

### 12.2 We Have Liftoff!-----Properties of Exponential Graphs

#### Vocabulary

1. Explain how the natural base  $e$  is similar to and different from  $\pi$ .

#### Problem Set

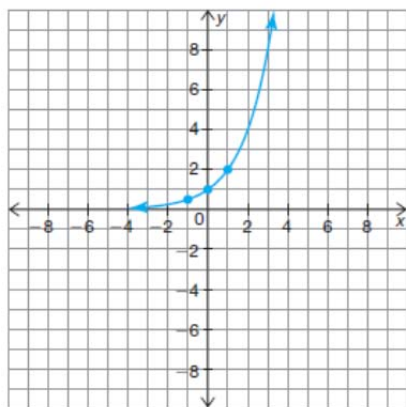
Identify each function as exponential “growth” or “decay.” Explain your reasoning.

2.  $f(x) = 8^x$  The function represents exponential growth because the base is greater than 1.
3.  $f(x) = 0.2^x$
4.  $f(x) = \left(\frac{5}{2}\right)^x$
5.  $f(x) = 25^x$
6.  $f(x) = \left(\frac{1}{6}\right)^x$
7.  $f(x) = 7.5^x$

Complete each table and graph the exponential function.

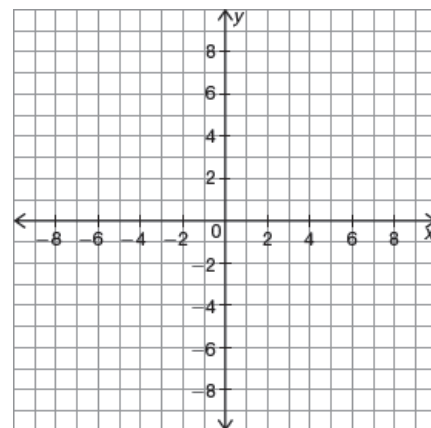
8.  $f(x) = 2^x$

$x$	$f(x)$
-1	$\frac{1}{2}$
0	1
1	2



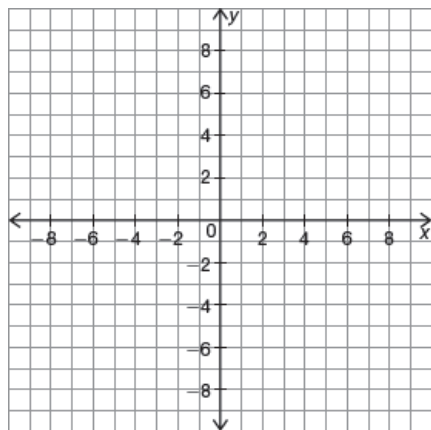
9.  $f(x) = \left(\frac{1}{2}\right)^x$

$x$	$f(x)$
-1	
0	
1	



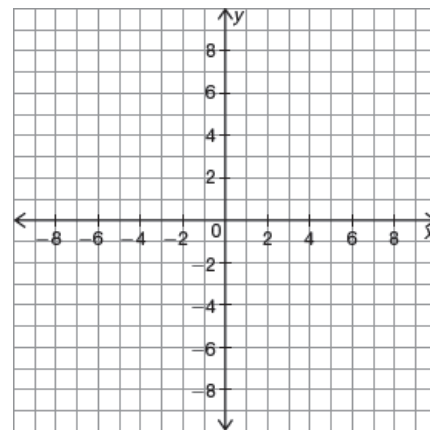
10.  $f(x) = \left(\frac{5}{4}\right)^x$

$x$	$f(x)$
-1	
0	
1	



11.  $f(x) = 0.3^x$

$x$	$f(x)$
-1	
0	
1	



Write an exponential function with the given characteristics.

12. increasing over  $(-\infty, \infty)$

reference point  $\left(-1, \frac{1}{9}\right)$

Answers will vary.

$f(x) = 9^x$

13. decreasing over  $(-\infty, \infty)$

reference point  $\left(1, \frac{2}{3}\right)$

14. increasing over  $(-\infty, \infty)$

reference point  $\left(-3, \frac{1}{8}\right)$

15. End behavior  $\lim_{x \rightarrow -\infty} f(x) = \infty$

and

$\lim_{x \rightarrow \infty} f(x) = 0$

reference point  $\left(-4, \frac{81}{16}\right)$

Use the formula for compound interest to determine the amount of money in each account after interest is accrued.

$$I(t) = P \left(1 + \frac{r}{n}\right)^{nt}$$

16. An investor deposits \$1,000 in an account that promises 5% interest calculated at the end of each year. How much will be in the account after seven years?

There will be \$1,407.10 in the account after seven years.

$$\begin{aligned} A(t) &= P \left(1 + \frac{r}{n}\right)^{nt} \\ A(7) &= 1,000 \left(1 + \frac{0.05}{1}\right)^{1 \cdot 7} \\ &= 1,000(1.05)^7 \\ &\approx 1,407.10 \end{aligned}$$

17. At the start of the school year, Fairview High School deposits PTA dues in an account that offers 3.5% compound interest at the end of a year. If \$2500 is collected in PTA dues, how much money will the school have at the start of the next school year?

18. Kyle put \$300 of his birthday money in the bank. The bank compounds interest twice a year at 4%. How much money will Kyle have after three years?

19. An investing group has \$50,000 to invest. They put the money in an account that compounds interest monthly at a rate 6%. How much money will the group have at the end of 10 years?

20. Interest is compounded quarterly at Money Bank at a rate of 5.5%. A new client opens an account with \$7200. How much money will be in the account at the end of six years?

21. Sasha wants to earn the maximum interest on her money. She decides to deposit \$50 in two different banks for 90 days (3 months) to compare them before she deposits all of her money. She finds a bank that compounds interest daily at 2.2% and another bank that compounds interest monthly at 4.8%. Which bank will earn her more money?

Use the formula for population growth to predict the population of each city.  $N(t) = N_0(e)^{rt}$

22. The population of Austin, Texas is growing 3.9% per year. If the population in 2010 was approximately 790,000, what is the predicted population for 2015? The population of Austin, Texas will be about 960,096 in 2015.

$$\begin{aligned} N(t) &= N_0 e^{rt} \\ N(5) &= 790,000 e^{(0.039 \cdot 5)} \\ &= 790,000 e^{0.195} \\ &\approx 960,096 \end{aligned}$$

23. The population of Boston, Massachusetts is growing at a rate of 1.8%. The population in 2013 was approximately 636,500. What is the predicted population for 2025?
24. The population of Charlotte, North Carolina in 2013 was approximately 775,000. If the rate of growth is about 3.2%, what is an approximation of Charlotte's population in 2000?
25. The population of Beijing, China in 2012 was approximately 20,690,000 and is growing at a rate of about 5.5%. What is an approximation of Beijing's population in 1980?
26. The population of Detroit, Michigan is decreasing at a rate of about 0.75%. Detroit's population in 2013 was approximately 700,000. What is the predicted population for 2015?
27. The population of Berlin, Germany was about 3,290,000 in 2011. Its population is declining at a rate of about 0.2%. What is the predicted population for 2050?