Name: ______________________

1. In 2006, the cost of a particular piece of computer equipment was \$110 and going down at a rate of 6% per year. Assuming this percentage remains constant, what is the formula for C, the cost of this equipment in dollars, as a function of t, the number of years since 2006?

   A) $C = 110(0.94)^t$
   B) $C = 110(-1.06)^t$
   C) $C = 110(0.06)^t$
   D) $C = 110(-0.94)^t$

   $C = 110(.94)^t$

2. A population is 160,000 in year $t = 0$ and declines at a continuous rate of 2% per year. By what percentage does the population decrease each year? Round to 2 decimal places.

   $P = 160{,}000e^{-.02t}$ $\quad e^{-.02(1)} = .980198$

   $1 - .980198$

   $.019801 = \boxed{1.98\%}$

3. The populations of 4 species of animals are given by the following equations:

   $P_1 = 870(0.85)^t$ $\quad P_2 = 400(1.19)^t$ $\quad P_3 = 460(0.93)^t$ $\quad P_4 = 610(1.05)^t$

   What is the annual percent growth rate for the population that is shrinking the fastest?

   -15%

4. A quantity decreased from 25 to 21. By what percentage did it decrease?

   $\frac{4}{25} = \boxed{16\%}$

5. A store's sales of cassette tapes of music decreased by 9% per year over a period of 4 years. By what total percent did sales of cassette tapes decrease over this time period? Round to 1 decimal place.

   $A = ab^x$

   $= a(.91)^4$

   $A = .6857a$

   $\Rightarrow 1 - .6857 = .314 = \boxed{31.4\%}$

6. A radioactive substance decays by 13% every year. Which of the following is the formula for the quantity, Q, of a 30 gram sample remaining after t years?

A) $Q = 30(0.87)^t$

B) $Q = 30(1.13)^t$

C) $Q = 30(-1.13)^t$

D) $Q = 30(-0.87)^t$

$Q = 30(.87)^t$

7. In the exponential formula $Q = 5600(1.33)^t$, if $Q = a(1+r)^t$ then $r =$ 33 %.

8. The number of books in a library tends to increase by the same amount each year. Should a linear or an exponential function be used to model this scenario? LINEAR

9. The following table gives values from an exponential or a linear function. Determine which, and find values for a and b so that $f(x) = a + bx$ if the function is linear, or $f(x) = a(b)^x$ if the function is exponential.

$a =$ 1, $b =$ .856.

x	$f(x)$
0	1.000
1	1.856
2	2.712
3	3.568
4	4.424

+.856
+.856
+.856
+.856

y-int

$f(x) = .856x + 1$

Q 10. A population has size 3100 at time $t = 0$, with t in years. If the population grows by 50 people per year, what is the formula for P, the population at time t?

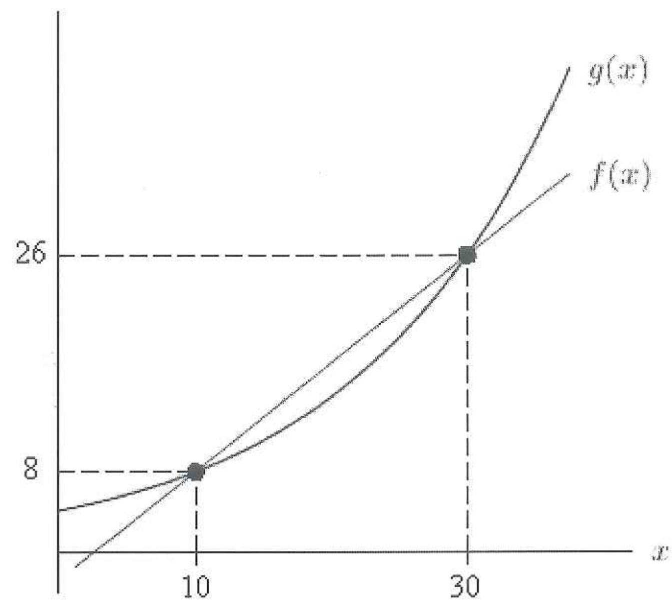
A) $P = 3100(1.5)t$

B) $P = 3100 + 50t$

C) $P = 3100(0.5)^t$

D) $P = 3100(1.5)^t$

11. The following figure shows two functions, one linear and the other exponential. The formula for the linear one is $f(x) = \underline{-1} + \underline{.9}\,x$, and the formula for the exponential one is $g(x) = \underline{4.438}\,(\underline{1.061})^x$. Round the first two answers to 2 decimal places and the last two answers to 3 decimal places.



