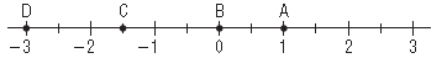


### 2.1

1. Write the absolute value of each number.

a) 15   b) -7.6   c) 0   d)  $-\frac{7}{2}$

2. Determine the absolute value of the number represented by each point on the number line.



3. Use absolute value to determine the distance between each pair of numbers on a number line. Sketch a number line to illustrate the solution.

a) -5 and 7                                      b) -3 and -10

4. Evaluate.

a)  $\sqrt{5^2}$    b)  $\sqrt{(-4)^2}$    c)  $\sqrt{10.1^2}$    d)  $\sqrt{(-11.4)^2}$

5. a) Determine each absolute value.

$|-11|, |12|, |0|, |4|, |-5|$

b) Order the numbers in part a from least to greatest. Show the solution on a number line.

6. For each pair of numbers, write two expressions to represent the distance between the numbers on a number line, then determine this distance.

a)  $-2\frac{3}{4}$  and  $5\frac{1}{4}$    b)  $-5\frac{3}{5}$  and  $-3\frac{7}{10}$    c) 12.47 and -8.23

7. Order the absolute values of the numbers in this set from greatest to least. Describe the strategy you used.

$8.5, -8\frac{1}{3}, -10.2, -0.2, 0.1, 9.8$

8. Evaluate.

a)  $|5(4) - 3|$    b)  $3|10 - 15|$    c)  $10 - |5 - 8|$

d)  $|6 + (-10)| - |5 - 7|$    e)  $3|-2| - 4|3|$

f)  $-3|4 - 1| + 2|1 - 4|$

9. Evaluate.

a)  $\sqrt{(5.1 - 2.3)^2} - |5.1 - 2.3|$

b)  $5.1 - 2.3 - |5.1 - 2.3|$

c)  $\frac{|2 - (-8)|}{|3| - |-2|}$    d)  $|5 - 4|(5 + 4) - 2(5 + 4)$

e)  $\frac{2}{3} \left| -\frac{5}{8} - \frac{1}{4} \right|$    f)  $\left| 1\frac{3}{4} - 2\frac{1}{2} \right| - \left| \frac{3}{4} - \frac{1}{2} \right|$

10. Evaluate each expression for the given value of x.

a)  $|x^2 + 6x - 5|, x = 2$    b)  $|-3x^2 + 7x + 1|, x = 3$

c)  $|x^3 - 5x - 2|, x = -3$

d)  $|5x^3 + 2x + 7|, x = -1$

11. When 7 is added to an integer, x, the absolute value of the sum is 12. Determine a value for x. How many values of x are possible? Show what you did to solve the problem.

2.1 ANS

1. a) 15 b) 7.6 c) 0 d) 3.5

2. a) 11 b) 1 c) 14 d) 0

3. a) 12 b) 7

4. a) 5 b) 4 c) 10.1 d) 11.4

5. a) 11, 12, 0, 4, 5 b) 0 < |4| < |5| < |-11| < |12|

6. a) 8 b) 19/10 c) 20.7

7.  $|-10.2| > |9.8| > |8.5| > |-8| > |0.1| > |-0.2| > |0.1|$

8. a) 17 b) 15 c) 7 d) 2 e) -6

9. a) 0 b) 0 c) 10 d) -9 e) 7/12

f) 1/2

10. a) 11 b) 5 c) 14 d) 0

11. two values x is 5 or -19

**2.2**

1. Write each mixed radical as an entire radical.

a)  $6\sqrt{5}$     b)  $3\sqrt[3]{4}$     c)  $-2\sqrt[3]{5}$     d)  $5\sqrt[4]{2}$

2. Write each entire radical as a mixed radical, if possible.

a)  $\sqrt{54}$     b)  $\sqrt[3]{96}$     c)  $\sqrt[3]{-81}$     d)  $\sqrt[4]{47}$

3. Arrange in order from least to greatest.

a)  $6\sqrt[3]{7}, 11\sqrt[3]{7}, 5\sqrt[3]{7}$     b)  $\sqrt{28}, 2\sqrt{5}, 3\sqrt{3}$

