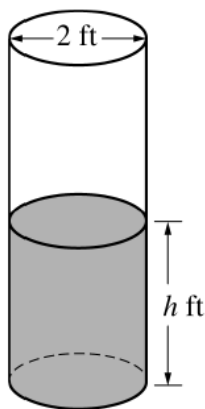


**2019 AP<sup>®</sup> CALCULUS AB FREE-RESPONSE QUESTIONS**



4. A cylindrical barrel with a diameter of 2 feet contains collected rainwater, as shown in the figure above. The water drains out through a valve (not shown) at the bottom of the barrel. The rate of change of the height  $h$  of the water in the barrel with respect to time  $t$  is modeled by  $\frac{dh}{dt} = -\frac{1}{10}\sqrt{h}$ , where  $h$  is measured in feet and  $t$  is measured in seconds. (The volume  $V$  of a cylinder with radius  $r$  and height  $h$  is  $V = \pi r^2 h$ .)
- (a) Find the rate of change of the volume of water in the barrel with respect to time when the height of the water is 4 feet. Indicate units of measure.
- (b) When the height of the water is 3 feet, is the rate of change of the height of the water with respect to time increasing or decreasing? Explain your reasoning.
- (c) At time  $t = 0$  seconds, the height of the water is 5 feet. Use separation of variables to find an expression for  $h$  in terms of  $t$ .
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