

## Topic 1: Fractional and Negative Exponents

Simplify using only positive exponents.

1.  $-3x^{-3}$

2.  $-5\left(\frac{3}{2}\right)(4-9x)^{\frac{-1}{2}}(-9)$

3.  $2\left(\frac{2}{2-x}\right)\left(\frac{-2}{(2-x)^2}\right)$

4.  $(16x^2y)^{\frac{3}{4}}$

5.  $-\frac{x^{\frac{-1}{2}}}{2}\sin\sqrt{x}$

6.  $\frac{\sqrt{4x-16}}{\sqrt{(x-4)^2}}$

7.  $-4\left(\frac{2x-1}{2x+1}\right)^{-3}\left[\frac{2(2x+1)-2(2x-1)}{(2x+1)^2}\right]$

8.  $\frac{\frac{1}{2}(2x+5)^{\frac{-3}{2}}}{\frac{3}{2}}$

9.  $\left(\frac{1}{x^{-2}} + \frac{4}{x^{-1}y^{-1}} + \frac{1}{y^{-2}}\right)^{\frac{-1}{2}}$

## Topic 2: Domain and Discontinuity

Find the domain of the following functions and describe the discontinuity, if any, as removable or non-removable.

$$1. y = \frac{3x-2}{4x+1}$$

$$2. y = \frac{x^2-4}{2x+4}$$

$$3. y = \frac{x^2-5x-6}{x^2-3x-18}$$

$$4. y = \frac{2^{2-x}}{x}$$

$$5. y = \sqrt{x-3} - \sqrt{x+3}$$

$$6. y = \frac{\sqrt{2x-9}}{2x+9}$$

$$7. y = \frac{x^2+8x+12}{\sqrt[4]{x+5}}$$

$$8. y = \sqrt{x^2-5x-14}$$

$$9. y = \frac{\sqrt[3]{x-6}}{\sqrt{x^2-x-30}}$$

$$10. y = \log(2x-12)$$

$$11. y = \sqrt{\tan x}$$

$$12. y = \frac{x}{\cos x}$$

### Topic 3: Solving Inequalities

Write the following absolute value equations as piecewise equations.

1.  $y = |x^2 - 1|$

2.  $y = |x^2 + x - 12|$

3.  $y = |x^2 + 4x + 4|$

Solve the following by factoring and making appropriate sign charts.

4.  $x^2 - 16 > 0$

5.  $x^2 + 6x - 16 > 0$

6.  $x^2 - 3x \geq 10$

7.  $2x^2 + 4x \leq 3$

8.  $x^3 + 4x^2 - x \geq 4$

9.  $x^2 - 9 > 0$

#### Topic 4: Special Factorization

Factor completely.

1.  $x^3 + 8$

2.  $x^3 - 64$

3.  $27x^3 - 125y^3$

4.  $x^4 + 11x^2 - 80$

5.  $ac + cd - ab - bd$

6.  $2x^2 + 50y^2 - 20xy$

7.  $x^2 + 12x + 36 - 9y^2$

8.  $x^3 - xy^2 + x^2y - y^3$

9.  $(x-3)^2(2x+1)^3 + (x-3)^3(2x+1)^2$

## Topic 5: Function Transformation

If  $f(x) = x^2 - 1$ , describe in words, using correct mathematical terminology, what the following would do to the graph of  $f(x)$ .

