## **AP CALCULUS**

## **Module 5: Analyzing Problems in Context**

A maple tree is tapped by drilling a hole into the trunk and the sap is collected in a pail with base radius 5 inches as shown in the figure on the right. Let *h* be the height of the sap in the pail and let *r* be the upper radius of the sap collected, both measured in inches. The volume *V* of sap in the pail is changing at a rate of  $\frac{1}{20}$  cubic inches per minute. The volume *V* of a pail with base radius 5, height *h*, and upper radius *r* is  $V = \frac{\pi}{3} \cdot h \cdot (r^2 + 5r + 25)$ .

(a) Find an expression for  $\frac{dV}{dt}$  in terms of *r*, *h*, and their derivatives.



- (b) Suppose when h = 3, r = 8 and  $\frac{dr}{dt} = 2 \cdot \frac{dh}{dt}$ . Find  $\frac{dh}{dt}$  and explain the meaning of this answer in the context of the problem.
- (c) Suppose the pail is replaced by a circular cylinder, so that r = 5 is constant. Find  $\frac{dh}{dt}$ .

