

Exponential Functions Practice Questions

Laws of Exponents

1) Write each of the following expressions as a single exponent with the same base.

a)

$$2^3 \cdot 2^6 \\ = 2^9$$

b)

$$(9^4)^2 \\ = 9^8$$

c)

$$3^0 \cdot 3^1 \cdot 3^5 \\ = 3^6$$

d)

$$(4^4)^{\frac{1}{2}} \\ = 4^2$$

e)

$$\left(\frac{1}{4^3}\right)^8 \\ = 4^{-24}$$

f)

$$\left(\frac{3^5}{3^2}\right)^{-7} \\ = 3^{-49}$$

g)

$$6^5 \cdot 6^{-5} \\ = 6^0 = 1$$

h)

$$12 \left(\frac{12^{-2}}{12}\right)^3 \\ = 12^{-8}$$

2) Write each of the following algebraic expressions in the form of a single exponent with the same base.

a)

$$a^2 \cdot a^5 \\ = a^7$$

b)

$$a(a^3)^2 \\ = a^7$$

c)

$$2^a \cdot 2^{2a} \\ = 2^{3a}$$

d)

$$\frac{a^5}{a^7} \\ = a^{-2}$$

e)

$$3^a \cdot 3^4 \\ = 3^{a+4}$$

f)

$$a^b \cdot a^{b+1} \\ = a^{2b+1}$$

g)

$$a \left(\frac{a^2}{a^0}\right) \\ = a^3$$

h)

$$a^7 \cdot a^{-7} \\ = a^0 = 1$$

3) For each of the following, find the value or values of x

a)

$$3^x = 27 \\ x = 3$$

b)

$$x^2 = 36 \\ x = 6$$

c)

$$2^5 = x \\ x = 32$$

d)

$$x^3 = 64 \\ x = 4$$

e)

$$2^x = 16 \\ x = 4$$

f)

$$7^4 = x \\ x = 2401$$

4) Re-write each of the following using exponents

a)

$$\sqrt{3} \\ = 3^{1/2}$$

b)

$$\sqrt[3]{9} \\ = 9^{1/3}$$

c)

$$\sqrt[5]{5^2} \\ = 5^{2/5}$$

d)

$$\sqrt{\frac{2^3}{3^3}} \\ = \left(\frac{2}{3}\right)^{3/2}$$

e)

$$\sqrt{5} \cdot \sqrt[3]{5^{-2}} \\ = 5^{-1/6}$$

f)

$$\left(\frac{\sqrt[4]{8}}{\sqrt{8}}\right)^{-1} \\ = 8^{1/4}$$

5) Simplify the following expressions

a)

$$\left(\sqrt[3]{a}\right)^3 \\ = a$$

b)

$$b^8 \div b^2 \\ = b^6$$

c)

$$\frac{12 \cdot \sqrt{3e} \cdot (4e)^{1/2}}{(-12e)^2} \\ = 12^{-1/2} e^{-1} \\ \text{or equivalent}$$

d)

$$2c^{1/3} \cdot 4\sqrt[3]{c} \\ = 8c^{2/3}$$

e)

$$\frac{4^{2d}}{2^{4d}} \\ = 1$$

6) For each case, find the value of x

a)

$$7^2 \cdot 7^3 = 7^x \\ x = 5$$

b)

$$13^{-5} \cdot 13 = 13^x \\ x = -4$$

c)

$$4^x \cdot 4^2 = 4^8 \\ x = 6$$

d)

$$(5^x)^2 = 5^{1/2} \\ x = 1/4$$

e)

$$\left(\frac{2}{3}\right)^x \cdot \left(\frac{2}{3}\right)^4 = \left(\frac{2}{3}\right)^{-5} \\ x = -9$$

f)

$$(2^4)^x = \frac{1}{2} \\ x = -1/4$$

Exponential Functions: Basics and Sketching

7) Indicate which of the following situations calls for an exponential model

- a) A city's population increases by 2.8% every year **Yes**
- b) Filling a pool using a water source with a constant flow **No**
- c) A bacteria's population triples every 30 minutes **Yes**
- d) The value of an investment earning 1.2% interest every year **Yes**

