$\boxed{7N}$ #2 Instantaneous Rate of change (the Derivative)

(a) $V(0) = 4000\ L$

$$V(20) = 4000\left(1 - \frac{20}{60}\right)^2 = 1778\ L$$

(b) $$\frac{V(20) - V(0)}{20 - 0} = \frac{1778 - 4000}{20 - 0} = -111\ L/\text{min}$$

*(c) $$\frac{dV}{dt} = 8000\left(1 - \frac{t}{60}\right)\left(-\frac{1}{60}\right)$$

$$-\frac{1}{60}\cdot t$$

$$\left.\frac{dV}{dt}\right|_{t=20} = 8000\left(1 - \frac{20}{60}\right)\left(-\frac{1}{60}\right) = -\underline{88.9}\ L/\text{min}$$

$$\left.\frac{dV}{dt}\right|_{t=0} = 8000\cancel{\left(1 - \frac{0}{60}\right)}\left(-\frac{1}{60}\right) = -133\ L/\text{min}$$

(d) $\frac{dv}{dt} = 8000\left(1 - \frac{t}{60}\right)\left(-\frac{1}{60}\right) = 0$

$t = 60\,\text{min}$

$V'(t)$ 0 ——— $-$ ——— 60

Ex. A ball is thrown upward so that its height is given by

$h(t) = -16t^2 + \underline{60t + 5}$

h in feet, t in seconds

initial height is $h(0) = 5$ ft.

(a) Find the initial velocity

$\frac{dh}{dt} = v(t) = -32t + 60$

$v(0) = 60$ ft/sec

(b) Find the initial acceleration.

$$a(t) = \frac{dv}{dt} = -32 \text{ ft/sec}^2 \qquad \frac{\text{ft/sec}}{\text{sec}}$$

(c) When does the ball reach its maximum height?

stops for an instant

$$v(t) = -32t + 60 = 0$$

$$-32t = -60$$

$$t = \frac{60}{32} = \frac{15}{8} \text{ sec}$$

Ex. A particle is moving along the x-axis so that its <u>displacement</u> from the origin is given by

$$s(t) = t^3 - t^2 - t - 2$$

(a) Find the position at time $t = 0$.

(b) Find the initial velocity

(c) When is the particle at rest? (if ever)

(d) Find the initial acceleration.

(a) $s(0) = -2$

(b) $\frac{ds}{dt} = v(t) = 3t^2 - 2t - 1$

$v(0) = -1$ (moving left)

(c) $v(t) = 3t^2 - 2t - 1 = 0$

$$t = \frac{2 \pm \sqrt{4 + 12}}{6}$$

$$= \frac{2 \pm 4}{6} = 1 \text{ or } -\frac{1}{3}$$

(d) $a(t) = \frac{dv}{dt} = 6t - 2$

$a(0) = -2$ (force pulling to the left)

HW 7N #3,4; 7O #2; 7P #1,2