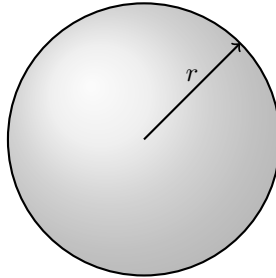


**Question 3****Problem:**

A spherical balloon is being inflated such that its radius increases at a constant rate of  $\frac{dr}{dt} = 3$  cm/min.

- (a) At what rate is the volume of the balloon increasing when the radius is 10 cm?
- (b) Include units and interpret the meaning of your result.



Spherical balloon

**Question 3 - Solution**

We are given:

$$\frac{dr}{dt} = 3 \text{ cm/min}, \quad r = 10 \text{ cm}$$

The volume of a sphere is given by:

$$V = \frac{4}{3}\pi r^3$$

Differentiate both sides with respect to  $t$ :

$$\frac{dV}{dt} = \frac{d}{dt} \left( \frac{4}{3}\pi r^3 \right) = 4\pi r^2 \frac{dr}{dt}$$

Substitute the known values:

$$\frac{dV}{dt} = 4\pi(10)^2(3) = 4\pi(100)(3) = 1200\pi$$

$$\frac{dV}{dt} \approx 3769.91 \text{ cm}^3/\text{min}$$

**Answer:** The volume is increasing at a rate of  $\boxed{1200\pi \approx 3769.91 \text{ cm}^3/\text{min}}$  when the radius is 10 cm.

**Interpretation:** When the balloon's radius is 10 cm and growing at 3 cm per minute, the volume is expanding at approximately 3769.91 cubic centimeters per minute. This tells us how rapidly the space inside the balloon is increasing at that instant.