

$$V = \frac{1}{3} \pi r^2 h$$

$$\frac{dV}{dt} = \frac{1}{3} \pi \left(2rh \frac{dr}{dt} + r^2 \frac{dh}{dt} \right)$$

$$50 = \frac{1}{3} \pi \left(2(37.5)(5) \left(\frac{45}{6} \frac{dr}{dt} \right) + (37.5)^2 \frac{dh}{dt} \right)$$

$$\frac{45}{6} = \frac{r}{5}$$

$$37.5 = r$$

$$\frac{45}{6} = \frac{r}{h}$$

$$\frac{45}{6} h = r$$

$$\boxed{\frac{45}{6} \frac{dh}{dt} = \frac{dr}{dt}}$$

$$50 = \frac{1}{3} \pi \left(2(37.5)(5) \left(\frac{45}{6} \frac{dh}{dt} \right) + (37.5)^2 \frac{dh}{dt} \right)$$

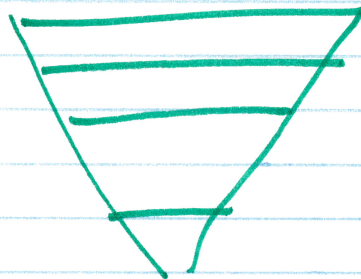
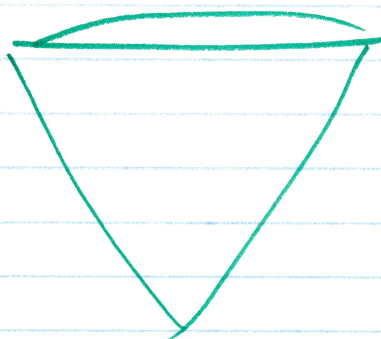
$$\frac{150}{\pi} = 2812.5 \frac{dh}{dt} + 1406.25 \frac{dh}{dt}$$

$$\frac{\left(\frac{150}{\pi} \right)}{4218.75} = \frac{4218.75 \frac{dh}{dt}}{4218.75}$$

$$\frac{dh}{dt} = .011 \text{ m/min}$$

$$= 1.132 \text{ cm/min}$$

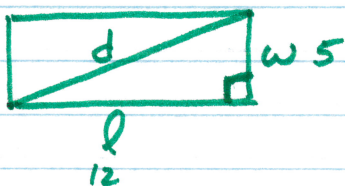
$$\frac{45}{6} (\text{ANS } 1.132) = \frac{dr}{dt} = \boxed{8.488 \text{ cm/min}}$$





4.6

⑨



$$(a) A = lw$$

$$\frac{dA}{dt} = w \frac{dl}{dt} + l \frac{dw}{dt}$$

$$= 5(-2) + 12(2)$$

$$= -10 + 24 = \boxed{14 \text{ cm}^2/\text{sec}}$$

$$(b) P = 2l + 2w$$

$$\frac{dP}{dt} = 2 \frac{dl}{dt} + 2 \frac{dw}{dt}$$

$$= 2(-2) + 2(2)$$

$$= 0$$

$$(c) l^2 + w^2 = d^2$$

$$2l \frac{dl}{dt} + 2w \frac{dw}{dt} = 2d \frac{dd}{dt}$$

$$2(12)(-2) + 2(5)(2) = 2(13) \frac{dd}{dt}$$

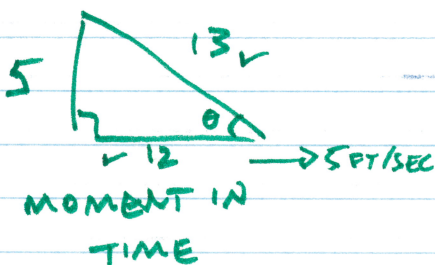
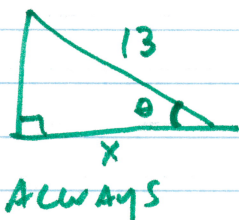
$$-48 + 20 = 26 \frac{dd}{dt}$$

