2. [5 points] Let

$$Q(r) = 1 + r^{\ln(r)}.$$

Use the limit definition of the derivative to write an explicit expression for $Q'(5)$. *Your answer should not involve the letter Q. Do not attempt to evaluate or simplify the limit.* Please write your final answer in the answer box provided below.

Answer: $Q'(5) =$ $\lim_{h\to 0} \dfrac{1 + (5+h)^{\ln(5+h)} - \left(1 + 5^{\ln(5)}\right)}{h}$

3. [11 points] Inga, a beekeeper, sets up a new hive on April 1. At two later times, she estimates the hive's population. These estimates are shown in the table below.

weeks after April 1	2	5
population of the hive, in thousands	7.7	10.9

a. [2 points] Find a formula for a linear function $L(t)$ modeling the hive's population, in thousands, t weeks after April 1.

Answer: $L(t) =$ $\dfrac{16}{15}(t-2) + 7.7$

b. [4 points] Find a formula for an exponential function $E(t)$ modeling the the hive's population, in thousands, t weeks after April 1.

Solution: Since $E(2) = 7.7$ and $E(5) = 10.9$ and we know $E(t) = ab^t$ for some a and b,

$$10.9 = ab^5$$
$$7.7 = ab^2$$
$$\frac{10.9}{7.7} = b^3$$
$$b = \left(\frac{10.9}{7.7}\right)^{1/3} \approx 1.1228 \text{ and } a = \frac{7.7}{b^2} = \frac{7.7}{\left(\frac{10.9}{7.7}\right)^{2/3}} \approx 6.1076.$$

Then $E(t) = \dfrac{7.7}{\left(\frac{10.9}{7.7}\right)^{2/3}} \left(\frac{10.9}{7.7}\right)^{t/3} \approx 6.1076(1.1228)^t.$

This problem continues on the next page.