8) Complete the following table below

Rule	Domain	Range	Initial Value	Variation	Asymptote
$f(x) = 3\left(\frac{1}{5}\right)^x$	$]-\infty, \infty[$	$]0, \infty[$	1	Decreasing over domain	$y = 0$
$g(x) = 2.5^x$	$]-\infty, \infty[$	$]0, \infty[$	1	Increasing over domain	$y = 0$
$h(x) = 3(5)^{x-3} + 1$	$]-\infty, \infty[$	$]1, \infty[$	1.024	Increasing over domain	$y = 1$
$i(x) = 4(0.3)^{x-4} + 2$	$]-\infty, \infty[$	$]2, \infty[$	495.8271	Decreasing over domain	$y = 2$
$j(x) = 2.5(1.01)^{12x}$	$]-\infty, \infty[$	$]0, \infty[$	1	Increasing over domain	$y = 0$
$k(x) = 1000(0.95)^{x/6}$	$]-\infty, \infty[$	$]0, \infty[$	1	Increasing over domain	$y = 0$

9) For each case, indicate whether the function is increasing or decreasing

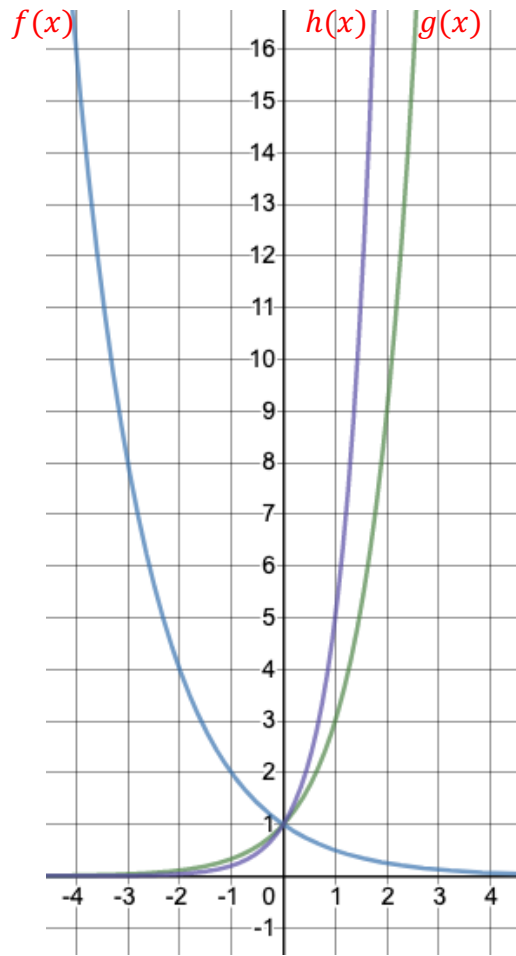
- a) $f(x) = 2(0.2)^x$
Decreasing
- b) $f(x) = 0.5(3)^{x-4}$
increasing
- c) $f(x) = 38\left(\frac{1}{5}\right)^{3-x} + 1$
increasing
- d) $f(x) = -7(0.3)^x$
increasing

10) Sketch each of the functions below

a) $f(x) = 0.5^x$

b) $g(x) = 3^x$

c) $h(x) = 5^x$



11) For each of the following rules, determine

- Whether it represents growth or decay
- The domain and range
- The y-intercept
- $f(1)$ and $f(-1)$
- The equation of the asymptote

