

Exponential Functions

Date _____ Period _____

Evaluate each function at the given value.

1) $f(x) = \frac{1}{3} \cdot 6^x$ at $x = 2$

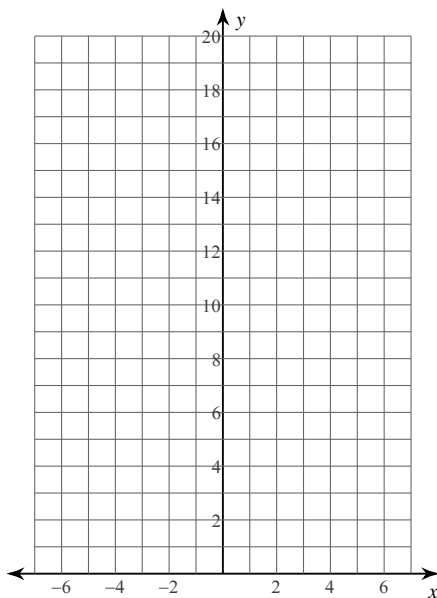
2) $f(n) = 10 \cdot 2^n$ at $n = 5$

3) $f(n) = 10 \cdot 2^n$ at $n = -2$

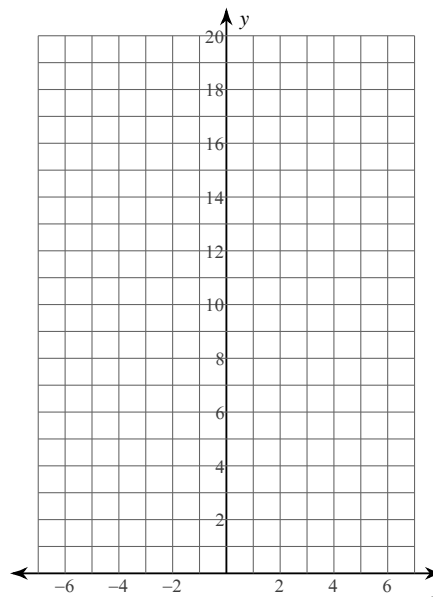
4) $g(x) = \frac{1}{5} \cdot \left(\frac{1}{3}\right)^x$ at $x = 3$

Sketch the graph of each function.

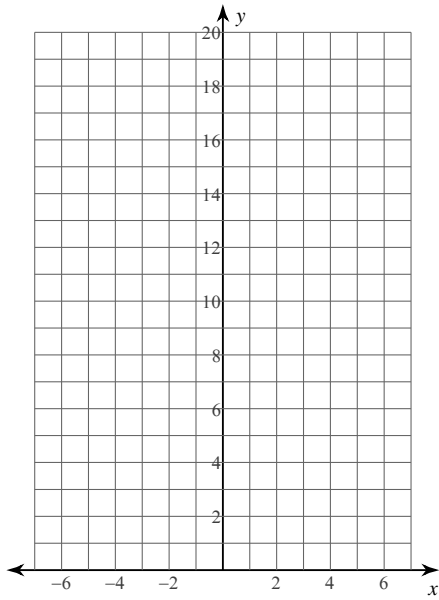
5) $f(x) = 4 \cdot 2^x$



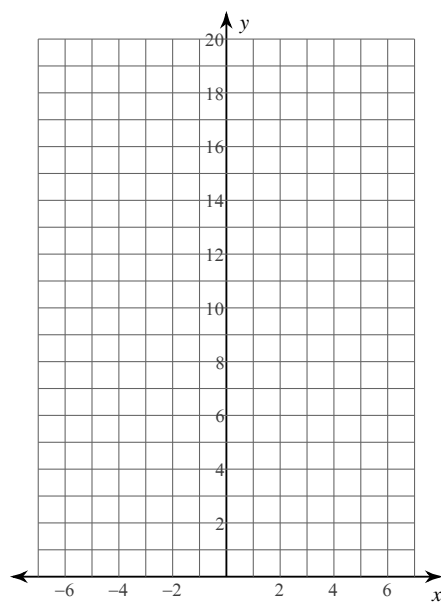
6) $f(x) = 4 \cdot \left(\frac{1}{2}\right)^x$



