Write a short sentence to answer each question.

1. A cylindrical tank of radius 10 cm is being filled at a rate of 3 cm³/sec. At what rate is the height changing?
   
   \[ V = \pi r^2 h \]
   \[ \frac{dV}{dt} = 100 \pi \frac{dh}{dt} \]
   \[ 3 = 100 \pi \frac{dh}{dt} \]
   \[ \frac{dh}{dt} = \frac{3}{100 \pi} \text{ cm/sec} \]

   The height is changing at a rate of \( \frac{3}{100 \pi} \text{ cm/sec} \).

2. A man 6 ft tall walks at a rate of 5 ft/sec away from a light that is 20 ft above ground. When he is 12 ft away from the base of the light,
   
   (a) what is the rate of change of the length of the shadow?
   
   \[ \frac{dx}{dt} = 5 \]
   \[ \frac{6}{20} = \frac{5}{x+5} \]
   \[ 6(x+5) = 20 \]
   \[ 6x + 30 = 20 \]
   \[ 6x = -10 \]
   \[ 6 \frac{dx}{dt} = 10 \frac{ds}{dt} \]

   \[ (a) \quad \frac{ds}{dt} = \frac{6}{14} \cdot (5) = \frac{3}{7} \cdot 5 = \frac{15}{7} \text{ ft/sec} \]

   Shadow is lengthening at a rate of \( \frac{15}{7} \text{ ft/sec} \).

   (b) at what rate is the tip of the shadow moving?

   \[ \frac{d(x+s)}{dt} = \frac{dx}{dt} + \frac{ds}{dt} = 5 + 15 = \frac{50}{7} \text{ ft/sec} \]

3. A spherical balloon is being inflated so that its volume is increasing at a rate of 5 m³/min. At what rate is the diameter increasing when the diameter is 12 m?

   \[ V = \frac{4}{3} \pi r^3 \]
   \[ \frac{dV}{dt} = \frac{2 \pi d^2}{2} \frac{dd}{dt} \]
   \[ 5 = \frac{2 \pi (12)^2}{2} \frac{dd}{dt} \]
   \[ \frac{dd}{dt} = \frac{5 \cdot 2}{144 \pi} = \frac{5}{72 \pi} \text{ m/min} \]

4. Sand is being dropped at a rate of 10 m³/min onto a conical pile. If the height of the pile is always twice the base radius, at what rate is the height increasing when the pile is 8 m high?

   \[ V = \frac{1}{3} \pi r^2 h \]
   \[ h = 2r \]
   \[ \frac{dV}{dt} = \frac{\pi}{12} \cdot 3 h^2 \frac{dh}{dt} \]
   \[ \frac{dV}{dt} = \frac{\pi}{4} h^2 \frac{dh}{dt} \]
   \[ 10 = \frac{\pi}{4} (8)^2 \frac{dh}{dt} \]
   \[ \frac{dh}{dt} = \frac{100}{64 \pi} \text{ m/min} \]

   The height is increasing at a rate of \( \frac{5}{64 \pi} \text{ m/min} \).