**(3 NO CALCULATOR)**

4. For which values of the variable is each radical defined? Justify your answers.

a)  $\sqrt{18x^2}$     b)  $\sqrt{-2a^3}$     c)  $\sqrt[3]{4c^3}$     d)  $\sqrt[4]{18z^5}$

5. Write each mixed radical as an entire radical.

a)  $3\sqrt{\frac{7}{3}}$     b)  $-\frac{2}{3}\sqrt{\frac{5}{8}}$     c)  $-\frac{2}{3}\sqrt[3]{\frac{2}{3}}$

6. Write each entire radical as a mixed radical, if possible.

a)  $\sqrt{\frac{125}{4}}$     b)  $\sqrt[4]{\frac{32}{243}}$     c)  $\sqrt[3]{\frac{64}{81}}$

7. Arrange in order from greatest to least.

a)  $3\sqrt[3]{5}, 2\sqrt{11}, 4\sqrt[4]{8}$     **(CALCULATOR)**

b)  $4\sqrt{6}, 4\sqrt{7}, 4\sqrt{2}, 4\sqrt{5}$     **(NO CALCULATOR)**

c)  $3\sqrt[3]{5}, 2\sqrt[3]{12}, 4\sqrt[3]{2}, 3\sqrt[3]{4}$     **(NO CALCULATOR)**

8. Write the values of the variable for which each radical is defined. Simplify the radical, if possible.

a)  $\sqrt[3]{-8x^2}$     b)  $\sqrt{48b^4}$     c)  $\sqrt[4]{16r^4}$     d)  $\sqrt[4]{125x^3}$

9. For which values of the variable is each radical defined? Rewrite the radical in simplest form.

a)  $\sqrt[3]{\frac{27x^2}{16}}$     b)  $\sqrt[3]{\frac{-48c^5}{125}}$     c)  $\sqrt[4]{\frac{81y^3}{16}}$

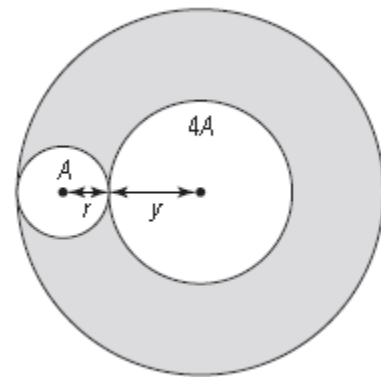
10. For which values of the variables is each radical defined? Simplify the radical, if possible.

a)  $\sqrt{98a^3b^6}$     b)  $\sqrt[3]{-40x^3y^5}$     c)  $\sqrt[4]{48r^4s^8}$   
d)  $\sqrt[3]{128}$

11. A circle with radius  $r$  and area  $A$  touches another circle with radius  $y$  and area  $4A$ . A larger circle is drawn around the other two as shown.

a) Determine an expression for the value of  $y$  in terms of  $r$ . State the restrictions on the variables.

b) Determine the area of the shaded region in terms of  $A$ .



