

2.6 Related Rates HW p.154 #1, 3, 11, 15, 19, 20, 21, 27ab, 30a, 32, 33

20) $V = x^3$ $\frac{dx}{dt} = 3 \text{ cm/s}$ $\frac{dV}{dt} = \underline{\hspace{2cm}}$

$$\frac{dV}{dt} = 3x^2 \left(\frac{dx}{dt} \right)$$

a) when $x=1$ $\frac{dV}{dt} = 3(1)^2(3) = 9 \text{ cm}^3/\text{s}$

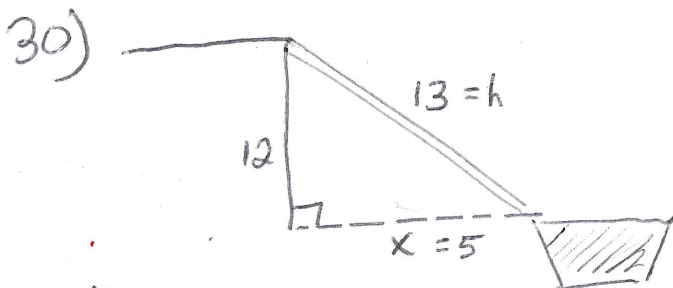
b) when $x=10$ $\frac{dV}{dt} = 3(10)^2(3) = 900 \text{ cm}^3/\text{s}$

21) $S = 6x^2$ 

$$\frac{dS}{dt} = 12x \left(\frac{dx}{dt} \right)$$

a) when $x=1$, $\frac{dS}{dt} = 12(1)(3) = 36 \text{ cm}^2/\text{s}$

b) when $x=10$, $\frac{dS}{dt} = 12(10)(3) = 360 \text{ cm}^2/\text{s}$



$$\frac{dh}{dt} = -4 \text{ ft/s}$$

$$\frac{dx}{dt} = \underline{\hspace{2cm}}$$

$$\frac{dy}{dt} = 0$$

$$x = 5$$

$$y = 12$$

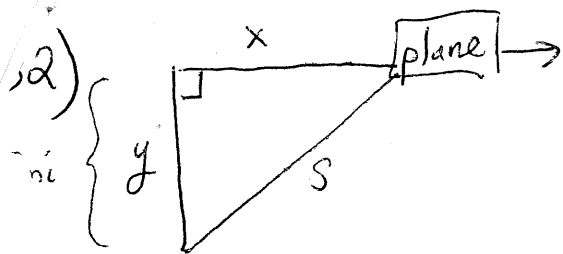
$$h = 13$$

$$x^2 + y^2 = h^2$$

$$2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 2h \frac{dh}{dt}$$

$$2(5) \left(\frac{dx}{dt} \right) + 2(12)(0) = 2(13)(-4)$$

$$\frac{dx}{dt} = \frac{2(13)(-4)}{2(5)} = \frac{-52}{5} = \boxed{-10.4 \text{ ft/s}}$$



$$x^2 + y^2 = s^2$$

$$2x \left(\frac{dx}{dt} \right) + 2y \left(\frac{dy}{dt} \right) = 2s \left(\frac{ds}{dt} \right)$$

$$x = \underline{\hspace{2cm}}$$

$$\frac{dx}{dt} = \underline{\hspace{2cm}}$$

$$y = 5 \text{ mi}$$

$$\frac{dy}{dt} = 0 \text{ mph}$$

$$s = 10 \text{ mi}$$

$$\frac{ds}{dt} = 240 \text{ mph}$$

$$x^2 + y^2 = s^2$$

$$x^2 + 5^2 = 10^2$$

$$x^2 = 75 =$$

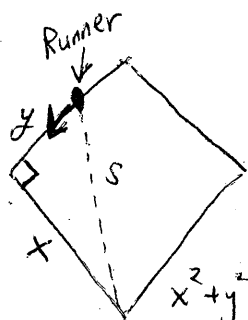
$$x = 5\sqrt{3} \text{ mi}$$

$$2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 2s \frac{ds}{dt}$$

$$2(5\sqrt{3}) \frac{dx}{dt} + 2(5)(0) = 2(10)(240)$$

$$\frac{dx}{dt} = \frac{2(10)(240)}{2(5\sqrt{3})} = \boxed{277.128 \text{ mph}}$$

33)



$$x^2 + y^2 = s^2$$

$$2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 2s \frac{ds}{dt}$$

$$x = 90$$

$$\frac{dx}{dt} = 0$$

$$y = 30$$

$$\boxed{\frac{dy}{dt} = -28 \text{ ft/s}}$$

$$s = \underline{\hspace{2cm}}$$

$$\frac{ds}{dt} = \underline{\hspace{2cm}}$$

$$x^2 + y^2 = s^2$$

$$90^2 + 30^2 = s^2$$

$$s = 94.868 \text{ ft.}$$

$$2(90)(0) + 2(30)(-28) = 2(94.868) \frac{ds}{dt}$$

$$-1680 = 189.736 \frac{ds}{dt}$$

$$\frac{-1680}{189.736} = \frac{ds}{dt}$$

$$\boxed{\frac{ds}{dt} = -8.854 \text{ ft/s}}$$