a) $f(x) = 0.25^x$

Decay

D: $]-\infty, \infty[$
R: $]0, \infty[$

y-int: 1

$f(1) = 0.25$
 $f(-1) = 4$

Asymptote:
 $y = 0$

b) $g(x) = \left(\frac{1}{2}\right)^x$

Decay

D: $]-\infty, \infty[$
R: $]0, \infty[$

y-int: 1

$f(1) = 0.5$
 $f(-1) = 2$

Asymptote:
 $y = 0$

c) $h(x) = 0.9^x$
Decay

D: $]-\infty, \infty[$
R: $]0, \infty[$

y-int: 1

$f(1) = 0.9$
 $f(-1) = 10/9$

Asymptote:
 $y = 0$

d) $i(x) = 1.5^x$
Growth

D: $]-\infty, \infty[$
R: $]0, \infty[$

y-int: 1

$f(1) = 1.5$
 $f(-1) = 2/3$

Asymptote:
 $y = 0$

e) $j(x) = 4^x$
Growth

D: $]-\infty, \infty[$
R: $]0, \infty[$

y-int: 1

$f(1) = 4$
 $f(-1) = 0.25$

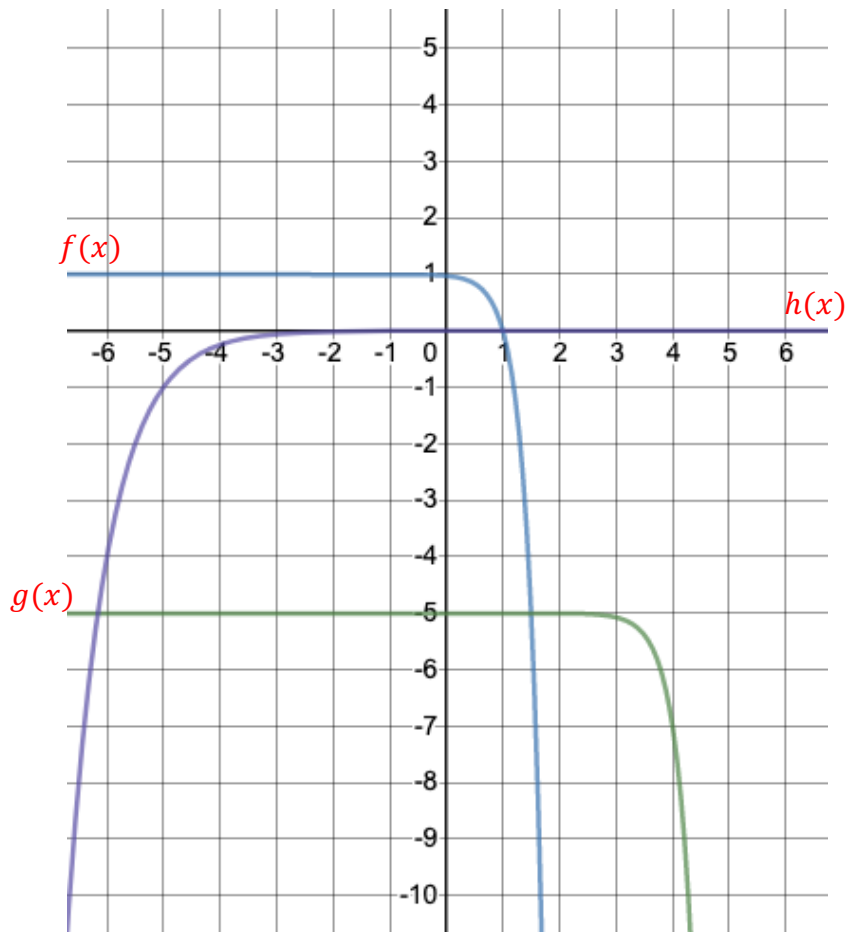
Asymptote:
 $y = 0$

12) Sketch the following functions

a) $f(x) = -(6)^{2(x-1)} + 1$

b) $g(x) = -2\left(\frac{1}{3}\right)^{-3x+12} - 5$

c) $h(x) = 0.25(0.5)^{2x+8}$



Exponential Functions: Finding the Rule from Words

13) An individual invests \$5 400 in a guaranteed investment certificate with an annual interest rate of 3.6%.

$$y = 5400(1.036)^x$$

14) The value of an investment is expected to increase by 0.5% every 4 months on a \$500 initial investment.

$$y = 500(1.005)^x$$

15) Each year, the frog population of a small wooded area decreases by 5%. The wooded area currently has 2000 frogs.

$$y = 2000(0.95)^x$$

Exponential Functions: Finding the Rule from Points

16) Determine the rule of the exponential function in the form $f(x) = y = ac^x$ given that it passes through the two points given.

a) (1, 24) and (4, 5184)

$$y = 4(6)^x$$

b) (2, 10.125) and (-1, 2)

$$y = 3.434(1.7171)^x$$

c) $(4, -81)$ and $(7, -2187)$

$$y = -1(3)^x$$

d) $(-3, 16)$ and $(2, 0.5)$

$$y = 2(0.5)^x$$

17) Determine the rule of an exponential function passing through the points $(0, 4)$ and $(1, 8)$ with an asymptote at $y = 2$

$$y = 2(3)^x + 2$$

18) Determine the rule of an exponential function passing through the points $(1, 3)$ and $(0, 23)$ with an asymptote at $y = -2$