**2.2Ans**

1. a)  $\sqrt{180}$  b)  $\sqrt[3]{108}$  c)  $\sqrt{-40}$  d)  $\sqrt[4]{1250}$   
 2. a)  $3\sqrt{6}$  b)  $2\sqrt[3]{12}$  c)  $-3\sqrt[3]{3}$  d) can't be written in mixed form  
 3. a)  $5\sqrt[3]{7} > 6\sqrt[3]{7} > 7\sqrt[3]{7}$  b)  $2\sqrt{5} > 3\sqrt{3} > \sqrt{28}$   
 4. a)  $x \geq 0$  b)  $a \leq 0$  c)  $c \geq 0$  d)  $z \geq 0$   
 5. a)  $\sqrt{21}$  b)  $-\sqrt{\frac{18}{5}}$  c)  $\sqrt[3]{-\frac{16}{81}}$   
 6. a)  $5\sqrt{5}$  b)  $\frac{z}{2}\sqrt[4]{\frac{3}{z}}$  c)  $\sqrt[3]{-\frac{3}{4}}$   
 7. a)  $4\sqrt[4]{8} < 2\sqrt[4]{11} < 3\sqrt[4]{5}$  b)  $4\sqrt[4]{7} < 4\sqrt[4]{6} < 4\sqrt[4]{5} < 4\sqrt[4]{2}$  c)  $3\sqrt[3]{5} < 4\sqrt[3]{2} < 3\sqrt[3]{4} < 2\sqrt[3]{12}$   
 8. a)  $-2\sqrt[3]{x^2}$ ,  $x \geq 0$  b)  $4b^2\sqrt{3}$ ,  $b \geq 0$  c)  $2|r|$ ,  $r \geq 0$  d) can't be simplified,  $x \geq 0$   
 9. a)  $\frac{z}{3}\sqrt[3]{x^2}$ ,  $x \geq 0$  b)  $-\frac{5}{2}c\sqrt[3]{6c^2}$ ,  $c \geq 0$  c)  $\frac{z}{3}y\sqrt[4]{y}$ ,  $y \geq 0$  d)  $7a|b|$ ,  $a \geq 0$ ,  $b \geq 0$  e)  $\sqrt[3]{2a}$ ,  $a \geq 0$  f)  $-2xy\sqrt[3]{5y^2}$ ,  $x \geq 0$ ,  $y \geq 0$   
 10. c)  $2|r|s^2\sqrt[4]{3}$ ,  $r, s \geq 0$  d)  $4n\sqrt[3]{2m^2n}$ ,  $m, n \geq 0$  e)  $Area = 11A$   
 11. a)  $y = 2r$  b)  $Area = 11A$

## 2.3

1. a) Simplify each radical, if possible.

$$\sqrt{27} \quad 3\sqrt{2} \quad \sqrt{8} \quad \sqrt{32}$$

$$\sqrt{6} \quad 2\sqrt{3} \quad \sqrt{48} \quad \sqrt{18}$$

- b) Group the radicals in part a into sets of like radicals.

2. Simplify by adding or subtracting like terms.

a)  $3\sqrt{2} + 2\sqrt{2} - 5\sqrt{2}$     b)  $\sqrt{108} - 2\sqrt{3} - \sqrt{75}$

c)  $5\sqrt{7} + 2\sqrt{5} - \sqrt{28} + \sqrt{45}$     d)  $\sqrt[3]{16} + \sqrt[3]{375} - 3\sqrt[3]{2}$

3. Simplify.

a)  $6\sqrt{x} - 4\sqrt{x} + 2\sqrt{x} + \sqrt{x}, x \geq 0$

b)  $\sqrt{4a} + \sqrt{16a} - \sqrt{9a}, a \geq 0$

c)  $\sqrt[3]{27x^2} - \sqrt[3]{8x^2} + \sqrt[3]{64x^2}, x \in \mathbb{R}$

4. Identify the values of the variables for which each radical is defined, then simplify.

a)  $7\sqrt{-x} + 15\sqrt{-x} - 13\sqrt{-x}$     b)  $\sqrt{28m^4n} + m^2\sqrt{63n}$

c)  $4\sqrt[3]{2p^4q} - 6p\sqrt[3]{2pq}$

5. Simplify.

a)  $\sqrt{5b} + 4\sqrt{5b} - 3\sqrt[3]{5b} - 2\sqrt{5b}, b \geq 0$

b)  $3\sqrt{x^3} + 5\sqrt{2x} - \sqrt{4x^3}, x \geq 0$

c)  $5e\sqrt{24e^3} - 7\sqrt{54e^5} + e^2\sqrt{6e} + 6e, e \geq 0$

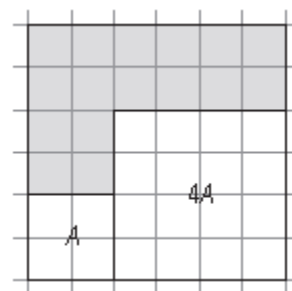
d)  $\sqrt[3]{16v^5} + \sqrt[3]{3w^4} + 2w\sqrt[3]{24w} - 5w\sqrt[3]{54v^2}, v, w \in \mathbb{R}$

6. A square with area 24 square units is placed beside a square with area 50 square units. In simplest form, write a radical expression for the perimeter of the shape formed.