$(10,8)(30,26)$

$\frac{26-8}{30-10} = \frac{18}{20} = \frac{9}{10}$

$\boxed{f(x) = \frac{9}{10}x - 1}$

$y = mx + b$

$8 = (\frac{9}{10})(10) + b$

$8 = 9 + b$

$-1 = b$

$\frac{g(30)}{g(10)} = \frac{\cancel{a}b^{30}}{\cancel{a}b^{10}}$

$\frac{26}{8} = b^{20}$

$(\frac{13}{4})^{\frac{1}{20}} = b$

$1.0607 = b$

$g(10) = a(1.0607)^{10}$

$\frac{8}{1.0607^{10}} = \frac{a(1.0607)^{10}}{1.0607^{10}}$

$4.438 = a$

(4.425)

$\boxed{g(x) = 4.438(1.061)^x}$

12. A biologist measures the amount of contaminant in a lake 6 hours after a chemical spill and again 12 hours after the spill. She sets up a possible model to determine Q, the amount of the chemical remaining in the lake as a function of t, the time in hours since the spill. The model assumes the contaminant is leaving the lake at a constant rate, which she determines to be 7 tons/hour. She estimates that the lake will be free from the contaminant 35 hours after the spill. How many tons of the contaminant were in the lake at the 6 hour reading?

$m = -7 \quad (35, 0)$

$0 = -7(35) + b$

$0 = -245 + b$

$+245 = b$

$y = -7x + 245$

$y = -7(6) + 245$

$= -42 + 245$

$\boxed{y = 203 \text{ tons}}$

13. The population of a city is increasing exponentially. In 2000, the city had a population of 25,000. In 2003, the population was 34,191. The formula for $P(t)$, the population of the town t years after 2000, is given by $P(t) = \underline{25{,}000}\,(\underline{1.110})^t$. Round your second answer to 3 decimal places.

$(0, 25{,}000)\ (3, 34{,}191)$

$\uparrow$

a

$P(3) = ab^3$

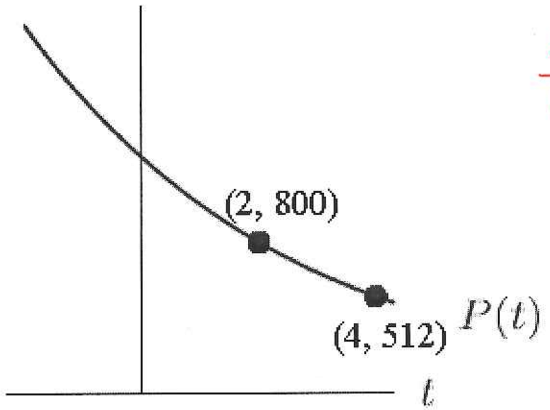
$\frac{34{,}191}{25{,}000} = \frac{25{,}000(b^3)}{25{,}000}$

$1.36764 = b^3$

$(1.36764)^{1/3} = b$

$b = 1.110$

14. The graph of the exponential function $P(t)$ is shown below. The formula for $P(t)$ must be $P(t) = \underline{1250}\ (\underline{.8})^t$.



