Show all work. Answers given with incomplete reasoning will not receive full credit.

**Question 1 (2 points)** Sketch a graph of a velocity function \( v(t) \) defined for \( 0 \leq t \leq 4 \) for a moving particle starting from rest such that both of the following conditions are satisfied:

(a) The particle is speeding up when \( 0 < t < \frac{3}{2} \)

(b) The particle is slowing down when \( 2 < t < 4 \)

Let \( a(t) \) be acceleration. Then \( a(t) = v'(t) \).

One possibility:

\( a(t) > 0 \) for \( 0 < t < \frac{3}{2} \)

\( a(t) < 0 \) for \( 2 < t < 4 \)

Thus:

\[
A(t) = \frac{\pi}{2} (4t)^2 = 16\pi t^2
\]

So, \( A'(t) = 32\pi t \) and \( A'(5) = 32\pi (5) = 160\pi \text{ m}^2/\text{s} \)

**Question 2 (2 points)** A ball is dropped into a pool, creating a circular ripple that travels outward at a speed of 4 m/s. Find the rate at which the area within the circle is increasing after 5 seconds.

Let \( t = \text{time} \). Then \( r(t) = 4t \)

Thus, \( A(t) = \pi [r(t)]^2 = \pi (4t)^2 = 16\pi t^2 \)

So, \( A'(t) = 32\pi t \) and \( A'(5) = 160\pi \text{ m}^2/\text{s} \)
Question 3 (2 points) The area of a circle is increasing at a rate of 5 cm$^2$/s. When the radius is 2 cm, how fast is the radius of the circle increasing?

**Picture:**

$$A = \pi r^2, \quad \frac{dA}{dt} = 2\pi r \frac{dr}{dt} \quad \text{(1)}$$

we have $\frac{dA}{dt} = 5$, so when $r = 2$, we have

$$5 = \frac{dA}{dt} = 2\pi (2) \frac{dr}{dt} = 4\pi \frac{dr}{dt}$$

$$\Rightarrow \frac{dr}{dt} = \frac{5}{4\pi} \text{ cm/s} \quad \text{(1)}$$