7) $f(x) = \frac{1}{2} \cdot 3^x$

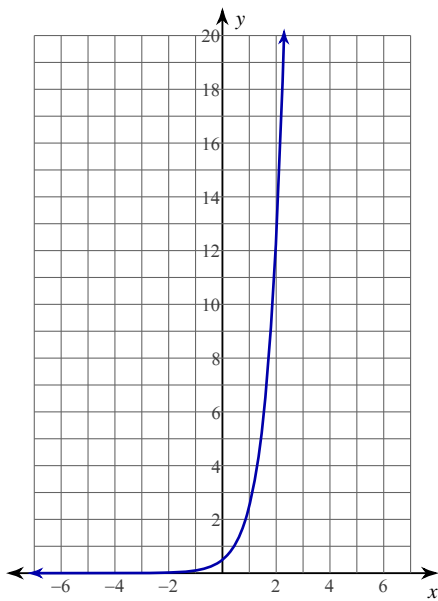


8) $f(x) = 5 \cdot \left(\frac{1}{2}\right)^x$

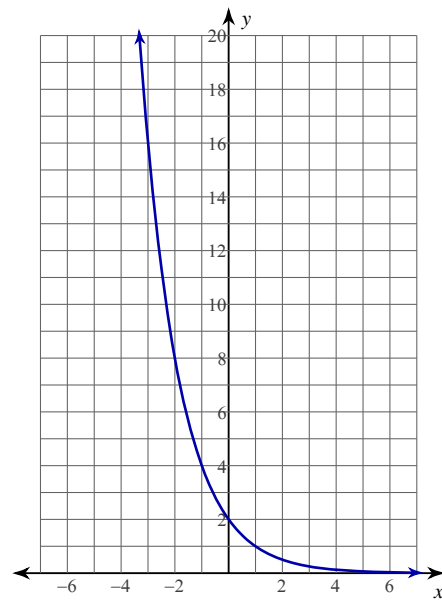


Write an equation for each graph.

9)



10)



Exponential Functions

Evaluate each function at the given value.

1) $f(x) = \frac{1}{3} \cdot 6^x$ at $x = 2$

12

2) $f(n) = 10 \cdot 2^n$ at $n = 5$

320

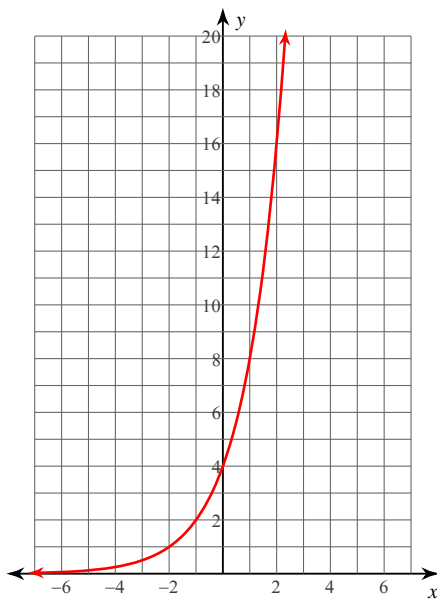
3) $f(n) = 10 \cdot 2^n$ at $n = -2$

 $\frac{5}{2}$

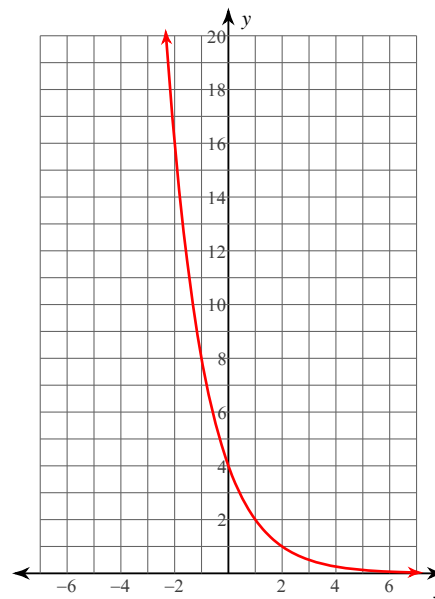
4) $g(x) = \frac{1}{5} \cdot \left(\frac{1}{3}\right)^x$ at $x = 3$

