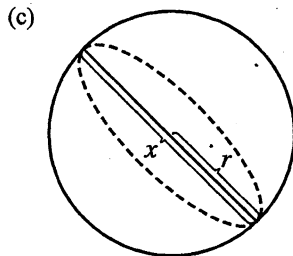


5. (a) Given: the rate of decrease of the surface area is $1 \text{ cm}^2/\text{min}$. If we let t be time (in minutes) and S be the surface area (in cm^2), then we are given that $dS/dt = -1 \text{ cm}^2/\text{s}$.

(b) Unknown: the rate of decrease of the diameter when the diameter is 10 cm . If we let x be the diameter, then we want to find dx/dt when $x = 10 \text{ cm}$.

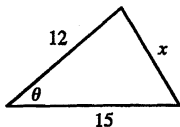


(d) If the radius is r and the diameter $x = 2r$, then $r = \frac{1}{2}x$ and $S = 4\pi r^2 = 4\pi(\frac{1}{2}x)^2 = \pi x^2 \Rightarrow$

$$\frac{dS}{dt} = \frac{dS}{dx} \frac{dx}{dt} = 2\pi x \frac{dx}{dt}.$$

(e) $-1 = \frac{dS}{dt} = 2\pi x \frac{dx}{dt} \Rightarrow \frac{dx}{dt} = -\frac{1}{2\pi x}$. When $x = 10$, $\frac{dx}{dt} = -\frac{1}{20\pi}$. So the rate of decrease is $\frac{1}{20\pi} \text{ cm/min}$.

24.



We are given $d\theta/dt = 2^\circ/\text{min} = \frac{\pi}{90} \text{ rad/min}$. By the Law of Cosines,

$$x^2 = 12^2 + 15^2 - 2(12)(15) \cos \theta = 369 - 360 \cos \theta \Rightarrow$$

$$2x \frac{dx}{dt} = 360 \sin \theta \frac{d\theta}{dt} \Rightarrow \frac{dx}{dt} = \frac{180 \sin \theta}{x} \frac{d\theta}{dt}. \text{ When } \theta = 60^\circ,$$

$$x = \sqrt{369 - 360 \cos 60^\circ} = \sqrt{189} = 3\sqrt{21}, \text{ so}$$

$$\frac{dx}{dt} = \frac{180 \sin 60^\circ}{3\sqrt{21}} \frac{\pi}{90} = \frac{\pi \sqrt{3}}{3\sqrt{21}} = \frac{\sqrt{7} \pi}{21} \approx 0.396 \text{ m/min}.$$