

Sec 4.1 (1, 2, 4, 8-12, 18, 20, 31, 33, 37a) page 260

$$\textcircled{1} V = x^3 \quad \frac{dV}{dt} = 3x^2 \frac{dx}{dt}$$

$$\textcircled{2} \text{ a) } A = \pi r^2 \quad \frac{dA}{dt} = 2\pi r \frac{dr}{dt}$$

$$\text{ b) } \frac{dr}{dt} = 1 \text{ m/s} \quad r = 30 \quad \frac{dA}{dt} = 2\pi(30)(1) = \boxed{60\pi \text{ m}^2/\text{s}}$$

$$\textcircled{3} \textcircled{1} \frac{dl}{dt} = 8 \text{ cm/s} \quad \frac{dw}{dt} = 3 \text{ cm/s} \quad l = 20 \quad w = 10$$

$$\textcircled{2} A = lw \quad \frac{dA}{dt} = \frac{dl}{dt} w + \frac{dw}{dt} l = 8(10) + 3(20)$$

$$\boxed{\frac{dA}{dt} = 140 \text{ cm}^2/\text{s}}$$

$$\textcircled{4} \textcircled{1} x^2 + y^2 = 25 \quad \frac{dy}{dt} = 6 \quad \frac{dx}{dt} = ? \quad y = 4 \quad x = 3$$

$$\textcircled{2} 2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 0 \quad 2(3) \frac{dx}{dt} + 2(4)(6) = 0$$

$$\boxed{\frac{dx}{dt} = -8}$$

$$\textcircled{9} \textcircled{1} z^2 = x^2 + y^2 \quad \frac{dx}{dt} = 2 \quad \frac{dy}{dt} = 3 \quad \frac{dz}{dt} = ?$$

$$x=5 \quad y=12 \quad z=13$$

$$\textcircled{2} 2z \frac{dz}{dt} = 2x \frac{dx}{dt} + 2y \frac{dy}{dt} \Rightarrow 2(13) \frac{dz}{dt} = 2(5)(2) + 2(12)(3)$$

$$\frac{dz}{dt} = \frac{+46}{13}$$

$$\textcircled{10} \textcircled{1} y = \sqrt{1+x^3} \quad (2, 3)$$

$$\frac{dy}{dt} = 4 \quad \frac{dx}{dt} = ?$$

$$\textcircled{2} \frac{dy}{dt} = \frac{3x^2 \frac{dx}{dt}}{2\sqrt{1+x^3}} \Rightarrow 4 = \frac{3(2)^2 \frac{dx}{dt}}{2\sqrt{1+2^3}} \Rightarrow 4 = \frac{12}{6} \frac{dx}{dt}$$

$$\frac{dx}{dt} = 2 \text{ cm}^3/\text{s}$$

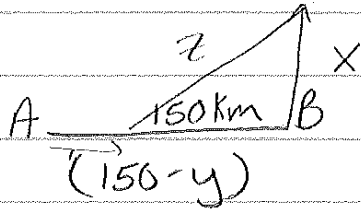
$$\textcircled{11} \textcircled{1} \frac{dA}{dt} = 1 \text{ cm}^2/\text{min} \quad d=10 \quad r=5 \quad \frac{dd}{dt} = ?$$

$$\textcircled{2} A = 4\pi r^2$$

$$\textcircled{3} \frac{dA}{dt} = 8\pi \left(\frac{d}{4}\right) \frac{dd}{dt} \Rightarrow 1 = 2(10)\pi \frac{dd}{dt}$$