 $\frac{1}{135}$ **Sketch the graph of each function.**

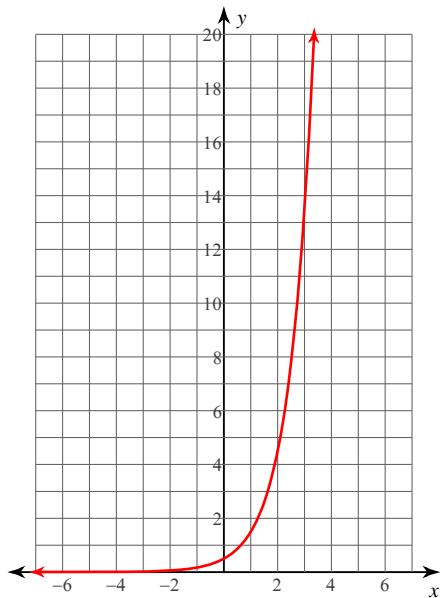
5) $f(x) = 4 \cdot 2^x$



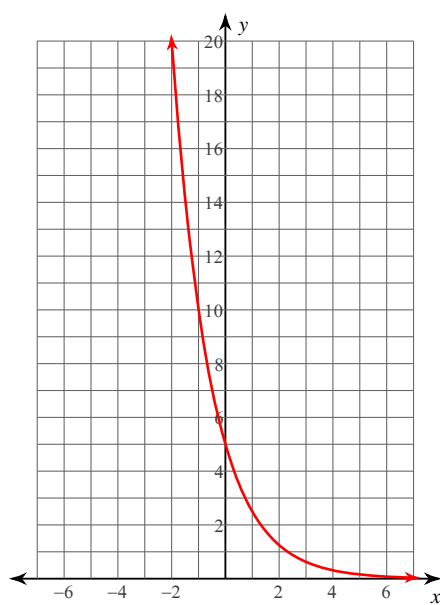
6) $f(x) = 4 \cdot \left(\frac{1}{2}\right)^x$



7) $f(x) = \frac{1}{2} \cdot 3^x$

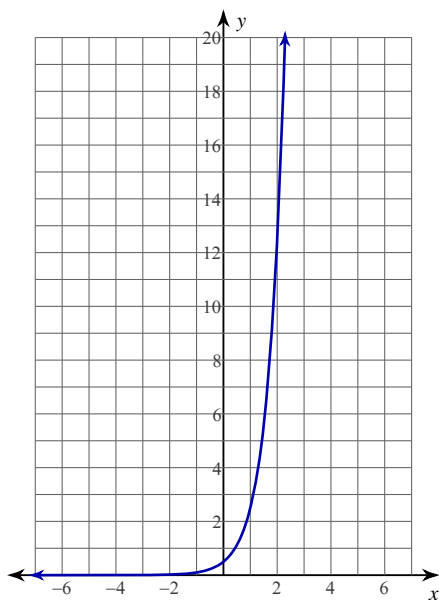


8) $f(x) = 5 \cdot \left(\frac{1}{2}\right)^x$



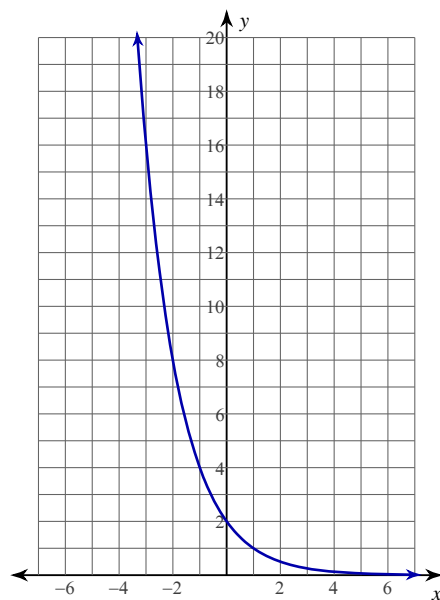
Write an equation for each graph.

