MATH 1030-005, Quiz 6 Solution **Fall 2013**

1. **(4 pts)** Suppose your pet dog weighed 2.5 pounds at birth, and weighed 15 pounds after one year. Based on these two data points find a linear function that describes how weight varies with age.

   First we find the slope, m, by using the two points. Let $p_1 = (0, 2.5)$ and $p_2 = (1, 15)$. Then

   $$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{15 - 2.5}{1 - 0} = 12.5.$$

   Now we use one of the two points in $y = b + 12.5x$ to solve for b:

   $$2.5 = b + 12.5 \cdot 0 \Rightarrow b = 2.5.$$

   Finally, we put all the info together to obtain

   $$y = 2.5 + 12.5x.$$

2. **(4 pts)** A snowplow has a maximum speed of 40 miles per hour on a dry highway. Its maximum speed decreases by 1.1 miles per hour for every inch of snow on the highway. Write an equation for the linear function to model the situation described.

   The rate of change is -1.1 mph per inch of snow; that is $m = \dfrac{\Delta y}{\Delta x} = \dfrac{speed}{snow\ depth}$, which tells us that the independent variable, x, is the snow-depth, while the dependent variable, y, is the snowplow's speed. Now we're ready to write the linear equation:

   $$y = 40 - 1.1x.$$

3. **(4 pts)** The population of a town with an initial population of 60,000 grows at a rate of 2.5% per year. Create an exponential function to model the situation described.

   $$Q = Q_0(1 + r)^t \Rightarrow Q = 60,000(1 + 0.025)^t = 60,000 \cdot 1.025^t.$$

4. **(4 pts)** The doubling time of a population of fruit flies is 8 hours. By what factor does the population increase in one week?

$$2^{t/T_d} = 2^{(24\cdot 7)/8} = 2^{168/8} = 2^{21} = 2.097 \cdot 10^6.$$

5. **(Extra Credit: 4 pts)** Solve for x in $12^{x/4} = 1,000$. *(Hint:* $\log_{10} a^b = b \cdot \log_{10} a$.*)*

$$\begin{aligned} 12^{x/4} &= 1,000 \\ \log_{10}\left(12^{x/4}\right) &= \log_{10}\left(10^3\right) \\ \frac{x}{4} \cdot \log_{10} 12 &= 3 \\ x &= 4 \cdot \frac{3}{\log_{10} 12} \\ x &= 11.12. \end{aligned}$$