1.  $f(x) - 4$

2.  $f(x - 4)$

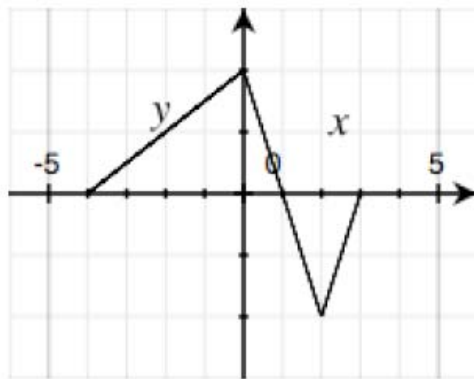
3.  $-f(x + 2)$

4.  $5f(x) + 3$

5.  $f(2x)$

6.  $|f(x)|$

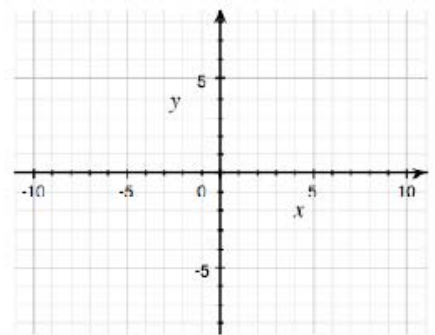
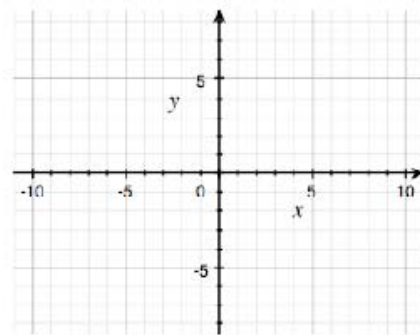
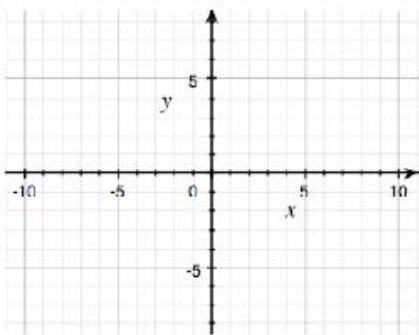
Using the following graph of  $y = f(x)$ , sketch the following graphs.



7.  $y = 2f(x)$

8.  $y = -f(x)$

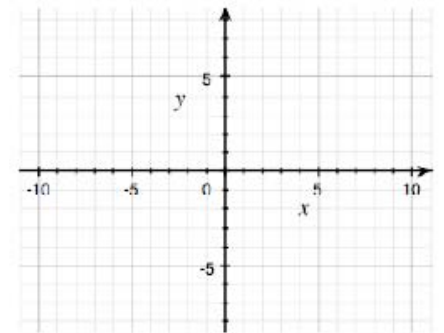
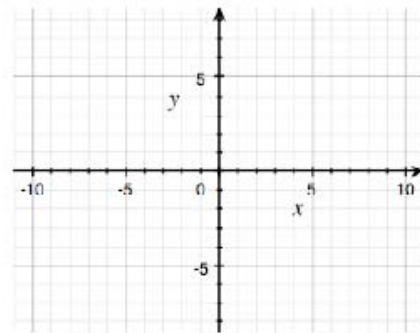
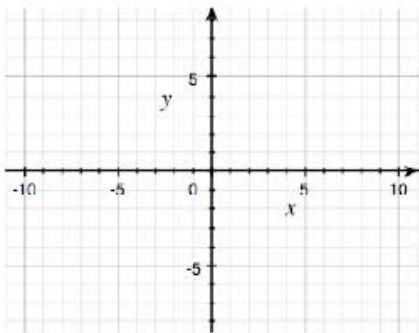
9.  $y = f(x - 1)$



10.  $y = f(x + 2)$

11.  $y = |f(x)|$

12.  $y = f|x|$



## Topic 6: Even and Odd Functions

Determine if the relation is even, odd or neither analytically.

1.  $f(x) = 2x^2 - 7$

2.  $f(x) = -4x^3 - 2x$

3.  $f(x) = 4x^2 - 4x + 4$

4.  $f(x) = x - \frac{1}{x}$

5.  $f(x) = |x| - x^2 + 1$

6.  $5x^2 - 6y = 1$

7.  $y = e^x - e^{-x}$

8.  $3y^3 = 4x^3 + 1$

9.  $3x = |y|$

## Topic 7: Solving Quadratic Equations

Solve each equation.

1.  $7x^2 - 3x = 0$

2.  $4x(x-2) - 5x(x-1) = 2$

3.  $x^2 + 6x + 4 = 0$

4.  $2x^2 - 3x + 3 = 0$

5.  $2x^2 - (x+2)(x-3) = 12$

6.  $x + \frac{1}{x} = \frac{13}{6}$

7.  $x^4 - 9x^2 + 8 = 0$

8.  $x - 10\sqrt{x} + 9 = 0$

9.  $\frac{1}{x^2} - \frac{1}{x} = 6$

## Topic 8: Asymptotes

Find the equations for all asymptotes, if any exist, for each function.

1.  $y = \frac{x}{x-3}$

2.  $y = \frac{x+4}{x^2-1}$

3.  $y = \frac{x+4}{x^2+1}$

4.  $y = \frac{x^2-2x+1}{x^2-3x-4}$

5.  $y = \frac{x^2-9}{x^3+3x^2-18x}$

6.  $y = \frac{2x^2+6x}{x^3-3x^2-4x}$

7.  $y = \frac{x^2-x-6}{x^3-6x^2+x-6}$

8.  $y = \frac{2x^3}{x^3-1}$

9.  $y = \frac{\sqrt{x}}{2x^2-10}$

## Topic 9: Complex Fractions

Simplify the following.