9)



$y = \frac{1}{2} \cdot 5^x$

10)



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

The Meaning Of Logarithms

Rewrite each equation in exponential form.

1) $\log_6 36 = 2$

2) $\log_{289} 17 = \frac{1}{2}$

3) $\log_{14} \frac{1}{196} = -2$

4) $\log_3 81 = 4$

Rewrite each equation in logarithmic form.

5) $64^{\frac{1}{2}} = 8$

6) $12^2 = 144$

7) $9^{-2} = \frac{1}{81}$

8) $\left(\frac{1}{12}\right)^2 = \frac{1}{144}$

Rewrite each equation in exponential form.

9) $\log_u \frac{15}{16} = v$

10) $\log_v u = 4$

11) $\log_{\frac{7}{4}} x = y$

12) $\log_2 v = u$

13) $\log_u v = -16$

14) $\log_y x = -8$

Rewrite each equation in logarithmic form.

15) $u^{-14} = v$

16) $8^b = a$

$$17) \left(\frac{1}{5}\right)^x = y$$

$$18) 6^y = x$$

$$19) 9^y = x$$

$$20) b^a = 123$$

Evaluate each expression.

$$21) \log_4 64$$

$$22) \log_6 216$$

$$23) \log_4 16$$

$$24) \log_3 \frac{1}{243}$$

$$25) \log_5 125$$

$$26) \log_2 4$$

$$27) \log_{343} 7$$

$$28) \log_2 16$$

$$29) \log_{64} 4$$

$$30) \log_6 \frac{1}{216}$$

Simplify each expression.

$$31) 12^{\log_{12} 144}$$

$$32) 5^{\log_5 17}$$

$$33) x^{\log_x 72}$$

$$34) 9^{\log_3 20}$$

The Meaning Of Logarithms

Rewrite each equation in exponential form.

1) $\log_6 36 = 2$

$$6^2 = 36$$

2) $\log_{289} 17 = \frac{1}{2}$

$$289^{\frac{1}{2}} = 17$$

3) $\log_{14} \frac{1}{196} = -2$

$$14^{-2} = \frac{1}{196}$$

4) $\log_3 81 = 4$

$$3^4 = 81$$

Rewrite each equation in logarithmic form.

5) $64^{\frac{1}{2}} = 8$

$$\log_{64} 8 = \frac{1}{2}$$

6) $12^2 = 144$

$$\log_{12} 144 = 2$$

7) $9^{-2} = \frac{1}{81}$

$$\log_9 \frac{1}{81} = -2$$

8) $\left(\frac{1}{12}\right)^2 = \frac{1}{144}$

$$\log_{\frac{1}{12}} \frac{1}{144} = 2$$

Rewrite each equation in exponential form.

9) $\log_u \frac{15}{16} = v$

$$u^v = \frac{15}{16}$$

10) $\log_v u = 4$

$$v^4 = u$$

11) $\log_{\frac{7}{4}} x = y$

$$\left(\frac{7}{4}\right)^y = x$$

12) $\log_2 v = u$

$$2^u = v$$

13) $\log_u v = -16$

$$u^{-16} = v$$

14) $\log_y x = -8$

$$y^{-8} = x$$

Rewrite each equation in logarithmic form.

15) $u^{-14} = v$

$$\log_u v = -14$$

16) $8^b = a$

$$\log_8 a = b$$

$$17) \left(\frac{1}{5}\right)^x = y$$

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$$18) 6^y = x$$

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$$19) 9^y = x$$

$$\log_9 x = y$$

$$20) b^a = 123$$

$$\log_b 123 = a$$

Evaluate each expression.

$$21) \log_4 64$$

$$3$$

$$22) \log_6 216$$

$$3$$

$$23) \log_4 16$$

$$2$$

$$24) \log_3 \frac{1}{243}$$

$$-5$$

$$25) \log_5 125$$

$$3$$

$$26) \log_2 4$$

$$2$$

$$27) \log_{343} 7$$

$$\frac{1}{3}$$

$$28) \log_2 16$$

$$4$$

$$29) \log_{64} 4$$

$$\frac{1}{3}$$

$$30) \log_6 \frac{1}{216}$$

$$-3$$

Simplify each expression.

$$31) 12^{\log_{12} 144}$$

$$144$$

$$32) 5^{\log_5 17}$$

$$17$$

$$33) x^{\log_x 72}$$

$$72$$

$$34) 9^{\log_3 20}$$

$$400$$

Properties of Logarithms

Date _____ Period _____

Expand each logarithm.