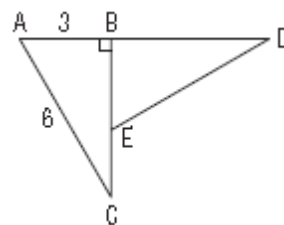


- 7.

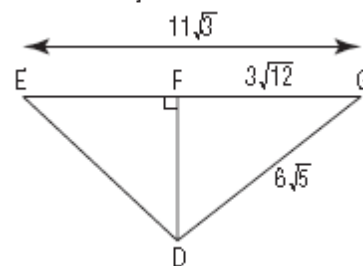
Two squares are enclosed in a large square as shown. The area of the smallest square is  $A$  square units. The area of the middle square is  $4A$  square units. Determine the area and perimeter of the shaded region in terms of  $A$ .



8. In right
- $\triangle ABC$
- ,
- $AB$
- has length 3 units and
- $AC$
- has length 6 units. A congruent triangle is placed adjacent to
- $\triangle ABC$
- as shown. Determine the perimeter of the shape formed.



9. Determine whether
- $\triangle EDG$
- is a right triangle. How did you find out?



- 10.

Determine if there are any values of  $x$  and  $y$  such that  $\sqrt{x+y}$  and  $\sqrt{x} + \sqrt{y}$  are equal. Explain your reasoning.

**2.4**

1. Expand and simplify.

a)  $\sqrt{6}(\sqrt{5} + 2)$       b)  $\sqrt{5}(\sqrt{2} - 4)$   
 c)  $\sqrt{2}(-7 + \sqrt{2})$       d)  $-\sqrt{3}(3 + \sqrt{8})$

2. Expand and simplify.

a)  $\sqrt{6}(\sqrt{3} + \sqrt{2})$       b)  $-2\sqrt{7}(3\sqrt{2} - \sqrt{7})$

3. Expand and simplify.

a)  $(\sqrt{3} + 2)(\sqrt{3} - 2)$       b)  $(\sqrt{5} + 2)^2$   
 c)  $(\sqrt{3} + \sqrt{2})^2$       d)  $(2\sqrt{3} + 3\sqrt{5})(\sqrt{3} - 2\sqrt{5})$

4. Rationalize the denominator.

a)  $\frac{2}{\sqrt{3}}$       b)  $\frac{1}{5\sqrt{3}}$

5. Expand and simplify.

a)  $(\sqrt{3} + 8)(2\sqrt{3} - 1) - \sqrt{3}(7\sqrt{3} - 4)$   
 b)  $-(3\sqrt{2} - \sqrt{5})(\sqrt{2} + 7) - (2\sqrt{2} - \sqrt{5})^2$   
 c)  $(6\sqrt{7} - 5\sqrt{5})(6\sqrt{7} + 5\sqrt{5}) + (3\sqrt{7} + 4\sqrt{5})^2$

6. Identify the values of the variable for which each expression is defined, then expand and simplify.

a)  $\sqrt{w}(2\sqrt{w} + 3)$       b)  $(3\sqrt{x} - 2)(2\sqrt{x} + 5)$   
 c)  $(\sqrt{c} + \sqrt{d})^2$       d)  $(2\sqrt{x} - 3\sqrt{y})(2\sqrt{x} + 3\sqrt{y})$   
 e)  $(2\sqrt{a} - \sqrt{b})(3\sqrt{a} - 4\sqrt{b}) - (\sqrt{a} - 3\sqrt{b})^2$

7. Simplify. Describe the strategy you used in part c.

a)  $\frac{2\sqrt{5} + 4}{\sqrt{5}}$       b)  $\frac{5\sqrt{8} - 2\sqrt{5}}{\sqrt{6}}$   
 c)  $\frac{-3\sqrt{12} + 2\sqrt{3}}{\sqrt{18}}$       d)  $\frac{4\sqrt{2} - 6\sqrt{5}}{2\sqrt{3}}$