$$1. \frac{x}{x - \frac{1}{2}}$$

$$2. \frac{\frac{1}{x} + 4}{\frac{1}{x} - 2}$$

$$3. \frac{x - \frac{1}{x}}{x + \frac{1}{x}}$$

$$4. \frac{\frac{3}{4} - \frac{4}{3}}{\frac{x}{y}}$$

$$5. \frac{1 - \frac{2}{3x}}{x - \frac{4}{9x}}$$

$$6. \frac{\frac{x^2 - y^2}{xy}}{y}$$

$$7. \frac{x^{-3} - x}{x^{-2} - 1}$$

$$8. \frac{\frac{x}{1-x} + \frac{1+x}{x}}{\frac{1-x}{x} + \frac{x}{1+x}}$$

$$9. \frac{\frac{4}{x-5} + \frac{2}{x+2}}{\frac{2x}{x^2 - 3x - 10} + 3}$$

### Topic 10: Composition of Functions

If  $f(x) = x^2$ ,  $g(x) = 2x - 1$ , and  $h(x) = \frac{1}{x}$ , find the following. For 6-9 state the domain of the resulting function.

1.  $f(g(2))$

2.  $g(f(2))$

3.  $f(h(-1))$

4.  $h(f(-1))$

5.  $g\left(f\left(h\left(\frac{1}{2}\right)\right)\right)$

6.  $f(g(x))$

7.  $g(f(x))$

8.  $g(g(x))$

9.  $g(h(x))$

## Topic 11: Solving Rational equations

Solve each equation for  $x$ .

$$1. \frac{2}{3} - \frac{5}{6} = \frac{1}{x}$$

$$2. x + \frac{6}{x} = 5$$

$$3. \frac{x+1}{3} - \frac{x-1}{2} = 1$$

$$4. \frac{x-5}{x+1} = \frac{3}{5}$$

$$5. \frac{60}{x} - \frac{60}{x-5} = \frac{2}{x}$$

$$6. \frac{2}{x+5} + \frac{1}{x-5} = \frac{16}{x^2-25}$$

$$7. \frac{x}{x-2} + \frac{2x}{4-x^2} = \frac{5}{x+2}$$

$$8. \frac{x}{2x-6} - \frac{3}{x^2-6x+9} = \frac{x-2}{3x-9}$$

$$9. \frac{2x+3}{x-1} = \frac{10}{x^2-1} + \frac{2x-3}{x+1}$$

## Topic 12: Logarithmic Function

Write each expression as a sum and/or difference without exponents.

1.  $\log(u^2 g^5)$

2.  $\ln\left(\frac{x(x+2)}{(x+3)^2}\right)$

3.  $\log\left(\frac{x}{\sqrt{x-5}(3x+7)}\right)$

Write each expression as a single logarithm.

4.  $2\log x^3 + \frac{1}{2}\log(4x-9)$

5.  $\frac{1}{3}\log x - 2(\log 3 + \log x)$

6.  $\ln(x^2+3x+2) - 2\ln(x+1)$

Solve each equation for x.

7.  $\log_3(x-8) = 2$

8.  $\ln x + \ln(x+2) = 4$

9.  $\log 4x - \log(x-3) = \log 12$

### Topic 13: Exponential Function

Solve each of the following for  $x$ .

1.  $4^{1-2x} = 8^x$

2.  $500e^{-x} = 300$

3.  $3^x = 14$

4.  $6^{x-3} = 3^{4x+1}$

5.  $2^{2x} + 2^x - 12 = 0$

6.  $e^{2x} + e^x - 2 = 0$

Solve each of the following.

7. Which rate would yield more after 1 year starting with \$500?

5 ½ % compounded quarterly    6 ¼ % compounded monthly    9% compounded annually

8. If a population increased from 300,000 to 450,000 from 2001 to 2004, what will the population be in 2007?

9. The half-life of carbon 14 is 5600 years. A piece of charcoal is found to contain 70% of the carbon 14 that it originally had. When did the tree from which the charcoal came die?

## Topic 14: Trig Identities

Establish each trig identity.

1.  $\tan \theta \cos \theta = \sin \theta$

2.  $\tan \theta (\cot \theta + \tan \theta) = \sec^2 \theta$

3.  $1 - \frac{\cos^2 x}{1 + \sin x} = \sin x$

4.  $\frac{\sin x}{\sin x - \cos x} = \frac{1}{1 - \cot x}$

5.  $\frac{\sec x}{1 - \sin x} = \frac{1 + \sin x}{\cos^3 x}$

6.  $(4 \sin x \cos x)(1 - 2 \sin^2 x) = \sin(4x)$

### Topic 15: Trig equations

Solve each equation for  $x$  on the interval  $[0, 2\pi]$ .

