

## Math 116 Prerequisite Material

### Practice Exercises

We summarize below that post-arithmetic material students need to be expert in if they are to be successful in Math 116. If any of this material is unfamiliar to you, the student, consult your instructor or the Math 116 coordinator, Professor Key, **during office hours** for help in mastering this material. **This is pre-requisite material and its mastery will be presumed. This material will not be covered during class meetings.**

### 1 Respect for definitions

1. Define **circle**.
2. Define **straight angle**.
3. Define **right angle**.
4. Define **square**.
5. Define **quadratic equation**.
6. Define **isosceles triangle**.
7. Define **right triangle**.
8. Define **hypotenuse**.

### 2 Check your work!

In each case check the answer to see if it is correct or not.

1.  $x = 3$  is a solution of  $2x + 4 = 3x + 1$ .
2.  $x = -3$  is a solution of  $x^2 + 4 = -x + 10$ .
3.  $x = 3$  is a solution of  $x^2 + 4 = -x + 10$ .
4.  $x = 2, y = 1$  is a solution of  $2x + 4y = 8, 3x + 2y = 9$ .
5.  $x = 2, y = 1$  is a solution of  $2x + 4y = 8, 3x + 2y = 8$ .

### 3 Some concepts from geometry

1. A triangle has sides of length 5, 12 and 13. Is it a right triangle?
2. A triangle has sides of length 7, 24 and 25. Is it a right triangle?
3. Two sides of a triangle measure 3 and 5. What possible lengths can the third side have so that this is a right triangle?
4. An equilateral triangle has side length 6. How long is its altitude? What is its area?
5. The diameter of a circle is 6 units. How long is its radius?

### 4 Absolute value

1. Which real numbers are 6 units from 0?
2. Which real numbers are more than 5 units from 0?
3. Which real numbers are negative and no more than 3 units from 0?
4. Solve  $|x| = 6$  for  $x$ .
5. Solve  $|x| > 6$  for  $x$ .
6. Solve  $|x| \leq 3$  and  $x < 0$  for  $x$ .
7. Solve  $|2x - 3| < 8$  for  $x$ .
8. Solve  $|-3x + 11| > 9$  for  $x$ .

#### 4.1 Quadrants

Identify the quadrant containing each point below, and give the distance from the point to the horizontal axis, to the vertical axis, and to  $(0, 0)$ .

1.  $(3, 4)$ .
2.  $(-3, 13)$ .
3.  $(13, -12)$ .
4.  $(2, -9)$ .
5.  $(-3, -8)$ .
6.  $(6, -8)$ .

Graph each triple of points, determine if they form the vertices of a triangle. If so, determine if the triangle is an isosceles triangle, an equilateral triangle or a right triangle.

1.  $(0, 0), (3, 0), (0, 4)$ .
2.  $(1, 1), (-2, 3), (5, 9)$ .
3.  $(-1, -1), (1, -1), (0, 4)$ .
4.  $(0, 0), (3, 0), (3/2, 3\sqrt{3}/2)$ .

Three points are given. The first is the center of a circle, the second is a point on the circle, and a line is drawn containing the second and third points. Determine the radius of the circle, and whether or not the line is tangent to the circle. Graph the circle and the line.

1.  $(0, 0), (3, 4)$  and  $(7, 1)$ .
2.  $(3, 2), (9, 6)$  and  $(10, 3)$ .
3.  $(-4, 7), (3, 8)$  and  $(5, 7)$ .

## 5 Lines

Graph each of the following lines. If they form a triangle, find the coordinates of the vertices and the lengths of the sides. Give the slope of each line, and its horizontal and vertical intercepts.

1.  $2x + 4y = 3$ .
2.  $3(x - 4) + 5(y - 1) = 0$ .
3.  $3(x - 2) + 6(y - 1) = 0$ .

Graph each of the following lines. If they form a triangle, find the coordinates of the vertices and the lengths of the sides. Give the slope of each line, and its horizontal and vertical intercepts.

1.  $-2x + 4y = 3$ .
2.  $4x + 2y = 8$ .
3.  $3(x - 2) + 6(y - 1) = 0$ .

Find a line parallel to the given line and passing through the given point:

1.  $2x + 4y = 3, (3, 5)$ .
2.  $3(x - 4) + 5(y - 1) = 0, (2, 5)$ .
3.  $3(x - 2) + 6(y - 1) = 0, (-3, 2)$ .
4.  $-2x + 4y = 3, (4, -5)$ .
5.  $4x + 2y = 8, (-11, -12)$ .