1) $\log (6 \cdot 11)$

2) $\log (5 \cdot 3)$

3) $\log \left(\frac{6}{11} \right)^5$

4) $\log (3 \cdot 2^3)$

5) $\log \frac{2^4}{5}$

6) $\log \left(\frac{6}{5} \right)^6$

7) $\log \frac{x}{y^6}$

8) $\log (a \cdot b)^2$

9) $\log \frac{u^4}{v}$

10) $\log \frac{x}{y^5}$

11) $\log \sqrt[3]{x \cdot y \cdot z}$

12) $\log (x \cdot y \cdot z^2)$

Condense each expression to a single logarithm.

13) $\log 3 - \log 8$

14) $\frac{\log 6}{3}$

15) $4\log 3 - 4\log 8$

16) $\log 2 + \log 11 + \log 7$

17) $\log 7 - 2\log 12$

18) $\frac{2\log 7}{3}$

19) $6\log_3 u + 6\log_3 v$

20) $\ln x - 4\ln y$

21) $\log_4 u - 6\log_4 v$

22) $\log_3 u - 5\log_3 v$

23) $20\log_6 u + 5\log_6 v$

24) $4\log_3 u - 20\log_3 v$

Critical thinking questions:

25) $2(\log 2x - \log y) - (\log 3 + 2\log 5)$

26) $\log x \cdot \log 2$

Properties of Logarithms

Expand each logarithm.

1) $\log (6 \cdot 11)$

$\log 6 + \log 11$

2) $\log (5 \cdot 3)$

$\log 5 + \log 3$

3) $\log \left(\frac{6}{11} \right)^5$

$5 \log 6 - 5 \log 11$

4) $\log (3 \cdot 2^3)$

$\log 3 + 3 \log 2$

5) $\log \frac{2^4}{5}$

$4 \log 2 - \log 5$

6) $\log \left(\frac{6}{5} \right)^6$

$6 \log 6 - 6 \log 5$

7) $\log \frac{x}{y^6}$

$\log x - 6 \log y$

8) $\log (a \cdot b)^2$

$2 \log a + 2 \log b$

9) $\log \frac{u^4}{v}$

$4 \log u - \log v$

10) $\log \frac{x}{y^5}$

$\log x - 5 \log y$

11) $\log \sqrt[3]{x \cdot y \cdot z}$

$\frac{\log x}{3} + \frac{\log y}{3} + \frac{\log z}{3}$

12) $\log (x \cdot y \cdot z^2)$

$\log x + \log y + 2 \log z$

Condense each expression to a single logarithm.

13) $\log 3 - \log 8$

$$\log \frac{3}{8}$$

14) $\frac{\log 6}{3}$

$$\log \sqrt[3]{6}$$

15) $4\log 3 - 4\log 8$

$$\log \frac{3^4}{8^4}$$

16) $\log 2 + \log 11 + \log 7$

$$\log 154$$

17) $\log 7 - 2\log 12$

$$\log \frac{7}{12^2}$$

18) $\frac{2\log 7}{3}$

$$\log \sqrt[3]{7^2}$$

19) $6\log_3 u + 6\log_3 v$

$$\log_3 (v^6 u^6)$$

20) $\ln x - 4\ln y$

$$\ln \frac{x}{y^4}$$

21) $\log_4 u - 6\log_4 v$

$$\log_4 \frac{u}{v^6}$$

22) $\log_3 u - 5\log_3 v$

$$\log_3 \frac{u}{v^5}$$

23) $20\log_6 u + 5\log_6 v$

$$\log_6 (v^5 u^{20})$$

24) $4\log_3 u - 20\log_3 v$

$$\log_3 \frac{u^4}{v^{20}}$$

Critical thinking questions:

25) $2(\log 2x - \log y) - (\log 3 + 2\log 5)$

$$\log \frac{4x^2}{75y^2}$$

26) $\log x \cdot \log 2$

Can't be simplified.