$$\frac{-28}{26} = \frac{dd}{dt}$$

$$= \boxed{-\frac{14}{13} \text{ cm/sec}}$$

⑩

↓ y



$$(b) A = \frac{1}{2}xy$$

$$\frac{dA}{dt} = \frac{1}{2} \left(y \frac{dx}{dt} + x \frac{dy}{dt} \right)$$

$$= \frac{1}{2} (5(5) + 12(-12))$$

$$= \frac{1}{2} (25 - 144)$$

$$= \boxed{-59.5 \text{ ft}^2/\text{sec}}$$

$$(a) y^2 + x^2 = 13^2$$

$$2y \frac{dy}{dt} + 2x \frac{dx}{dt} = 0$$

$$2(5) \frac{dy}{dt} + 2(12)(5) = 0$$

$$10 \frac{dy}{dt} + 120 = 0$$

$$10 \frac{dy}{dt} = -120$$

$$\frac{dy}{dt} = -12 \text{ ft/sec}$$

4.6

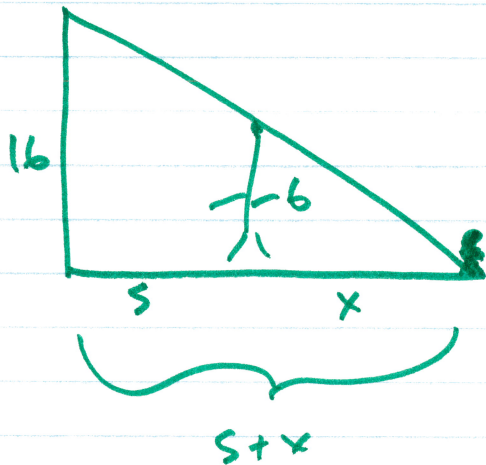
$$(19) \quad (c) \quad \cos \theta = \frac{x}{13}$$
$$-\sin \theta \frac{d\theta}{dt} = \frac{1}{13} \frac{dx}{dt}$$

$$-\frac{5}{13} \frac{d\theta}{dt} = \frac{1}{13} (5)$$

$$-\frac{5}{13} \frac{d\theta}{dt} = \frac{5}{13}$$

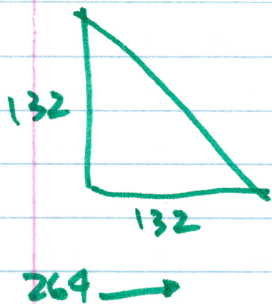
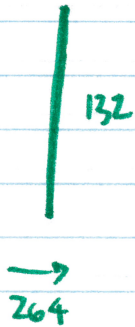
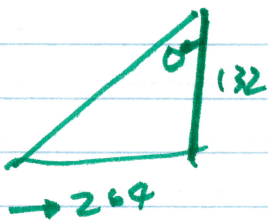
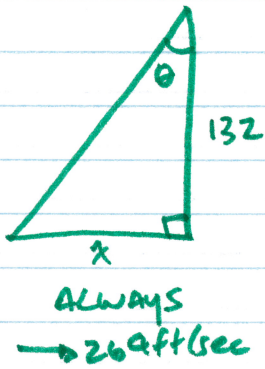
$$\frac{d\theta}{dt} = -1 \text{ radians/sec}$$

(29)



4.6

(31)



$$(a) \tan \theta = \frac{x}{132}$$

$$\sec^2 \theta \frac{d\theta}{dt} = \frac{1}{132} \frac{dx}{dt}$$

$$(\sec^2 \theta) \frac{d\theta}{dt} = \frac{1}{132} (264)$$

radians

$$\frac{d\theta}{dt} = 2 \text{ /sec}$$

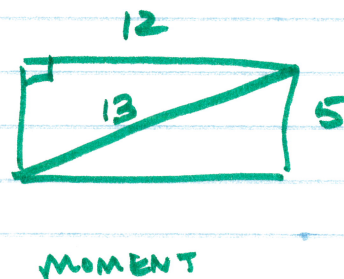
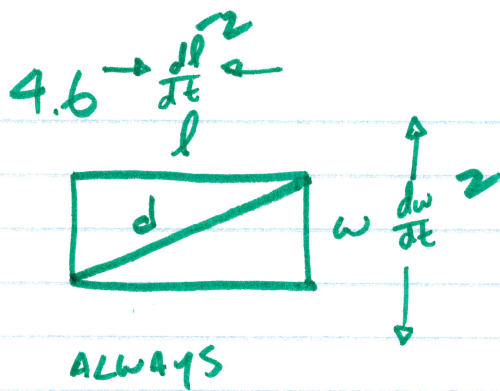
$$(b) \sec^2 \theta \frac{d\theta}{dt} = \frac{1}{132} \frac{dx}{dt}$$

