

# Exponents Study Guide

Math 1

Name: Key  
Date: \_\_\_\_\_ Block: \_\_\_\_\_

**Directions:** Simplify each expression. Use positive exponents.

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

2.  $\frac{p^3q^{-1}}{q^2r^{-6}}$

3.  $\left(\frac{16x^{-4}}{32y^{-5}}\right)^2$

4.  $(m^3n^{-5}m^{-1})^{-3}$

5.  $\left(\frac{3^2y^{-4}}{3^2x^0y^2}\right)^2$

$\left(\frac{x^4y^{-2}}{x^{-3}y^5}\right)^{-1}$

6. If  $z = \frac{1}{2}$ , which expression has the greatest value?

a)  $z^{-6}z^4$

b)  $(z^{-2}z^5)^{-2}$

c)  $(z^3)^5$

d)  $-(z^2z^{-4})^{-3}$

Simplify the following:

7.  $\left(\frac{9a^{-3}}{18b^{-4}}\right)^2$

8.  $\left(\frac{5^3t^{-2}}{5^3s^0t^3}\right)^2$

9.  $(x^{-2})^{-5}$

10.  $(x^2y^{-2})(xy)^4$

Write using rational exponents.

11.  $(\sqrt[3]{3a})^4$

12.  $\frac{1}{(\sqrt{3k})^5}$

13.  $(\sqrt[3]{6x})^4$

14.  $(\sqrt[4]{m})^3$

Write using radicals.

15.  $(10n)^{\frac{3}{2}}$

16.  $(27p^6)^{\frac{5}{3}}$

17.  $(5x)^{-\frac{5}{4}}$

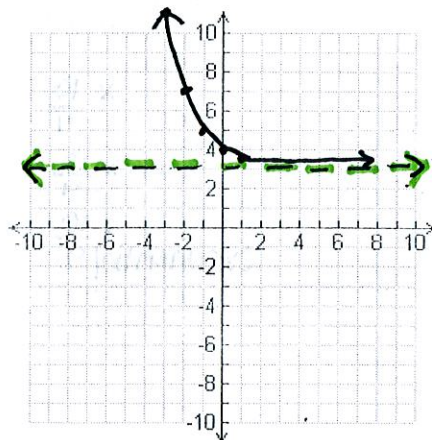
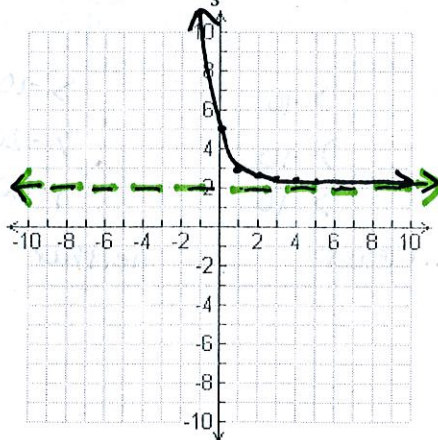
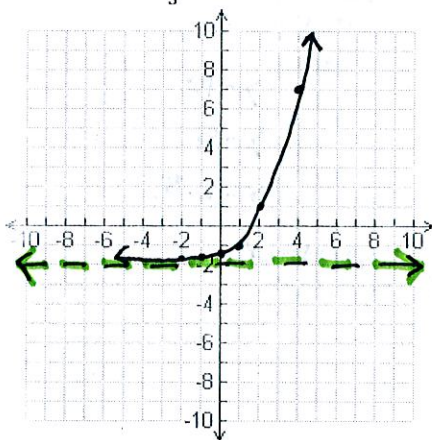
18.  $a^{\frac{6}{5}}$

Graph each function. Make sure to draw a dotted line for the horizontal asymptote.

19.  $f(x) = \frac{1}{3} \cdot 3^x - 2$

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

21.  $y = 0.5^x + 3$



22. Your other grandfather owns two new cars. His 2007 Honda is worth \$16,000 and its value depreciates at a rate of 8% per year. His 2007 Ford is worth \$21,000 and depreciates at a rate of 11% per year.
- How much will the Honda be worth in 2012?
  - How much will the Ford be worth in 2015?
23. The function  $y = 195 \cdot 0.75^x$  models the average time (in minutes) of math tests in 1980.
- Does the exponential function represent *growth* or *decay*?
  - Estimate the average time for math tests in 1990.
  - Predict the average time for math tests in 2025.
24. Find the balance in a bank account after 8 years if \$500 is invested at 7% interest.
25. Find the balance in a bank account after 5 years if \$2000 is invested at 6% interest.
26. On the first swing, a pendulum swings through an arc of length 60 cm. On each successive swing, the length of the arc is 82% of the length of the previous swing.
- Write a rule to model this situation.
  - Find the length of the arc on the fifth swing. Round your answer to the nearest cm.

27. **Reasoning:** Does the table below represent an exponential function? Explain why or why not.

$x$	2	3	4	5
$y$	2.25	3.375	5.063	7.953

28. Bacteria in a culture are growing exponentially with time, as shown in the table below.

**Bacteria Growth**

Day	Bacteria
0	100
1	200
2	400

Which of the following equations expresses the number of bacteria,  $y$ , present at any time,  $t$ ?