8. Simplify.

a)  $\frac{-\sqrt{5}}{\sqrt{7} - 3}$       b)  $\frac{5\sqrt{3} + \sqrt{2}}{\sqrt{3} - \sqrt{2}}$   
 c)  $\frac{5\sqrt{8} - 3\sqrt{2}}{\sqrt{32} + 3\sqrt{2}}$       d)  $\frac{6\sqrt{3} - 2}{5 + 4\sqrt{2}}$

9. Simplify.

i)  $\frac{1}{\sqrt{5}} - \frac{1}{\sqrt{3}}$       ii)  $\frac{\sqrt{2}}{\sqrt{12}} - \frac{5\sqrt{3}}{\sqrt{8}}$   
 iii)  $\frac{\sqrt{6}}{2\sqrt{5} + 3\sqrt{3}} - \frac{\sqrt{2}}{\sqrt{7} - 2\sqrt{3}}$

10. Rationalize the denominator.

a)  $\frac{3}{\sqrt[3]{4}}$       b)  $\frac{4}{\sqrt[4]{3}}$

2.4 ANS  
 1. a)  $\sqrt{30} + 2\sqrt{6}$  b)  $\sqrt{10} - 4\sqrt{5}$  c)  $-7\sqrt{2} + 2$   
 d)  $-3\sqrt{3} - 2\sqrt{6}$   
 2. a)  $3\sqrt{2} + 2\sqrt{3}$  b)  $-6\sqrt{14} + 14$   
 3. a) -1 b) 9 + 4 $\sqrt{5}$  c) 5 + 2 $\sqrt{6}$  d) -24 -  $\sqrt{15}$   
 4. a)  $\frac{2\sqrt{3}}{3}$  b)  $\frac{\sqrt{3}}{15}$  5. a) -23 + 19 $\sqrt{3}$  b) -19 - 21 $\sqrt{2}$  + 5 $\sqrt{10}$  + 7 $\sqrt{5}$  c) 270 + 24 $\sqrt{35}$   
 6. a) 2w + 3 $\sqrt{w}$  b) 6x + 11 $\sqrt{x}$  - 10 c) c + 2 $\sqrt{cd}$  + d  
 d) 4x - 9y e) 5a - 5 $\sqrt{ab}$  - 5b  
 7. a)  $\frac{10 + 4\sqrt{5}}{5}$  b)  $\frac{10\sqrt{3} - \sqrt{30}}{3}$  c)  $\frac{3}{-2\sqrt{6}}$  d)  $\frac{3}{2\sqrt{6} - 3\sqrt{15}}$   
 8. a)  $\frac{\sqrt{35} + 3\sqrt{5}}{2}$  b) 17 + 6 $\sqrt{6}$  c) 1 d)  $\frac{7}{-30\sqrt{3} + 22\sqrt{6} + 10 - 8\sqrt{2}}$   
 9. i)  $\frac{3\sqrt{5} - 5\sqrt{3}}{15}$  ii)  $\frac{12}{-13\sqrt{6}}$  iii)  $\frac{35}{-10\sqrt{30} + 45\sqrt{2} + 7\sqrt{14} + 14\sqrt{6}}$   
 10. a)  $\frac{4}{3(\sqrt[3]{4})^2}$  b)  $\frac{4}{4(\sqrt[4]{3})^3}$

2.3 ANS  
 1) a) 3 $\sqrt{3}$ , 3 $\sqrt{2}$ , 2 $\sqrt{2}$ , 4 $\sqrt{2}$ ,  $\sqrt{6}$ , 2 $\sqrt{3}$ , 4 $\sqrt{3}$ , 3 $\sqrt{2}$   
 b) (3 $\sqrt{3}$ , 2 $\sqrt{2}$ ), (3 $\sqrt{2}$ , 2 $\sqrt{2}$ ), (4 $\sqrt{2}$ , 3 $\sqrt{2}$ ), (3 $\sqrt{3}$ , 4 $\sqrt{3}$ ), (3 $\sqrt{2}$ , 4 $\sqrt{2}$ ), (4 $\sqrt{2}$ , 3 $\sqrt{2}$ )  
 2) a) 0 b) - $\sqrt{3}$  c) 3 $\sqrt{7} + 5\sqrt{5}$  d) - $\sqrt{2} + 5\sqrt{3}$   
 3) a) 5 $\sqrt{x}$  b) 3 $\sqrt{a}$  c) 5 $\sqrt{z}$  4) a) x < 0; 9 -  $\sqrt{-x}$  b) n > 0, mER; 5m<sup>2</sup> $\sqrt{7n}$  c) p, qER; -2p<sup>3</sup> $\sqrt{2pq}$   
 5) a) 3 $\sqrt{5d}$  - 3 $\sqrt{5d}$  b) x $\sqrt{x} + 5\sqrt{2x}$  c) -10e<sup>2</sup> $\sqrt{6e} + 6e$  d) -13v $\sqrt{2v^2} + 5w\sqrt{3w}$   
 6) 20 $\sqrt{2} + 4\sqrt{6}$  7) a = 44 p = 10 $\sqrt{A}$  8) 12 + 6 $\sqrt{3}$  9) no 10) x = 0 OR y = 0

