

**AP<sup>®</sup> CALCULUS AB/CALCULUS BC  
2017 SCORING GUIDELINES**

**Question 4**

(a)  $H'(0) = -\frac{1}{4}(91 - 27) = -16$   
 $H(0) = 91$

An equation for the tangent line is  $y = 91 - 16t$ .

The internal temperature of the potato at time  $t = 3$  minutes is approximately  $91 - 16 \cdot 3 = 43$  degrees Celsius.

(b)  $\frac{d^2H}{dt^2} = -\frac{1}{4} \frac{dH}{dt} = \left(-\frac{1}{4}\right)\left(-\frac{1}{4}\right)(H - 27) = \frac{1}{16}(H - 27)$

$$H > 27 \text{ for } t > 0 \Rightarrow \frac{d^2H}{dt^2} = \frac{1}{16}(H - 27) > 0 \text{ for } t > 0$$

Therefore, the graph of  $H$  is concave up for  $t > 0$ . Thus, the answer in part (a) is an underestimate.

(c)  $\frac{dG}{(G - 27)^{2/3}} = -dt$

$$\int \frac{dG}{(G - 27)^{2/3}} = \int (-1) dt$$

$$3(G - 27)^{1/3} = -t + C$$

$$3(91 - 27)^{1/3} = 0 + C \Rightarrow C = 12$$

$$3(G - 27)^{1/3} = 12 - t$$

$$G(t) = 27 + \left(\frac{12 - t}{3}\right)^3 \text{ for } 0 \leq t < 10$$

The internal temperature of the potato at time  $t = 3$  minutes is

$$27 + \left(\frac{12 - 3}{3}\right)^3 = 54 \text{ degrees Celsius.}$$

3 :  $\left\{ \begin{array}{l} 1 : \text{slope} \\ 1 : \text{tangent line} \\ 1 : \text{approximation} \end{array} \right.$

1 : underestimate with reason

5 :  $\left\{ \begin{array}{l} 1 : \text{separation of variables} \\ 1 : \text{antiderivatives} \\ 1 : \text{constant of integration and} \\ \quad \text{uses initial condition} \\ 1 : \text{equation involving } G \text{ and } t \\ 1 : G(t) \text{ and } G(3) \end{array} \right.$

Note: max 2/5 [1-1-0-0-0] if no constant of integration

Note: 0/5 if no separation of variables