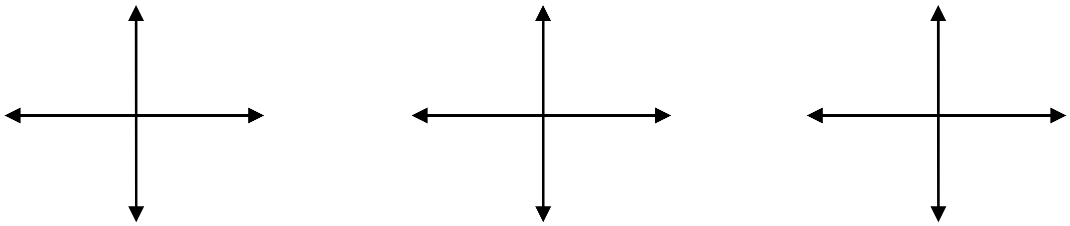
Write your questions and thoughts here!

9.2 – Exponential Decay

Name:______________________

RECALL: What is an exponential function?

Today, we will focus on exponential functions that _______ towards the asymptote as you move left to right.



Write down two examples of real-world application where exponential decay functions occur. (I give several examples in the video!)

1.

2.

How do you know if $\boldsymbol{y = a(b)^x}$ represents an exponential growth or exponential decay function?

Exponential _________ if

Exponential _________ if

Identify if following functions are exponential *growth* or *decay*.

a. $y = 2(3)^x$

b. $y = 3(0.2)^x$

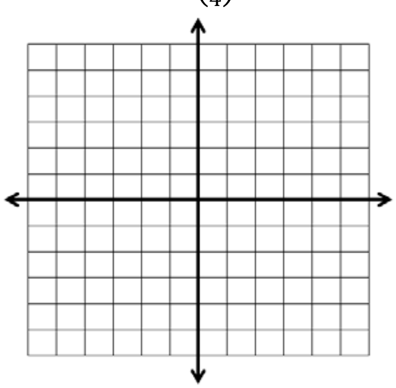
c. $y = -0.4\left(\frac{1}{2}\right)^x$

d. $y = -0.8\left(\frac{5}{4}\right)^x$

e. $y = 1000(5)^{-x}$

f. $y = 0.4\left(\frac{7}{10}\right)^{-x}$

1. Graph $y = 3\left(\frac{3}{4}\right)^x$



x	y

Domain:

Range:

Write your questions and thoughts here!

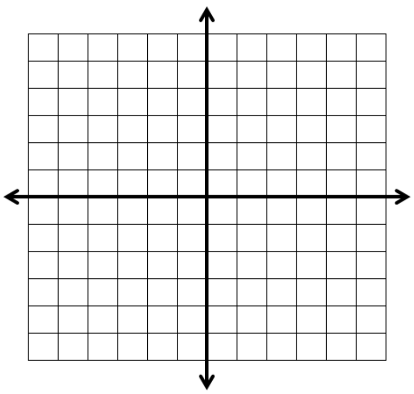
9.2 – Exponential Decay

For exponential functions that are in the form $y = a(b)^x$, the graph will go through:

$$(0, a), (1, ab), \text{ and } (-1, \qquad\qquad)$$

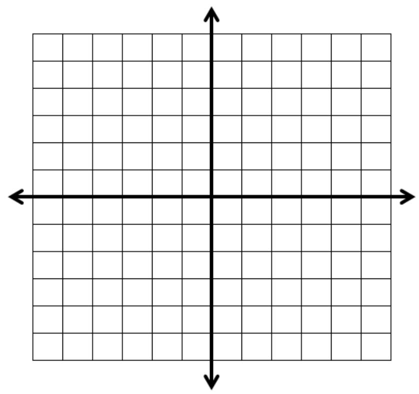
and have an asymptote on the x-axis (that's the line $y = 0$).

2. Graph $y =$



Domain: Range:

3. Graph $y = -2\left(\frac{1}{4}\right)^{x-1} + 3$



Domain: Range:

TRANSLATIONS

$$y = ab^{x-h} + k$$

To graph the function above, sketch the graph of $y = a(b)^x$, then translate the graph horizontally (left/right) by ***h*** units and vertically (up/down) by ***k*** units.

Growth & Decay Models (% increase, % decrease)

Percent increase: $y = a(1 \qquad)^t$

Percent decrease: $y = a(1 \qquad)^t$

a = ***r*** = % increase (or decrease) $t =$

Give the **percent *increase*** or **percent *decrease*** for each equation.

4. $y = 37(3)^x$
5. $y = 1.08(0.925)^x$
6. $y =$
7. $y =$

Now summarize what you learned!

9.2 Practice – Exponential Decay

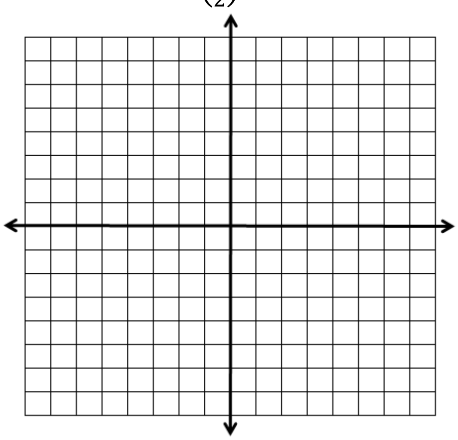
Name: ___________________________

Tell whether the equation represents an exponential **growth** or an exponential **decay** function.