Logarithmic Equations

Date_____ Period____

Solve each equation.

1) $\log 5x = \log (2x + 9)$

2) $\log (10 - 4x) = \log (10 - 3x)$

3) $\log (4p - 2) = \log (-5p + 5)$

4) $\log (4k - 5) = \log (2k - 1)$

5) $\log (-2a + 9) = \log (7 - 4a)$

6) $2\log_7 -2r = 0$

7) $-10 + \log_3 (n + 3) = -10$

8) $-2\log_5 7x = 2$

9) $\log -m + 2 = 4$

10) $-6\log_3 (x - 3) = -24$

11) $\log_{12} (v^2 + 35) = \log_{12} (-12v - 1)$

12) $\log_9 (-11x + 2) = \log_9 (x^2 + 30)$

$$13) \log (16 + 2b) = \log (b^2 - 4b)$$

$$14) \ln (n^2 + 12) = \ln (-9n - 2)$$

$$15) \log x + \log 8 = 2$$

$$16) \log x - \log 2 = 1$$

$$17) \log 2 + \log x = 1$$

$$18) \log x + \log 7 = \log 37$$

$$19) \log_8 2 + \log_8 4x^2 = 1$$

$$20) \log_9 (x + 6) - \log_9 x = \log_9 2$$

$$21) \log_6 (x + 1) - \log_6 x = \log_6 29$$

$$22) \log_5 6 + \log_5 2x^2 = \log_5 48$$

$$23) \ln 2 - \ln (3x + 2) = 1$$

$$24) \ln (-3x - 1) - \ln 7 = 2$$

$$25) \ln (x - 3) - \ln (x - 5) = \ln 5$$

$$26) \ln (4x + 1) - \ln 3 = 5$$

Logarithmic Equations

Solve each equation.

