201 §3.8 #s 1, 4, 7, 9, 10, 12, 17, 23

① Assume radius r & Area A are dif'ble fncs of t. Write eq'n relating $\frac{dA}{dt}$ & $\frac{dr}{dt}$:

$$A = \pi r^2 \implies$$

$$\boxed{\frac{dA}{dt} = 2\pi r \frac{dr}{dt}}$$

④ If $y = 5x$ & $\frac{dx}{dt} = 2$. Find dy/dt:

$$\frac{dy}{dt} = 5\frac{dx}{dt} = 5(2) = \boxed{10 = \frac{dy}{dt}}$$

⑦ $x^2 + y^2 = 25$ & $\frac{dy}{dt} = -2$, then find

$$\left.\frac{dy}{dt}\right|_{x=3,\ y=4} \qquad 2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 0 \implies$$

$$2(3)(-2) + 2(4)\left(\frac{dy}{dt}\right) = 0 \implies$$

$$8y' = 12$$

$$y' = \frac{12}{8} = \boxed{\frac{3}{2} = y'}$$

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(10) $r + s^2 + v^3 = 12$, $\frac{dr}{dt} = 4$, $\frac{ds}{dt} = -3$ given.

Find $\left.\frac{dv}{dt}\right|_{\substack{r=3\\ s=1}}$

$\frac{dr}{dt} + 2s\frac{ds}{dt} + 3v^2\frac{dv}{dt} = 0$, so $r=3, s=1 \Longrightarrow$

$4 + 2(1)(-3) + 3v^2\frac{dv}{dt} = 0 \Longrightarrow$

$\frac{dv}{dt} = \frac{-2}{3v^2}$ Need v:

$3 + 1^2 + v^3 = 12 \Longrightarrow$

$v^3 = 8 \Longrightarrow$

$v = 2$

This gives $\frac{dv}{dt} = \frac{-2}{3(2)^2} = \boxed{\frac{-1}{6} = \left.\frac{dv}{dt}\right|_{\substack{r=3\\ s=1}}}$

(12) $\frac{dA}{dt} = 72\ in^2/s$ = rate of change of area of cube. At what rate is cube's Volume changing, when $x = 3$ in = edge length?

$A = 6x^2 \Longrightarrow \frac{dA}{dt} = 72 = 12x\frac{dx}{dt} \Longrightarrow$

$\left.\frac{dx}{dt}\right|_{x=3} = \frac{72}{12(3)} = \frac{72}{36} = 2\ in/s$.

$V = x^3$

$\left.\frac{dV}{dt}\right|_{x=3} = \left.3x^2\frac{dx}{dt}\right|_{x=3} = 3(9)(2) = \boxed{54\ in^3/s}$

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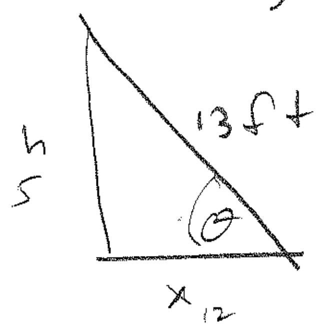
(17) Done in class, see notes

(23) Sliding Ladder



$$\left.\frac{dx}{dt}\right|_{x=12} = 5\ \frac{ft}{s}$$

$$x^2 + h^2 = 13^2$$

(a) $\left.\frac{dh}{dt}\right|_{x=12} = ?$

$$2xx' + 2hh' = 0$$

$x = 12 \longrightarrow h = \sqrt{169 - 144} = 5$

$$2(12)(5) + 2(5)h' = 0$$

$$\longrightarrow h' = -\frac{120}{10} = \boxed{-12\ ft/s = \left.\frac{dh}{dt}\right|_{x=12}}$$

(b) Area of triangle $= A$.

What's $\left.\frac{dA}{dt}\right|_{x=12}$?

$$A = \frac{1}{2}xh \longrightarrow$$

$$\left.\frac{dA}{dt}\right|_{x=12} = \left.\frac{1}{2}\left[\frac{dx}{dt}h + x\frac{dh}{dt}\right]\right|_{x=12} = \frac{1}{2}\left[(5)(5) + (12)(-12)\right]$$

$$= \frac{1}{2}\left[25 - 144\right] = -\frac{1}{2}\left[199\right] = \boxed{-\frac{199}{2}\ \frac{ft^2}{s} = \left.\frac{dA}{dt}\right|_{x=12}}$$

(c) What's $\left.\frac{d\theta}{dt}\right|_{x=12}$?

$$\frac{h}{13} = \sin\theta \Longrightarrow h = 13\sin\theta \Longrightarrow \frac{dh}{dt} = 13\cos\theta\,\frac{d\theta}{dt} \Longrightarrow \boxed{\frac{d\theta}{dt} = -\frac{1\ rad}{s}}$$

$$-12 = 13\left(\frac{12}{13}\right)\frac{d\theta}{dt}$$