$(2, 800)\ (4, 512)$

$\dfrac{P(4)}{P(2)} = \dfrac{\cancel{a}b^4}{\cancel{a}b^2}$

$\dfrac{512}{800} = b^2$

$.64 = b^2$

$(.64)^{\frac{1}{2}} = b$

$.8 = b$

$P(2) = ab^t$

$P(2) = a(.8)^2$

$\dfrac{800}{.64} = \dfrac{a(.64)}{.64}$

$1250 = a$

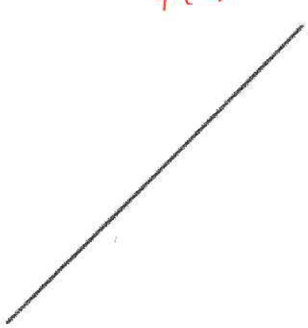
$P(t) = 1250(.8)^t$

15. Each of the functions in the table below is increasing, but each increases in a different way. One is linear, one is exponential, and one is neither.

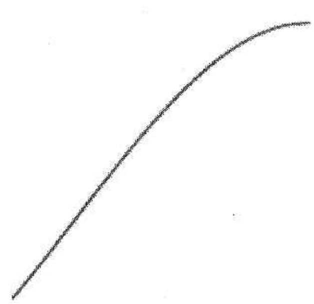
t	$f(t)$		$g(t)$		$h(t)$	
1	23.97	+1.9	21	+10	32.25	×1.29
2	25.87	+1.9	31	+9	41.60	×1.29
3	27.77	+1.9	40	+8	53.67	×1.29
4	29.67	+1.9	48	+7	69.23	×1.29
5	31.57	+1.9	55	+6	89.31	×1.29
6	33.47		61		115.21	
	Linear		Neither		Exponential	

The following three graphs correspond with the functions in the table. Match each graph to its function.

(a) $f(t)$



(b) $g(t)$



(c) $h(t)$

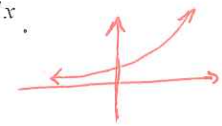
Q 16. The US population in 2005 was approximately 296.4 million. Assume the population increases at a rate of 1.24% per year. Some demographers believe that the ideal population of the United States is about 125 million. According to this model, in what year did this occur?

(Intersection) $125 = 296.4(1.0124)^t$ $t = -70.06$

$2005 - 70.06 = 1934.96$ (end of 1934) $\boxed{1934}$

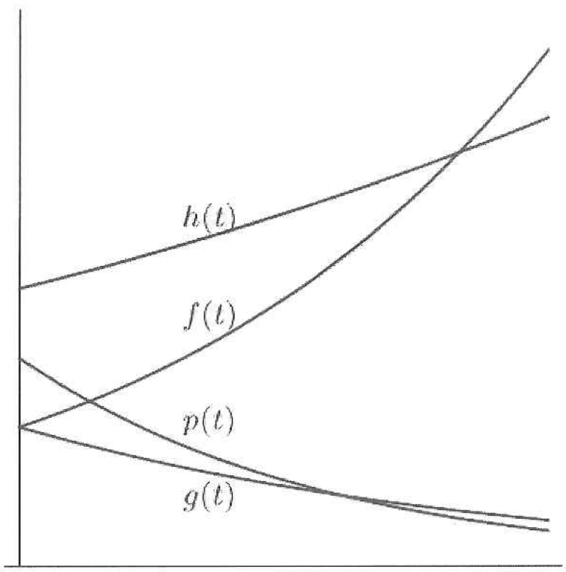
$-200 \le x \le 200$ $0 \le y \le 400$

17. Find $\lim_{x \to -\infty} 3.1e^{0.17x}$.



$\boxed{0}$

18. In the following figure, the functions *f*, *g*, *h*, and *p* can all be written in the form $y = ab^t$. Which one has the largest value for *a*?



h

19. The price of an item increases due to inflation. Let $p(t) = 52.50(1.028)^t$ give the price of the item as a function of time in years, with $t = 0$ in 2004. Estimate $p^{-1}(145)$ to 2 decimal places.

$145 = 52.50(1.028)^t$ (Intersection)

$t = \boxed{36.79 \text{ years}}$

20. The population of a city is increasing exponentially. In 2000, the city had a population of 65,000. In 2006, the population was 79,331. Let $P(t)$ be the population of the town t years after 2000. Use a graph of $P(t)$ to estimate the year in which the population will reach 250,000.