1) $\log 5x = \log (2x + 9)$

 $\{3\}$

2) $\log (10 - 4x) = \log (10 - 3x)$

 $\{0\}$

3) $\log (4p - 2) = \log (-5p + 5)$

 $\left\{\frac{7}{9}\right\}$

4) $\log (4k - 5) = \log (2k - 1)$

 $\{2\}$

5) $\log (-2a + 9) = \log (7 - 4a)$

 $\{-1\}$

6) $2\log_7 -2r = 0$

 $\left\{-\frac{1}{2}\right\}$

7) $-10 + \log_3 (n + 3) = -10$

 $\{-2\}$

8) $-2\log_5 7x = 2$

 $\left\{\frac{1}{35}\right\}$

9) $\log -m + 2 = 4$

 $\{-100\}$

10) $-6\log_3 (x - 3) = -24$

 $\{84\}$

11) $\log_{12} (v^2 + 35) = \log_{12} (-12v - 1)$

 $\{-6\}$

12) $\log_9 (-11x + 2) = \log_9 (x^2 + 30)$

 $\{-7, -4\}$

$$13) \log (16 + 2b) = \log (b^2 - 4b)$$

$$\{8, -2\}$$

$$14) \ln (n^2 + 12) = \ln (-9n - 2)$$

$$\{-2, -7\}$$

$$15) \log x + \log 8 = 2$$

$$\left\{\frac{25}{2}\right\}$$

$$16) \log x - \log 2 = 1$$

$$\{20\}$$

$$17) \log 2 + \log x = 1$$

$$\{5\}$$

$$18) \log x + \log 7 = \log 37$$

$$\left\{\frac{37}{7}\right\}$$

$$19) \log_8 2 + \log_8 4x^2 = 1$$

$$\{1, -1\}$$

$$20) \log_9 (x + 6) - \log_9 x = \log_9 2$$

$$\{6\}$$

$$21) \log_6 (x + 1) - \log_6 x = \log_6 29$$

$$\left\{\frac{1}{28}\right\}$$

$$22) \log_5 6 + \log_5 2x^2 = \log_5 48$$

$$\{2, -2\}$$

$$23) \ln 2 - \ln (3x + 2) = 1$$

$$\left\{\frac{2 - 2e}{3e}\right\}$$

$$24) \ln (-3x - 1) - \ln 7 = 2$$

$$\left\{\frac{-7e^2 - 1}{3}\right\}$$

$$25) \ln (x - 3) - \ln (x - 5) = \ln 5$$

$$\left\{\frac{11}{2}\right\}$$

$$26) \ln (4x + 1) - \ln 3 = 5$$

$$\left\{\frac{3e^5 - 1}{4}\right\}$$

Exponential Equations Not Requiring Logarithms

Date_____ Period____

Solve each equation.

1) $4^{2x+3} = 1$

2) $5^{3-2x} = 5^{-x}$

3) $3^{1-2x} = 243$

4) $3^{2a} = 3^{-a}$

5) $4^{3x-2} = 1$

6) $4^{2p} = 4^{-2p-1}$

7) $6^{-2a} = 6^{2-3a}$

8) $2^{2x+2} = 2^{3x}$

9) $6^{3m} \cdot 6^{-m} = 6^{-2m}$

10) $\frac{2^x}{2^x} = 2^{-2x}$

11) $10^{-3x} \cdot 10^x = \frac{1}{10}$

12) $3^{-2x+1} \cdot 3^{-2x-3} = 3^{-x}$

$$13) 4^{-2x} \cdot 4^x = 64$$

$$14) 6^{-2x} \cdot 6^{-x} = \frac{1}{216}$$

$$15) 2^x \cdot \frac{1}{32} = 32$$

$$16) 2^{-3p} \cdot 2^{2p} = 2^{2p}$$

$$17) 64 \cdot 16^{-3x} = 16^{3x-2}$$

$$18) \frac{81^{3n+2}}{243^{-n}} = 3^4$$

$$19) 81 \cdot 9^{-2b-2} = 27$$

$$20) 9^{-3x} \cdot 9^x = 27$$

$$21) \left(\frac{1}{6}\right)^{3x+2} \cdot 216^{3x} = \frac{1}{216}$$

$$22) 243^{k+2} \cdot 9^{2k-1} = 9$$

$$23) 16^r \cdot 64^{3-3r} = 64$$

$$24) 16^{2p-3} \cdot 4^{-2p} = 2^4$$

Exponential Equations Not Requiring Logarithms

Date_____ Period____

Solve each equation.

