Related Rates Starter Pack Solutions

1. $V = \frac{4}{3}\pi r^3 \rightarrow V' = \frac{4}{3}\pi(3r^2r') \rightarrow V' = 4\pi(r^2r') \rightarrow 72\pi = 4\pi(3^2r') \rightarrow$
$$72\pi = 36\pi r' \rightarrow r' = 2\ \frac{ft}{sec}$$

2. $d^2 = x^2 + y^2 \rightarrow d^2 = 3^2 + y^2 \rightarrow 2\,d\,d' = 2\,y\,y' \rightarrow d\,d' = y\,y'$
Now: when 4m above the ground **à** $d^2 = 3^2 + 4^2 = 25 \rightarrow d = 5\,m$
So: $d\,d' = y\,y' \rightarrow (5)(d') = (4)(-10) \rightarrow d' = -8\ \frac{m}{s}$
Not that the negative sign means the distance is decreasing with the speed of 8 m/sec.

3.
a) $v_{avg} = \frac{x(2)-x(0)}{2-0} = \frac{[2(4)-2+1]-[0-0+1]}{2-0} = \frac{7-1}{2} = 3\ \frac{m}{s}$
b) $v = 4t - 1 \rightarrow v(3) = 4(3) - 1 = 11\ \frac{m}{s}$

4.
$$V = \pi r^2 h \rightarrow V = \pi(3)^2 h = 9\pi h \rightarrow V' = 9\pi h' \rightarrow 50 = 9\pi h' \rightarrow h' = \frac{50}{9\pi}\ \frac{m}{s}$$
Note that we did not use h here. In a cylinder (with fixed radius) the height changes at a fixed rate and does not matter how much water is in the cylinder (unlike the cone).

5.
$$A = \pi r^2 \rightarrow A' = \pi(2rr') \rightarrow 0.25 = \pi(2rr')$$
Now: when area is 10π it means: $10\pi = \pi r^2 \rightarrow r^2 = 10 \rightarrow r = \sqrt{10}\,m$
So: $0.25 = \pi(2rr') = \pi\left(2\sqrt{10}r'\right) \rightarrow r' = \frac{0.25}{2\pi\sqrt{10}} = \frac{1}{8\pi\sqrt{10}}\ \frac{m}{s}$

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