(0, 65,000) (6, 79,331)

$P(6) = 65{,}000 \cdot b^6$

$\frac{79{,}331}{65{,}000} = \frac{65{,}000\, b^6}{65{,}000}$

$(1.22048)^{1/6} = b$

$1.0338 = b$

$P(t) = 65{,}000(1.0338)^t$

$250{,}000 = 65{,}000(1.0338)^t$

$t = 40.52$ years

$2000 + 40.52 = 2040.52$

$\boxed{2040}$

$0 \le x \le 100$ $0 \le y \le 300{,}000$

21. Which bank has the best effective annual yield?

A) Bank 1 with a nominal rate of 6.5% compounded monthly.
B) Bank 2 with a nominal rate of 6.32% compounded weekly.
C) Bank 3 with a nominal rate of 6.6% compounded yearly.

$\left(1+\frac{.065}{12}\right)^{12}$ $\left(1+\frac{.0632}{52}\right)^{52}$ $\left(1+\frac{.066}{1}\right)^{1}$

1.06697 1.06520 1.066

6.697% 6.520% 6.6%

22. Suppose you would like to have $21,000 in 10 years. What is the minimum amount you need to deposit into a bank account earning 3% compounded daily to reach this goal?

$21,000 = a\left(1+\frac{.03}{365}\right)^{365 \cdot 10}$

$\frac{21,000}{1.349842166} = \frac{1.349842166a}{1.349842166}$

$\boxed{\$15,557.37 = a}$

23. Use the formula $V = 2200(1.01)^t$ to answer the following questions about the investment it describes. Units are dollars and years.

A) Is the investment increasing or decreasing? Increasing
B) What is the initial value of the investment? $2200
C) What is the effective annual rate of the account? 1%

24. Write a formula that gives the value of an investment which is initially worth $123,000 and loses value at a rate of 2.9% per year.

$f(t) = 123,000(.971)^t$

25. Kathleen opens a savings account with $1500. The account earns 3.2% annual interest compounded monthly. How much will be in the account after 13 years?

$f(13) = 1500\left(1+\frac{.032}{12}\right)^{13 \cdot 12}$

$= \boxed{\$2272.57}$

Q 26. How much interest is earned in an account yielding 4.1% annual interest compounded weekly if the initial investment is \$3500 and the money stays in the account for 20 years?

$A = 3500\left(1 + \frac{.041}{52}\right)^{52 \cdot 20}$

$A = \$7944.18$

$- \ 3500.00$

$\boxed{\$4444.18}$

27. An investment grows by 1.8% per year for 25 years. By what percent does it increase over the 25-year period? Give your answer correct to four decimal places.

$A = P(1.018)^{25}$

$A = P(1.562048)$

$\boxed{56.2048\%}$

28. An investment grows according to the formula $V = 2000e^{0.034t}$. How many years will it take for the original investment to quadruple? Round to 1 decimal place.

$\frac{8000}{2000} = \frac{2000e^{.034t}}{2000}$

$4 = e^{.034t}$ (Intersection)

$\boxed{t = 40.8 \text{ years}}$

29. The price of an item increases due to inflation. Let $p(t) = 2.50(1.041)^t$ give the price of the item as a function of time in years, with $t = 0$ in 2004. At what continuous annual rate is the price increasing? Round to 2 decimal places.

$e^{rt} = 1.041^t$

$(e^r)^t = (1.041)^t$

$e^r = 1.041$ (Intersect) $\boxed{4.02\%}$

$r = .04018$

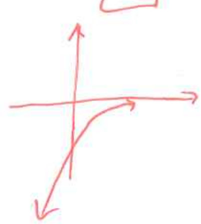
30. An ant population grows at a continuous growth rate of 11.2%. If the population starts with 24,000 ants, how many ants are there after 6 months? Round your answer to the nearest ant.

$P = 24{,}000(e)^{.112t}$

$P = 24{,}000(e)^{.112(.5)}$

$P = \boxed{25{,}382 \text{ ants}}$

31. What is $\lim_{x\to\infty} -5e^{-2x}$? $\boxed{0}$



$x = 5$ $\quad -5e^{-2(5)}$

$-5e^{-10}$

$\frac{-5}{e^{10}}$