1.  $\sin x = \frac{1}{2}$

2.  $\sin^2 - 1 = 0$

3.  $\tan x = 2 \sin x$

4.  $1 + \sin x = 2 \cos^2 x$

5.  $\sin(2x) = \cos x$

6.  $\cos(2x) = \cos x$

7.  $\sin^2 x = 2 \cos x + 2$

8.  $\sin(2x) = \frac{1}{2}$

9.  $2 \sin \frac{x}{2} + \sqrt{3} = 0$

## Topic 16: Limits Algebraically

Find each limit analytically.

1.  $\lim_{x \rightarrow 3} (x^2 + 3x - 7)$

2.  $\lim_{x \rightarrow -2} \frac{4 - x^2}{2 + x}$

3.  $\lim_{x \rightarrow 1} \frac{\sqrt{x} - 1}{x - 1}$

4.  $\lim_{x \rightarrow 0} \frac{\sin^2 x}{x^2}$

5.  $\lim_{x \rightarrow 0} \frac{\sec x - 1}{x \sec x}$

6.  $\lim_{x \rightarrow \frac{\pi}{6}} \frac{1 - \tan x}{\sin x - \cos x}$

7.  $\lim_{x \rightarrow 1} f(x)$  if  $f(x) = \begin{cases} \frac{x^2 - x}{x - 1} & x < 1 \\ \sqrt{1 - x} & x \geq 1 \end{cases}$

8.  $\lim_{x \rightarrow 3} f(x)$  if  $f(x) = \begin{cases} 2(x + 1) & x < 3 \\ x^2 - 1 & x > 3 \end{cases}$

9. If  $\lim_{x \rightarrow c} f(x) = \frac{3}{2}$  and  $\lim_{x \rightarrow c} g(x) = \frac{1}{2}$ , find

a.  $\lim_{x \rightarrow c} [4f(x)]$

b.  $\lim_{x \rightarrow c} [f(x) + g(x)]$

c.  $\lim_{x \rightarrow c} [f(x)g(x)]$

d.  $\lim_{x \rightarrow c} \frac{f(x)}{g(x)}$

10. If  $\lim_{x \rightarrow c} f(x) = 27$  find

a.  $\lim_{x \rightarrow c} \sqrt[3]{f(x)}$

b.  $\lim_{x \rightarrow c} \frac{f(x)}{18}$

c.  $\lim_{x \rightarrow c} [f(x)]^2$

d.  $\lim_{x \rightarrow c} [f(x)]^{2/3}$

## Topic 17: Limits at Infinity

Solve each limit without a calculator.

$$1. \lim_{x \rightarrow 2^+} \frac{x-3}{x-2}$$

$$2. \lim_{x \rightarrow 3^-} \frac{x^2}{x^2-9}$$

$$3. \lim_{x \rightarrow 4^+} \frac{x^2}{x^2+16}$$

$$4. \lim_{x \rightarrow -3^-} \frac{x^2+2x-3}{x^2+x-6}$$

$$5. \lim_{x \rightarrow (-1/2)^+} \frac{x^2+x-1}{4x^2-4x-3}$$

$$6. \lim_{x \rightarrow 0^-} \left(1 + \frac{1}{x}\right)$$

$$7. \lim_{x \rightarrow 0^-} \left(x^2 - \frac{1}{x}\right)$$

$$8. \lim_{x \rightarrow 0^+} \frac{2}{\sin x}$$

$$9. \lim_{x \rightarrow (\pi/2)^+} \frac{-2}{\cos x}$$

$$10. \lim_{x \rightarrow 1^+} \frac{x^2+x+1}{x^3-1}$$

$$11. \lim_{x \rightarrow 1^+} \frac{x^3-1}{x^2+x+1}$$

$$12. \lim_{x \rightarrow -1^-} \frac{x+1}{x^4-1}$$

$$13. \lim_{x \rightarrow \infty} \left(5 - \frac{1}{x^2}\right)$$

$$14. \lim_{x \rightarrow \infty} \left(\frac{2x-1}{x+1}\right)$$

$$15. \lim_{x \rightarrow -\infty} \left(\frac{2x+5}{3x^2+1}\right)$$

$$16. \lim_{x \rightarrow -\infty} \left(\frac{5x^2}{x+3}\right)$$

$$17. \lim_{x \rightarrow \infty} \left(\frac{3x-2}{\sqrt{4x^2+1}}\right)$$

$$18. \lim_{x \rightarrow -\infty} \left(\frac{3x-2}{\sqrt{4x^2+1}}\right)$$