- a)  $y = 100 + 2^t$       \*b)  $y = (100) \cdot (2)^t$       c)  $y = 2^t$       d)  $y = (200) \cdot (2)^t$

29. This table shows the number of subscribers to four magazines.

Year	Subscribers to Music Magazine	Subscribers to Sports Magazine	Subscribers to Business Magazine	Subscribers to History Magazine
1	100,000	100,000	100,000	100,000
2	90,000 $\times \frac{10}{9}$	90,000 $\rightarrow -10$	90,000 $\rightarrow -10$	90,000 $\rightarrow -10$
3	81,000 $\times \frac{10}{9}$	80,000 $\rightarrow -10$	70,000 $\rightarrow -20$	85,000 $\rightarrow -5$
4	72,900 $\times \frac{10}{9}$ exponential $\frac{10}{9}$	70,000 linear	40,000 neither	82,500 neither

Which magazine's subscribers are best modeled by an exponential function?



## Exponents Study Guide

$$1. \left(\frac{y^5}{x^4}\right)^{-3} = \frac{y^{-15}}{x^{-12}} = \boxed{\frac{x^{12}}{y^{15}}}$$

$$2. \frac{p^3 q^{-1}}{q^2 r^{-6}} = \frac{p^3 r^6}{q^2 q^1} = \boxed{\frac{p^3 r^6}{q^3}}$$

$$3. \left(\frac{16x^{-4}}{32y^{-5}}\right)^2 = \frac{16^2 x^{-8}}{32^2 y^{-10}} = \frac{256y^{10}}{1024x^8} = \boxed{\frac{y^{10}}{4x^8}}$$

$$4. (m^3 n^{-5} m^{-1})^{-3} = (m^2 n^{-5})^{-3} = m^{-6} n^{15} = \boxed{\frac{n^{15}}{m^6}}$$

$$5. \left(\frac{3^2 y^{-4}}{3^2 x^0 y^2}\right)^2 = \frac{3^4 y^{-8}}{3^4 x^0 y^4} = \frac{1}{y^4 y^8} = \boxed{\frac{1}{y^{12}}}$$

$$6. \left(\frac{x^4 y^{-2}}{x^{-3} y^5}\right)^{-1} = \frac{x^{-1} y^2}{x^3 y^{-5}} = \frac{y^2 y^5}{x^3 x^1} = \boxed{\frac{y^7}{x^4}}$$

$$7. \left(\frac{9a^{-3}}{18b^{-4}}\right)^2 = \frac{9^2 a^{-6}}{18^2 b^{-8}} = \frac{81b^8}{324a^6} = \boxed{\frac{b^8}{4a^6}}$$

$$8. \left(\frac{5^3 t^{-2}}{5^3 s^0 t^3}\right)^2 = \frac{5^6 t^{-4}}{5^6 s^0 t^6} = \frac{1}{t^4 t^6} = \boxed{\frac{1}{t^{10}}}$$

$$9. (x^{-2})^{-5} = \boxed{x^{10}}$$



$$10. (x^2 y^{-2})(xy)^4 = (x^2 y^{-2})(x^4 y^4) = \frac{x^2 x^4 y^4}{y^2} = x^6 y^2$$

$$11. (\sqrt[3]{3a})^4 = 3^{\frac{4}{3}} a^{\frac{4}{3}}$$

$$12. \frac{1}{(\sqrt{3k})^5} = \frac{1}{3^{5/2} k^{5/2}}$$

$$13. (\sqrt[3]{6x})^4 = 6^{\frac{4}{3}} x^{\frac{4}{3}}$$

$$14. (\sqrt[4]{m})^3 = m^{\frac{3}{4}}$$

$$15. (10n)^{\frac{3}{2}} = \sqrt[2]{10^3 n^3} \text{ or } \sqrt{(10n)^3}$$

$$16. (27p^6)^{\frac{5}{3}} = \sqrt[3]{(27p^6)^5} \text{ or } \sqrt[3]{27^5 p^{30}}$$

$$17. (5x)^{-\frac{5}{4}} = \sqrt[4]{(5x)^{-5}} = \frac{1}{\sqrt[4]{(5x)^5}} \text{ or } \frac{1}{\sqrt[4]{5^5 x^5}}$$

$$18. a^{\frac{6}{5}} = \sqrt[5]{a^6}$$

19-21 see sheet

$$22. a) y = 16000(1 - 0.08)^{2012 - 2007}$$

$$y = 16000(1 - 0.08)^{2012 - 2007}$$

$$y = \$10545.30$$

$$b) y = 21000(1 - 0.11)^{2012 - 2007}$$

$$y = \$8266.84$$

23. a) Decay

b)  $y = 195(0.75)^{10}$

$y = 10.98$  minutes

c)  $y = 195(0.75)^{45}$

$y = 0$  minutes

24.  $y = 500(1+0.07)^8$

$y = \$859.09$

25.  $y = 2000(1+0.06)^5$

$y = \$2676.45$

26.  $y = 60(0.82)^x$

$y = 60(0.82)^5$

$y = 22.2$  cm

27.

x	2	3	4	5
y	2.25	3.375	5.063	7.953

$\vee$            $\vee$            $\vee$   
          x1.5      x1.5      x1.5

yes, exponential  
b/c the values are  
increasing through  
multiplication

28.  $y =$  ending amt

$a =$  initial amt = 100

$b =$  rate of change = x2

$t =$  time

$$y = ab^x$$
$$y = 100(2)^t$$

(B)

29. See sheet → Music Magazines