6.  $3(x - 2) + 6(y + 1) = 0, (\sqrt{2}, \sqrt{5})$ .

Find a line perpendicular to the given line and passing through the given point:

1.  $2x + 4y = 3, (3, 5)$ .

2.  $3(x - 4) + 5(y - 1) =, (2, 5)$ .

3.  $3(x - 2) + 6(y - 1) = 2, (-3, 2)$ .

4.  $-2x + 4y = 3, (4, -5)$ .

5.  $4x + 2y = 8, (-11, -12)$ .

6.  $3(x - 2) + 6(y - 1) = 2, (\sqrt{2}, \sqrt{5})$ .

## 6 Graphing absolute value equations

Graph each of the following equations.

1.  $y = 3|x - 2| + 4$ .

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

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

4.  $y = 4|x + 7| + 2$ .

5.  $x = 3|y - 2| + 4$ .

6.  $x = -3|y + 2| + 2$ .

## 7 Two factor patterns, completing the square, quadratic formula

Factor the following into the product of two binomials.

1.  $x^2 - 4$ .

2.  $4x^2 - 25$ .

3.  $9y^2 - 16w^2$ .

4.  $3x^2 - 2$ .

5.  $9x^4 - 16s^6$ .

6.  $x - 1$  assuming  $x \geq 0$ .

Factor each perfect square:

1.  $x^2 + 4x + 4$ .

2.  $x^2 - 6x + 9$ .
3.  $x^2 + 2\sqrt{2}x + 2$ .
4.  $y^4 + 6y^2 + 9$ .
5.  $x + 2\sqrt{x} + 1$ .
6.  $4x^2 + 4x + 1$ .

Complete the square in each expression. Example:  $x^2 + 2x + 2 = (x + 1)^2 + 1$ .

1.  $x^2 + 4x = \dots$ .
2.  $x^2 - 4x - 1 = \dots$ .
3.  $9x^2 - 4x = \dots$ .
4.  $x^2 + 3x + 2 = \dots$ .
5.  $3x^2 + 2x + 1 = \dots$ .

Solve each of the following equations two ways: first by completing the square and second by using the quadratic formula. If there are no real solutions, state why this is the case.

1.  $x^2 - 4x - 2 = 0$
2.  $x^2 + 2x - 1 = 0$
3.  $x^2 + 12x - 4 = 0$
4.  $x^2 - 12x - 4 = 0$
5.  $3x^2 - 12x - 4 = 0$
6.  $x^4 - 12x^2 - 4 = 0$

## 8 Graphing quadratic equations

Graph each of the following quadratic equations:

1.  $y = x^2$ .
2.  $y = x^2 + 2x + 1$ .
3.  $y = x^2 + 2x + 2$ .
4.  $y = 4x^2 + 4x + 2$ .
5.  $y = x^2 - 6x - 3$ .
6.  $y = 3x^2 + 12x - 4$ .

## 9 Exponents and roots

Combine exponents where possible:

1.  $x^2y^3x^5y^2$ .
2.  $x^3yx^3y^2$ .
3.  $x^{-2}y^3x^5y^{-2}$ .
4.  $x^{-3}yx^3y^2$ .
5.  $(x^2y^3x^5y^2)^2$ .
6.  $(x^3yx^3y^2)^{-1}$ .

Combine exponents where possible. Give any appropriate restrictions on  $x$  and  $y$ .

1.  $x^{1/2}y^3x^{1/4}y^2$ .
2.  $x^{1/3}yx^{2/3}y^{1/2}$ .
3.  $x^{-1/2}y^3x^{-1/2}y^{-1/4}$ .
4.  $x^{-1/3}yx^3y^{-1/12}$ .
5.  $(x^2y^3x^5y^2)^{-1/6}$ .
6.  $(x^3yx^3y^2)^{2/3}$ .

Solve for  $x$ :

1.  $x^{1/2} = 4$ .
2.  $x^{1/3} = -4$ .
3.  $x^{2/3} = 4$ .
4.  $2^x = 4$ .
5.  $3^x = -1/27$ .

## 10 Complex numbers

Add, subtract, multiply and divide each pair of complex numbers. Give the absolute value and complex conjugate of each answer. Each pair should yield 6 answers since subtraction and division are not commutative.

1.  $3 + 4i, 3 - 4i$ .
2.  $1 + 2i, 2 + 3i$ .

Reduce each of the following to the form  $a + bi$ :

1.  $i^{57}$ .
2.  $(1 + i)^4$ .