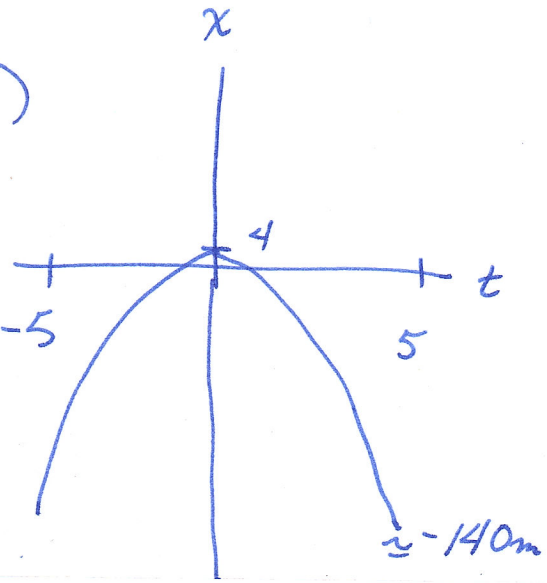
a) stops when $v = \frac{dx}{dt} = 0 = -12t$ so $\underline{t = 0}$

b) $x(0) = \underline{4\text{m}}$

c) d) when does $x = 0$?

$$0 = 4 - 6t^2 \quad t^2 = \frac{4}{6} \quad t = \pm\sqrt{\frac{4}{6}} = \pm\frac{2\sqrt{6}}{6} \simeq \underline{\pm 0.82\text{s}}$$

e)



f) shift to right: $\underline{+20t}$

g) increases - also shift to right

4. $x(t) = 20t - 5t^3$ [HRW 2.20]

a) $v(t) = \frac{dx}{dt} = 20 - 15t^2 = 0$

$15t^2 = 20$, $t^2 = \frac{20}{15} = \frac{4}{3}$, $t = \pm\sqrt{\frac{4}{3}} = \pm\frac{2\sqrt{3}}{3} \simeq \pm 1.2$ sec

b) $a = \frac{d^2x}{dt^2} = \frac{dv}{dt} = -30t$ zero at $t = 0$

c) $a < 0$ for all $t > 0$

d) $a > 0$ for all $t < 0$

e)