1) $4^{2x+3} = 1$

$$\left\{-\frac{3}{2}\right\}$$

2) $5^{3-2x} = 5^{-x}$

$$\{3\}$$

3) $3^{1-2x} = 243$

$$\{-2\}$$

4) $3^{2a} = 3^{-a}$

$$\{0\}$$

5) $4^{3x-2} = 1$

$$\left\{\frac{2}{3}\right\}$$

6) $4^{2p} = 4^{-2p-1}$

$$\left\{-\frac{1}{4}\right\}$$

7) $6^{-2a} = 6^{2-3a}$

$$\{2\}$$

8) $2^{2x+2} = 2^{3x}$

$$\{2\}$$

9) $6^{3m} \cdot 6^{-m} = 6^{-2m}$

$$\{0\}$$

10) $\frac{2^x}{2^x} = 2^{-2x}$

$$\{0\}$$

11) $10^{-3x} \cdot 10^x = \frac{1}{10}$

$$\left\{\frac{1}{2}\right\}$$

12) $3^{-2x+1} \cdot 3^{-2x-3} = 3^{-x}$

$$\left\{-\frac{2}{3}\right\}$$

$$13) 4^{-2x} \cdot 4^x = 64$$

$$\{-3\}$$

$$14) 6^{-2x} \cdot 6^{-x} = \frac{1}{216}$$

$$\{1\}$$

$$15) 2^x \cdot \frac{1}{32} = 32$$

$$\{10\}$$

$$16) 2^{-3p} \cdot 2^{2p} = 2^{2p}$$

$$\{0\}$$

$$17) 64 \cdot 16^{-3x} = 16^{3x-2}$$

$$\left\{\frac{7}{12}\right\}$$

$$18) \frac{81^{3n+2}}{243^{-n}} = 3^4$$

$$\left\{-\frac{4}{17}\right\}$$

$$19) 81 \cdot 9^{-2b-2} = 27$$

$$\left\{-\frac{3}{4}\right\}$$

$$20) 9^{-3x} \cdot 9^x = 27$$

$$\left\{-\frac{3}{4}\right\}$$

$$21) \left(\frac{1}{6}\right)^{3x+2} \cdot 216^{3x} = \frac{1}{216}$$

$$\left\{-\frac{1}{6}\right\}$$

$$22) 243^{k+2} \cdot 9^{2k-1} = 9$$

$$\left\{-\frac{2}{3}\right\}$$

$$23) 16^r \cdot 64^{3-3r} = 64$$

$$\left\{\frac{6}{7}\right\}$$

$$24) 16^{2p-3} \cdot 4^{-2p} = 2^4$$

$$\{4\}$$

Solving Exponential Equations with Logarithms

Date_____ Period____

Solve each equation. Round your answers to the nearest ten-thousandth.

1) $3^b = 17$

2) $12^r = 13$

3) $9^n = 49$

4) $16^v = 67$

5) $3^a = 69$

6) $6^r = 51$

7) $6^n = 99$

8) $20^r = 56$

9) $5 \cdot 18^{6x} = 26$

10) $e^{x-1} - 5 = 5$

11) $9^{n+10} + 3 = 81$

12) $11^{n-8} - 5 = 54$

$$13) 16^{n-7} + 5 = 24$$

$$14) 20^{-6n} + 6 = 55$$

$$15) 5 \cdot 6^{3m} = 20$$

$$16) 8^{-5a} - 5 = 53$$

$$17) 3.4e^{2-2n} - 9 = -4$$

$$18) -6e^{8n+8} - 3 = -23$$

$$19) -e^{-3.9n-1} - 1 = -3$$

$$20) -2e^{7v+5} - 10 = -17$$

$$21) -3e^{7a+9} + 6 = -6$$

$$22) -3e^{9x-1} + 6 = -58$$

$$23) -e^{6-9p} + 5 = -48.4$$

$$24) -10e^{2-2b} - 6 = -66$$

$$25) 6e^{-4k-10} - 4 = 63$$

$$26) 6e^{5x-6} - 4 = 50$$

Solving Exponential Equations with Logarithms

Date _____ Period _____

Solve each equation. Round your answers to the nearest ten-thousandth.

1) $3^b = 17$

2.5789

2) $12^r = 13$

1.0322

3) $9^n = 49$

1.7712

4) $16^v = 67$

1.5165

5) $3^a = 69$

3.854

6) $6^r = 51$

2.1944

7) $6^n = 99$

2.5646

8) $20^r = 56$

1.3437

9) $5 \cdot 18^{6x} = 26$

0.0951

10) $e^{x-1} - 5 = 5$

3.3026

11) $9^{n+10} + 3 = 81$

-8.0172

12) $11^{n-8} - 5 = 54$

9.7005

$$13) 16^{n-7} + 5 = 24$$

8.062

$$14) 20^{-6n} + 6 = 55$$

-0.2165

$$15) 5 \cdot 6^{3m} = 20$$

0.2579

$$16) 8^{-5a} - 5 = 53$$

-0.3905

$$17) 3.4e^{2-2n} - 9 = -4$$

0.8072

$$18) -6e^{8n+8} - 3 = -23$$

-0.8495

$$19) -e^{-3.9n-1} - 1 = -3$$

-0.4341

$$20) -2e^{7v+5} - 10 = -17$$

-0.5353

$$21) -3e^{7a+9} + 6 = -6$$

-1.0877

$$22) -3e^{9x-1} + 6 = -58$$

0.4511

$$23) -e^{6-9p} + 5 = -48.4$$

0.2247

$$24) -10e^{2-2b} - 6 = -66$$

0.1041

$$25) 6e^{-4k-10} - 4 = 63$$

-3.1032

$$26) 6e^{5x-6} - 4 = 50$$

1.6394