1. $y = -2(3.2)^x$
2. $y = 5\left(\frac{1}{3}\right)^x$
3. $y = 6\left(\frac{5}{3}\right)^x$
4. $y = -3\left(\frac{1}{9}\right)^{-x}$
5. $y = 8(4)^{-x}$
6. $y = 3(0.2)^x$
7. $y = -\frac{1}{2}(6.3)^x$
8. $y = 12(0.8)^{-x}$
9. $y = 0.4\left(\frac{121}{120}\right)^{-x}$
10. $y = -4\left(\frac{5}{6}\right)^x$
11. $y = \frac{5}{6}\left(\frac{1}{3}\right)^{-x}$
12. $y = 2(10)^{-x}$

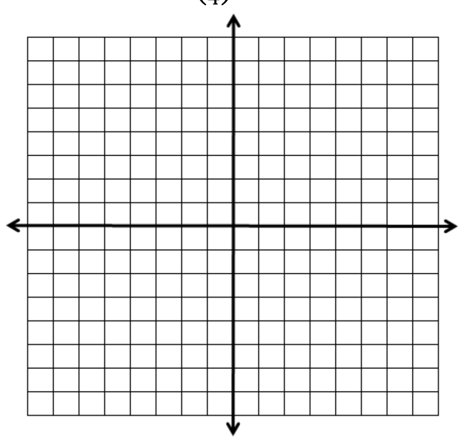
Sketch the graph of each exponential function by doing the following: Sketch the asymptote, label at least **<u>two distinct coordinate points</u>** on each graph, and write the domain and range of each function.

13. $y = 3\left(\frac{1}{2}\right)^x$



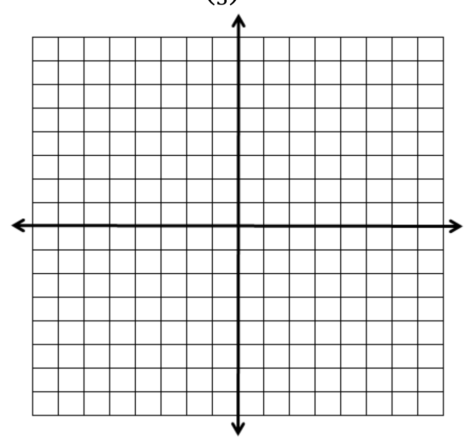
Domain: Range:

14. $y = -2\left(\frac{1}{4}\right)^x$



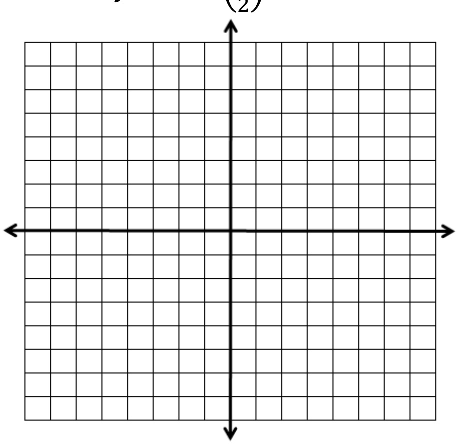
Domain: Range:

15. $y = 4\left(\frac{1}{3}\right)^x - 5$



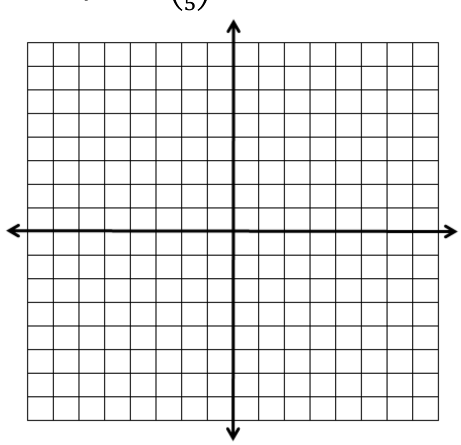
Domain: Range:

16. $y = -3\left(\frac{1}{2}\right)^{x-4}$



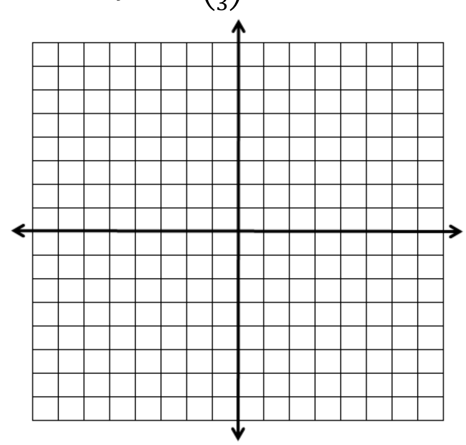
Domain: Range:

17. $y = 2\left(\frac{1}{5}\right)^{x+3} - 2$



Domain: Range:

18. $y = 3\left(\frac{1}{3}\right)^{x-3} - 4$



Domain: Range:

Give the **percent *increase*** or **percent *decrease*** for each equation.

