Lesson 16: Applying Exponential Equations Date:

(A) Lesson Objectives:

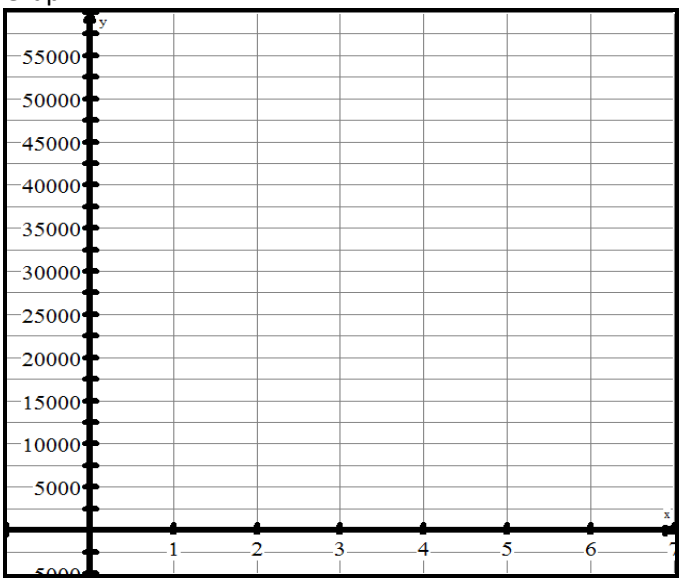
a. Review Multiple Representations & Apply to Exponential Equations
b. Apply Exponential Equations to Real World Applications
c. Graph Exponential Equations

(B) Review of the General Exponential Equation:

(C) Example #1

Mr. Santowski has been given a new job contract. He will earn $40,000 per year and get a yearly pay raise of 6% of his previous year's salary.

Graph:



DEFINE YOUR VARIABLES, then complete the tables

X ➔

Y ➔

Data Table:

x						
y						

(a) Write an equation for Mr. S's salary.

(b) What does the y-intercept represent?

(c) What would my salary be in 8 years?

(d) After how many years would my salary be $70,000?

(e) What assumption are you making as you answer Qc,d?

Lesson 16: Applying Exponential Equations Date:

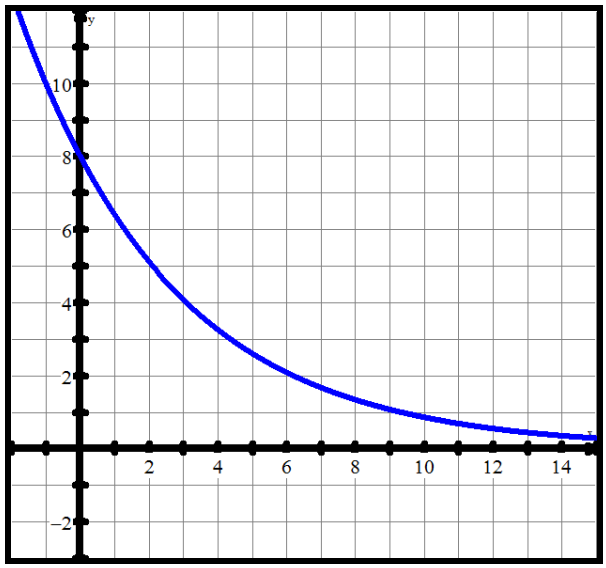
(D) Example #2

Mr. S. owns a 2007 Starex van. I bought it in Oct of 2009 and I paid 800,000 php. The van unfortunately depreciates in value by 20% every year

Data Table: (Define variables first)

x										
y										

Graph:



Equation:

Y-intercept:

Questions:

a. Determine the value of the car today.

b. Can you determine the value of the van if x = -2. What might the x- and y- values mean?

c. Write an equation that will help you to determine the value of x if y = 5. Explain how you solved this equation.

d. You are making an assumption as you work through these questions. What might the assumption be?

(E) A bacteria culture grows according to the formula $N = 12000(2)^{\frac{t}{4}}$ where *t* is in hours.

a. How many bacteria are present at the beginning of the experiment?
b. How many bacteria are present after 12 hours?
c. How many bacteria are present after 1 day?
d. How long would it take to before you have 1,500,000 bacteria?

(F) A sodium isotope, Na^{24}, has a half-life of 15 hours. The isotope decays exponentially according to the formula $A = 4\left(\frac{1}{2}\right)^{\frac{t}{15}}$ Determine the amount of sodium that remains from a 4 g sample after:

a. (i) 45 hours (ii) 100 hours (iii) 5 days
b. How long will it take before you are down to 1% of the original amount remaining?