$$\sec^2 \left(\frac{\pi}{4} \right) \frac{d\theta}{dt} = \frac{1}{132} (264)$$

$$\frac{2 \frac{d\theta}{dt}}{2} = \frac{2}{2}$$

$$\frac{d\theta}{dt} = 1 \text{ radians/sec}$$

9



(a) $A = l \times w$

$$\frac{dA}{dt} = \frac{dl}{dt} w + \frac{dw}{dt} l$$

$$= (-2)(5) + (2)(12)$$

$$= -10 + 24$$

$$= \boxed{14 \text{ cm}^2/\text{sec}}$$

$$\frac{d}{dt} l^2 = 2l \frac{dl}{dt}$$

$$\frac{d}{dt} l = 1 l^0 \frac{dl}{dt}$$

(b) $P = 2l + 2w$

$$\frac{dP}{dt} = 2 \frac{dl}{dt} + 2 \frac{dw}{dt}$$

$$= 2(-2) + 2(2) = \boxed{0 \text{ cm/sec}}$$

(c) $d^2 = l^2 + w^2$

$$2d \frac{dd}{dt} = 2l \frac{dl}{dt} + 2w \frac{dw}{dt}$$

$$2(13) \frac{dd}{dt} = 2(12)(-2) + 2(5)(2)$$

$$\frac{26 \frac{dd}{dt}}{26} = \frac{-28}{26}$$

$$\boxed{\frac{dd}{dt} = \frac{-14}{13} \text{ cm/sec}}$$

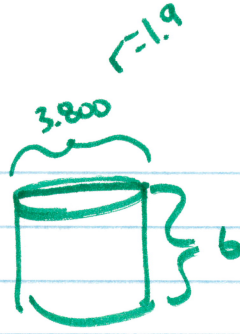
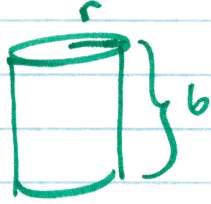
$$d = (l^2 + w^2)^{1/2}$$

$$\frac{dd}{dt} = \frac{1}{2} (l^2 + w^2)^{-1/2}$$

$$\left[2l \frac{dl}{dt} + 2w \frac{dw}{dt} \right]$$

(15)

$$4.6 \rightarrow \frac{dr}{dt} = \frac{1/1000}{3} = \frac{1}{3000}$$



$$V = \pi r^2 h = \pi r^2 (6)$$

$$= 6\pi r^2$$

$$\frac{dV}{dt} = 12\pi r \frac{dr}{dt}$$

$$= 12\pi (1.9) \left(\frac{1}{3000}\right)$$

$$= .024 \text{ in}^3/\text{min} \quad \frac{19\pi}{2500}$$

(7) $V = IR$

$$\frac{dV}{dt} = 1 \quad \frac{dI}{dt} = -\frac{1}{3} \quad 12 = 2R$$

$$\boxed{6 = R}$$

$$\frac{dV}{dt} = \frac{dI}{dt} R + \frac{dR}{dt} I$$

$$1 = \frac{-1}{3}(6) + \frac{dR}{dt}(2)$$

+2 +2

$$\frac{3}{2} = \frac{dR}{dt}(2)$$

$$\frac{3}{2} \text{ ohms} = \frac{dR}{dt}$$

/Sec

z z

4.6

⑤

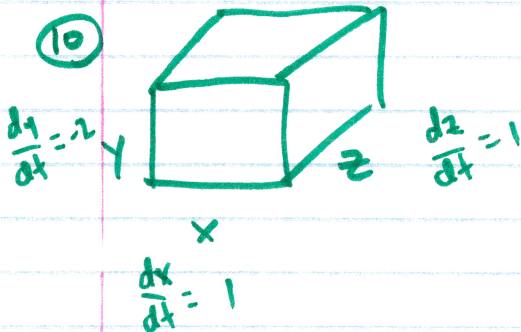
$$s = \sqrt{x^2 + y^2 + z^2}$$

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

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

$$\frac{ds}{dt} = \frac{x \frac{dx}{dt} + y \frac{dy}{dt} + z \frac{dz}{dt}}{\sqrt{x^2 + y^2 + z^2}}$$

⑩



$$(a) V = xyz$$

$$\frac{dV}{dt} = \frac{dx}{dt} yz + \frac{dy}{dt} xz + \frac{dz}{dt} xy$$

$$= (1)(3)(2) + (-2)(4)(2) + (1)(4)(3)$$

$$= 6 - 16 + 12 = \boxed{2 \text{ m}^3/\text{sec}}$$

$$(b) SA = \cancel{4xy} + \cancel{2yz} + 2yz + 2zx + 2xy$$

$$\frac{dSA}{dt} = 2z \frac{dy}{dt} + 2y \frac{dz}{dt} + 2z \frac{dy}{dt} + 2x \frac{dz}{dt} + 2y \frac{dx}{dt} + 2x \frac{dy}{dt}$$

$$= 2(2)(-2) + 2(3)(1) + 2(2)(1) + 2(4)(1) + 2(3)(1)$$

$$\cancel{-8} + 6 + 4 + \cancel{8} + 6 - 16 = \boxed{0 \text{ m}^2/\text{sec}} + 2(4)(-2)$$