MA 160
Section 1.6, Logarithmic Functions

1. Your local plumber charges a flat fee of $50 plus an additional charge of $30 per hour.

a) Write an equation to represent your plumber's charges *C* as a function of time *t* in hours.

b) Use your model to determine the cost of hiring the plumber for 3.5 hours. Fractions of hours are NOT rounded. For instance, the plumber will charge an additional $15 for an extra 30 minutes.

c) If your bill is $170, how many hours did the plumber work? Show your algebra.

d) If your bill is $117.50, how many hours did the plumber work? Show your algebra.

2. A bacteria culture starts with 200 bacteria and triples in size every hour.

a) Complete the following table.

t hours	N Population at time t (pattern)	N Population at time t (calculated population)
0	200×3^0	
1	200×3^1	
2	200×3^2	
3	200×3^3	
4	200×3^4	
. . .	. . .	. . .
t		

b) Write down the model: an equation to represent the population N as a function of time t in hours.

c) Use your model to determine the population of bacteria after 10 hours. Show your substitution.

d) Use your model to determine the population of bacteria after 3.5 hours. Show your substitution.

e) Use your model to determine the number of hours required for the bacteria to reach a population of 5.4 thousand. Justify your answer.

f) Use your model to determine the number of hours required for the bacteria to reach a population of 437.4 thousand. Justify your answer.

g) Use your model to determine the number of hours required for the bacteria to reach a population of 3 thousand. Justify your answer. If you cannot solve for the number of hours using algebra, use your calculator to estimate the answer.

3. Part g) of question #2 (the bacterial problem) required you to solve the equation $3000 = 200 \cdot 3^t$. Use your calculator and the formula $\log_a b = c \Leftrightarrow a^c = b$ found in the blue box on p. 64 of your text to solve the following similar equations as well as the bacteria problem:

a) $6^x = 290$

b) $10^t = 810$

c) $1000 = 25 \cdot 3^t$

d) $3000 = 200 \cdot 3^t$

e) $e^t = 1000$

4. Because logarithms allow you to solve exponential equations, the rules of logarithms are based on the rules of exponents. Match each rule of logarithms from the left column with a corresponding rule of exponents from the right column.

i) $\ln\left(\frac{x}{y}\right) = \ln\ x - \ln\ y$

ii) $\ln\ x \cdot y = \ln\ x + \ln\ y$

iii) $\ln\ x^2 = 2 \cdot \ln(x)$

iv) $\ln\ x^r = r \ln\ x$

a) $a^x a^y = a^{x+y}$

b) $a^{x\ 2} = a^{2x}$

c) $a^{x\ r} = a^{x \cdot r} = a^{r \cdot x} = a^{r\ x}$

c) $\frac{a^x}{a^y} = a^{x-y}$