1 Problem 12-24

Given: A particle starts from rest and travels along a straight line with an acceleration $a = (30 - .2v)ft/s^2$, where v is in ft/s.
Determine: The time when the velocity of the particle is $v = 30ft/s$
Solution:

$$a = (30 - .2v)[ft/s^2]\}$$

$$\frac{dv}{dt} = (30 - .2v)$$

$$\frac{dv}{(30 - .2v)} = dt$$

$$\int\limits_{v_0}^{v} \frac{dv}{(30 - .2v)} = \int dt$$

$$-5\ln|30 - .2v| = t + C$$

setting initial condition

$$-5\ln|30| = C$$

$$-5\ln|30 - .2v| + 5\ln|30| = t$$

setting target condition

$$t = -5\ln|30 - .2(30)| + 5\ln|30|$$

$$\boxed{\text{t} = 1.16 \text{ [s]}} \quad \overbrace{1.11572[s]}$$ assuming 3 sig figs

2 Problem 12-36

Given: The acceleration of a particle traveling along a striaght line is $a = (8 - 2s)[m/s^2]$, where s is in meters. If $v = 0$ at $s = 0$, determine the velocity of the particle at $s = 2[m]$, and the position of the particle when the velocity is maximum.
Solution:

$$a = \frac{dv}{ds}\frac{ds}{dt}$$

$$a\ ds = v\ dv$$

$$\int_{s_0}^{s} (8 - 2s)ds = \int_{v_0}^{v} v\ dv$$

$$s_0 = 0 \ \&\ v_0 = 0$$

$$8s - s^2 = \frac{v^2}{2}$$

$$v = \pm\frac{1}{2}\sqrt{8s - s^2}$$

$$v(2) = .5\sqrt{16 - 4}$$

$$\boxed{\text{v(2)=1.73[m/s]}}\ \text{assuming 3 sig figs}$$

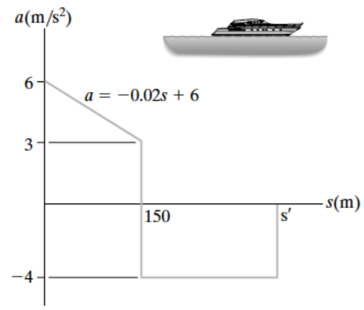
$$\frac{dv}{dt} = a = 0 \text{ to maximize}$$

$$8 - 2s = 0$$

$$\boxed{\text{s=4.00 when v is maximized}}$$

3 Problem 12-42

Given: The boat travels in a straight line with the acceleration described by $a - s$ graph. If it starts from rest construct the $v - s$ graph and determine the boat's maximum speed. What distance s' does it travel before it stops?



$$a = \begin{cases} -.02s + 6 & : x \leq 150 \\ -4 & : x > 150 \end{cases}$$

$$\int_{s_0}^{s} \begin{cases} -.02s + 6 & : x \leq 150 \\ -4 & : x > 150 \end{cases} ds = \int_{v_0}^{v} v \, dv$$

$$v_0 = 0 \text{ and } s_0 = 0$$

$$\begin{cases} -.01s^2 + 6s & : x \leq 150 \\ -4(s - 150) + \frac{v(150)^2}{2} & : x > 150 \end{cases} = \frac{v^2}{2}$$

$$v(150) = -.01(150)^2 + 6(150) = \boxed{675 \text{ [m/s]}} \leftarrow \text{ v max}$$

$$v = \begin{cases} \sqrt{-.02s^2 + 12s} & : x \leq 150 \\ \sqrt{-8(s - 150) + 1350} & : x > 150 \end{cases}$$

for v = 0 finding maximum "s" of second verison of the equation yeilds

$$\boxed{\text{s} = 318.75 \text{ [m]}}$$