$$\frac{dd}{dt} = \frac{1}{20\pi} \text{ cm/min}$$

(12) ①



4 hrs

$$\frac{dx}{dt} = 25$$

$$x = 4(25) = 100$$

$$\frac{dy}{dt} = 35$$

$$y = 4(35) = 140$$

$$\frac{dz}{dt} = ?$$

$$z \Rightarrow 100^2 + 10^2 = z^2$$

$$\sqrt{10100} = z$$

②

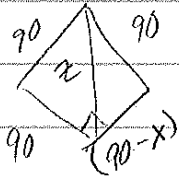
$$z^2 = (150-y)^2 + x^2$$

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

$$2\sqrt{10100} \frac{dz}{dt} = -2(35)(10) + 2(100)(25)$$

$$\frac{dz}{dt} = \frac{2150}{\sqrt{10100}} \approx \boxed{21.4 \text{ Km/hr}}$$

(18) ①



$$\frac{dx}{dt} = 24 \text{ ft/s}$$

$$x = 45 \text{ ft}$$

$$z = \sqrt{10125}$$

$$\frac{dz}{dt} = ?$$

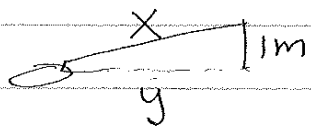
$$z^2 = (90-x)^2 + 90^2$$

$$2z \frac{dz}{dt} = -2 \frac{dx}{dt} (90-x) \Rightarrow \frac{dz}{dt} \sqrt{10125} = -2(24)(45)$$

$$\frac{dz}{dt} = \frac{-1080}{\sqrt{10125}} \approx \boxed{-10.73 \text{ ft/s}}$$

b) Same as a.

20) ①



$$\frac{dx}{dt} = 1 \text{ m/s}$$

$$y = 8$$

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

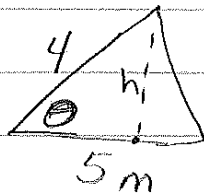
$$x = \sqrt{65}$$

$$\textcircled{2} \quad y^2 + 1^2 = x^2$$

$$2y \frac{dy}{dt} = 2x \frac{dx}{dt} \Rightarrow 2(8) \frac{dy}{dt} = 2\sqrt{65}(1)$$

$$\frac{dy}{dt} = \frac{\sqrt{65}}{8} \approx \boxed{1.008 \text{ m/s}}$$

31) ①



$$\frac{d\theta}{dt} = 0.06 \text{ rad/s}$$

$$\sin \theta = \frac{h}{4} \therefore h = 4 \sin \theta$$

$$\frac{dA}{dt} = ?$$

$$A = \frac{1}{2} bh \quad b = 5$$

$$\textcircled{2} \quad A = \frac{5}{2} (4 \sin \theta) = 10 \sin \theta$$

$$\frac{dA}{dt} = 10 \cos \theta \frac{d\theta}{dt}$$

$$\frac{dA}{dt} = 10(\cos \pi/3) \cdot 0.06$$

$$\boxed{\frac{dA}{dt} = 0.3 \text{ m}^2/\text{s}}$$

kilopascal)
re. newton

33)

$$C = PV$$

$$\frac{dP}{dt} = 20 \text{ kPa/min} \quad \frac{dV}{dt} = ?$$

$$V = 600 \text{ cm}^3$$

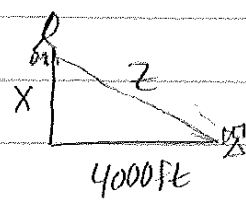
$$P = 150 \text{ kPa}$$

$$0 = V \frac{dP}{dt} + P \frac{dV}{dt}$$

$$0 = 600(20) + 150 \left(\frac{dV}{dt} \right)$$

$$\boxed{\frac{dV}{dt} = -80 \text{ cm}^3/\text{min}}$$

370



$$\frac{dx}{dt} = 400 \text{ ft/s}$$

$$x = 3000 \text{ ft}$$

$$z = 5000 \text{ ft}$$

$$\frac{dz}{dt} = ?$$

$$x^2 + 4000^2 = z^2$$

$$2x \frac{dx}{dt} = 2z \frac{dz}{dt}$$

$$2(3000) 400 = 2(5000) \frac{dz}{dt}$$

$$360 = \frac{dz}{dt}$$

$$\boxed{360 \text{ ft/s}}$$