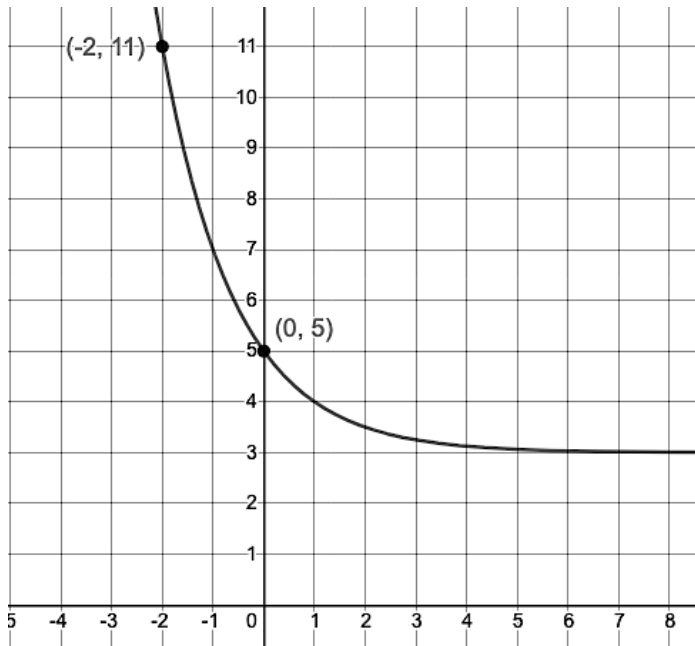
$$y = 25(0.2)^x - 2$$

19) Determine the rule of an exponential function passing through the points $(0, -24)$ and $(1, -4)$ with an asymptote at $y = 1$

$$y = -25(0.2)^x + 1$$

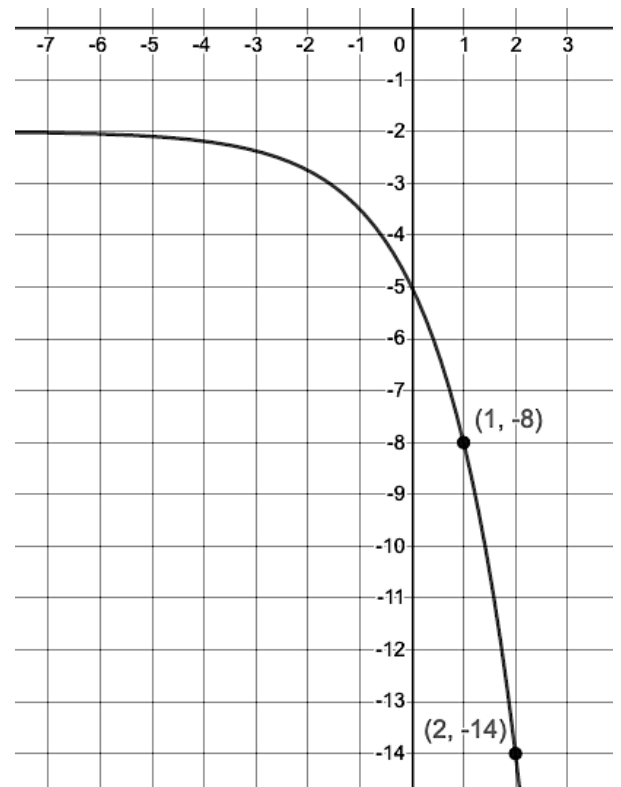
20) Determine the rule of the functions shown in the graphs below.

a)



$$y = 2(0.5)^x + 3$$

b)



$$y = -3(2)^x - 2$$

Exponential Functions: Solving Equalities

21) Find the zeros of the functions given below

a)

$$f(x) = 3(2)^{x-3} - 96$$

$$x = 8$$

b)

$$g(x) = 10 - 15\left(\frac{2}{3}\right)^{x-2}$$

$$x = 3$$

c)

$$h(x) = 7.5(6)^x + 6$$

no solution

d)

$$i(x) = 0.2(0.85)^{x-5} - 0.2$$

$$x = 2$$

22) Solve each of the following equations algebraically

a)

$$5^{6-x} = 25^{2x-13}$$

$$x = 6.4$$

b)

$$\left(\frac{1}{2}\right)^x = 4^{10}$$

$$x = -20$$

c)

$$\sqrt{2}^{x+1} = 8^{-3x}$$

$$x = -\frac{1}{19}$$

Exponential Functions: Solving Inequalities

23) Given functions f and g , where $f(x) = 2(3^{-2x} - 5)$ and $g(x) = 2\left(\frac{1}{9}\right)^{4x} - 10$
Determine the values for which:

a) $f(x) = g(x)$ $x = 0$

b) $f(x) > g(x)$ $]0, \infty[$

c) $f(x) < g(x)$ $] -\infty, 0[$

24) Solve the following inequalities

a)

$$25^x > 1025$$

Cannot solve unless you use
guess and check

$$]2.1537, \infty[$$

b)

$$2^{x+1} > 256$$

$$]7, \infty[$$

c)

$$7^{x-2} \leq 2401$$

$$]-\infty, 6]$$