1. State whether the growth (or decay) is linear or exponential, and answer the associated question.

(a) The population of Winesburg is increasing at a rate of 3% per year. If the population is 75,000 today, what will it be in three years? (2 pts)

This is an exponential growth, and

\[ \text{population in 3 yrs} = 75,000 \times \left(1 + \frac{3}{100}\right)^3 = 81,955. \]

(b) The price of a gallon of gasoline is increasing by 3 cents per week. If the price is $3.10 today, what will it be in 10 weeks? (2 pts)

This is a linear growth, and

\[ \text{price in 10 weeks} = 3.10 + \frac{0.03}{\text{week}} \times 10 \text{ weeks} = 3.40. \]

(c) The value of your car is decreasing by 10% per year. If the car is worth $12,000 today, what will it be worth in five years? (2 pts)

This is an exponential decay, an

\[ \text{value in 5 yrs} = 12,000 \times \left(1 - \frac{10}{100}\right)^5 = 7,086. \]

2. You are given one magic penny that becomes 2 magic pennies over night. So after one day you’ll have 2, after two days 4, after three days 8, and so on. How much money will you have after 22 days? (4 pts)

\[ \text{money in 22 days} = 0.01 \times 2^{22} = 41,943.04. \]

3. Draw a set of axes in the coordinate plane. Plot and label the following points:

\( (1, 5), (-2, 0), (5, -2), (-6, -3). \) (4 pts)
4. 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 weighed varies with age. Use this model to predict the dog’s weight at 5 and 10 years of age. How realistic is this model? (4 pts)

The two points are \((0, 2.5)\) and \((1, 15)\), so the slope of our equation is

\[
m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{15 - 2.5}{1 - 0} = 12.5.
\]

Now we use this information and the first point to solve for \(b\):

\[
y = b + mx \\
2.5 = b + 12.5 \times 0 \\
2.5 = b.
\]

So, finally, the equation is \(y = 2.5 + 12.5x\). To find what the dog’s weight is going to be at age 5 and 10 we simply plug these for \(x\):

\[
y = 2.5 + 12.5 \times 5 = 65,
\]

so the dog will weigh 65 pounds when 5 years old. Similarly,

\[
y = 2.5 + 12.5 \times 10 = 127.5,
\]

so it will weigh 127.5 pounds when 10 years old. The model is not realistic because most dogs would grow faster (hence, gain weight faster) early in life.

5. A $1,200 washing machine in a laundromat is depreciated for tax purposes at a rate of $75 per year. Find a function for the depreciated value of the washing machine as it varies with time. When does the depreciated value reach $0? (Extra Credit: 4 pts)

The general formula for a linear equation is \(y = b + mx\), and in our situation this becomes \(y = 1200 - 75x\). So,

\[
0 = 1200 - 75x \\
75x = 1200 \\
x = \frac{1200}{75} = 16.
\]

Therefore, in 16 years the value of the washing machine will depreciate to $0.