(G) A cup of coffee contains approximately 96 mg of caffeine. When you drink the coffee, the caffeine is absorbed into the bloodstream and is eventually metabolized by the body. Every 5 hours the amount of caffeine present in the body is reduced by one-half.

a. How many hours does it take for the amount of caffeine to be reduced to 12 mg?
b. How many hours does it take for the amount of caffeine to be reduced to 1 mg?
c. If I drink another cup of coffee 12 hours after my first cup, how much caffeine do I now have in my blood?
d. If I then go to sleep (or try to) 4 hours after my second cup, how much caffeine is in my blood?

(H) The 50 cent Bluenose is one of Canada's most famous postage stamps. In 1930 it could be bought at the post office for $0.50. In 2000, a stamp in excellent condition was sold at an auction for $512. Determine the doubling time for the stamp's value.

(I) Over the last several years there has been an increase in the amount of school age children carrying cell phones. Current estimates are that there are 1,237,000 students in the US with cell phones. The trend is likely to continue, with the amount of children with phones tripling every 10 years. At that rate, how many students will have cell phones in . . .

a) 2015 b) 2100 c) two years

(J) 9. Coal was once a booming industry in central Pennsylvania. However, the industry has begun to decline. In the year 1950 about 600,000 were employed in the local coalmines. Since then the number of coalminers has declined by 5% every 6 years. How many coal workers were/will be employed in the year . . .

a) 1962 b) 2010 c) 1971

Resources

(K) http://regentsprep.org/REgents/math/ALGEBRA/AE7/ExpDecayL.htm
(L) http://regentsprep.org/Regents/math/ALGEBRA/AE7/ExpDecayP.htm
(M) http://www.youtube.com/watch?v=m5Tf6vgoJtQ
(N) http://www.onlinemathlearning.com/exponential-growth-decay.html
(O) http://hotmath.com/help/gt/genericalg1/section_9_6.html

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Explorations: Starting with an Equation

Equation #1 ➔ $P = 100(2)^t$.

Equation #2 ➔ $P = 1800(2/3)^t$.

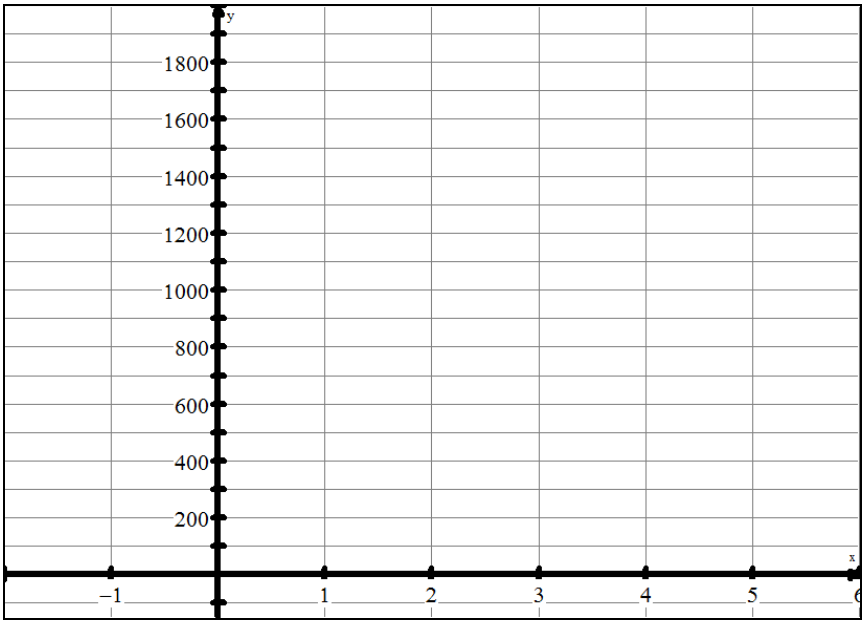
Data Table #1:

t										
P										

Data Table #2:

t										
P										

Graph:



Equation #1 might represent:

Y-intercept #1 might represent:

Equation #2 might represent:

Y-intercept #2 might represent:

Questions: Some exponential equations are used to model EXPONENTIAL GROWTH, while other equations are used to model EXPONENTIAL DECAY.

a. From these exercises in the lesson, explain what EXPONENTIAL GROWTH might mean.

b. From these exercises in the lesson, explain how an EQUATION shows EXPONENTIAL GROWTH is occurring.

c. From these exercises in the lesson, explain how a DATA TABLE shows EXPONENTIAL GROWTH is occurring.

d. From these exercises in the lesson, explain how a GRAPH shows EXPONENTIAL GROWTH is occurring.

e. From these exercises in the lesson, explain what EXPONENTIAL DECAY might mean.

f. From these exercises in the lesson, explain how an EQUATION shows EXPONENTIAL DECAY is occurring.

g. From these exercises in the lesson, explain how a DATA TABLE shows EXPONENTIAL DECAY is occurring.

h. From these exercises in the lesson, explain how a GRAPH shows EXPONENTIAL DECAY is occurring.