## 2.5

1. Solve each equation. Verify the solution.

a)  $\sqrt{3x} = 6$    b)  $2\sqrt{5x} = 10$    c)  $42 = 7\sqrt{2x}$

d)  $-2\sqrt{6x} = -12$

2. Solve each equation. Verify the solution.

a)  $\sqrt{x-2} = 5$    b)  $\sqrt{3x+1} = 5$

c)  $4 = \sqrt{2-7x}$    d)  $3 = \sqrt{2x+1}$

e)  $\sqrt{5x-9} - 2 = 7$    f)  $2\sqrt{1-3x} + 1 = 9$

3. Determine whether the given value of  $x$  is a root of the equation.

a)  $\sqrt{2x+1} = 9$ ;  $x = 16$

b)  $\sqrt{3x-6} = 6$ ;  $x = 14$

c)  $9 = \sqrt{121-2x}$ ;  $x = 20$

d)  $\sqrt{2x-5} = \sqrt{3x-2}$ ;  $x = -3$

e)  $\sqrt{2x+5} = \sqrt{3x+2}$ ;  $x = 3$

4. Determine the root of each equation. Verify the solution.

a)  $\sqrt{6x} = 2$    b)  $2 = \sqrt{2x+1}$

c)  $3 - \sqrt{x} = -2$    d)  $4 = \sqrt{-2x+3}$

e)  $1 - 3\sqrt{5x} = -3 - 2\sqrt{5x}$

f)  $2 - 2\sqrt{3x} = 1 - \sqrt{3x}$

5. Determine the root of each equation. Verify the solution.

a)  $\frac{\sqrt{x}}{5} = 2$    b)  $-2 = \frac{-\sqrt{2x}}{4}$

c)  $\frac{\sqrt{3x-2}}{2} = 1$    d)  $\sqrt{x-7} = \frac{\sqrt{2x+4}}{2}$

6. Which of these equations have real roots? Justify your answers.

a)  $2 = \sqrt{3x-1}$

b)  $\sqrt{3x-1} + 5 = 2$

c)  $\sqrt{5x+3} = \sqrt{3x+1}$

d)  $\sqrt{-3x+7} = \sqrt{-2x+9}$

7. Which of these equations have real roots? Justify your answers.

a)  $2\sqrt{x+8} = 3\sqrt{3x+1}$

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

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

d)  $2\sqrt{x-8} = 3\sqrt{3x-1}$

1. a)  $x = 12$  b)  $x = 5$  c)  $x = 18$  d)  $x = 6$   
 2. a)  $x = 27$  b)  $x = 8$  c)  $x = -2$  d)  $x = -4$  e)  $x = 18$   
 f)  $x = -5$   
 3. a) no b) yes c) yes d) no e) yes  
 4. a)  $x = \frac{3}{2}$  b)  $x = \frac{2}{3}$  c)  $x = 25$  d)  $x = -\frac{2}{1}$  e)  $x = 3\frac{5}{1}$   
 f)  $x = \frac{3}{1}$   
 5. a)  $x = 100$  b)  $x = 32$  c)  $x = 2$  d)  $x = 16$   
 6. a) real root b) no real roots c) no real roots  
 d) real root  
 7. a) real root b) no real roots c) real root  
 d) no real roots