19. $y = 50(2)^x$

21. $y = 1.25(0.95)^x$

22. $y = 0.9(0.8)^x$

23. $y = 3(3.4)^x$

24. $y = 10(0.855)^x$

25. $y = 30(10)^x$

26. $y = 0.5(1.23)^x$

27. $y = 1.3(0.005)^x$

28. $y = 2(1.3)^x$

29. $y = 1.5(0.45)^x$

30. $y = 0.5(0.3)^x$

31. $y = 1.3(4.075)^x$

For each scenario, write an exponential model in function notation. Choose variables that would make sense for the problem. (There are no "correct" variables, but try to have them fit.)

32. A car that is worth $25,000, decreases in value by 15% per year.

33. Mr. Brust's IQ is currently 173, but it is decaying at a rate of 4.5% every year.

34. A plague of mice has hit Australia again! Starting with only 30 mice, they can increase by 650% every month.

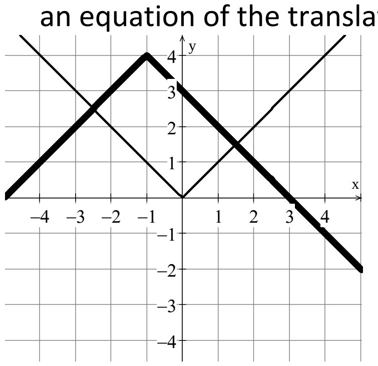
35. There are 2,300 counts of bacteria in a Petri dish. Its total count increases by 168% per day.

36. During a Cleveland Brown's game, Sully's blood pressure rises 7.8% each quarter. At kickoff, his systolic blood pressure is 120.

37. Mr. Bean's yard is getting overrun with weeds. The first year he bought his home, there was 1800 square feet of grass. It is decreasing by 16.1% per year.

Algebra Skillz:

1. Below are graphs of $f(x) = |x|$ (thin line) and its translation (bold line). Write an equation of the translation.



Simplify the fraction by rationalizing the denominator.

2. $\frac{3}{\sqrt{2}}$

3. $\frac{15}{4\sqrt{5}}$

Solve by factoring.

4. $2x^3 - 4x^2 - 126x = 0$

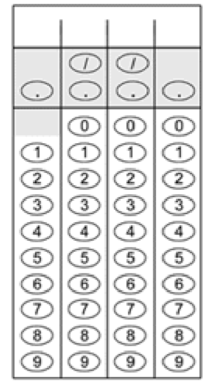
5. $30x^2 - 17x - 2 = 0$

SAT Prep:

1. Simplify: $(4^{3-x})^{2x}$

(A) $(4)^{3+x}$
(B) $(4)^{6x-2x^2}$
(C) $(8)^{3x-x^2}$
(D) $(16)^3$

2. If $f(x) = 6(2)^{4-2x} + 2$, find $f(3)$.



9.2 Application and Extension

1. Write down three coordinate points for the graph of $f(x) = -3\left(\frac{3}{5}\right)^{x-9} + 72$

2. The amount of toxic fumes (measured in Odor Units or *OU*) left in Mr. Bean's car after Mr. Kelly plays basketball can be modeled by

$$\boldsymbol{f(h) = 2000(0.87)^h}$$

where $\boldsymbol{h}$ is the number of hours since Mr. Kelly gets out of the car. The dude really reeks!

   a. How many fumes are there when Mr. Kelly gets out of the car?

   b. What is the percent increase/decrease of the fumes?

3. The number of mosquitos at a lake where the time is measured in days is modeled by the equation:

$$\boldsymbol{m(d) = 1000(4.25)^d}$$

   a. How many mosquitos are at the lake when the initial count was taken?

   b. What is the percent increase/decrease of the mosquito population every day?

   c. If this rate continues, how many mosquitos will there be 10 days from now.

4. Mr. Sullivan bought a new trailer for a lot at his favorite trailer park. It cost him \$35,000. Unfortunately, it depreciates in value by 6.5% per year.

   a. Write a model for the value of the trailer home.

   b. How much will the trailer home be worth in 13 years?

   c. Use a graphing calculator to determine how many years it will take before the trailer home is worth \$6,000?

5. When a plant or animal dies, it stops acquiring carbon-14 from the atmosphere. Carbon-14 decays over time with a half-life of about 5730 years. (This means it takes 5730 years to lose half of its carbon-14.) The percent $\boldsymbol{P}$ of the original amount of carbon-14 that remains in a sample after $\boldsymbol{t}$ years is given by this equation: $\boldsymbol{P(t) = 100\left(\frac{1}{2}\right)^{t/5730}}$

   a. What percent of the original carbon-14 remains in a sample after 2,000 years? 4,000 years? 20,000 years?

   b. An archaeologist found a bison bone that contained about 41% of the carbon-14 present when the bison died. Use a graphing calculator to determine the age of the bone when it was found.