



**AMERICAN RIVER COLLEGE  
ASSESSMENT CENTER**

**Math Competency Study Guide**

**This study guide is intended to be an aid for the review of some basic algebra skills needed for the math competency exam. Additional resources, such as math textbooks available through the library and videos available in the LRC, should be used to supplement this guide.**

**This is not a comprehensive review for the test nor is it intended to develop algebra skills for those who have not had algebra in the last 5 years.**

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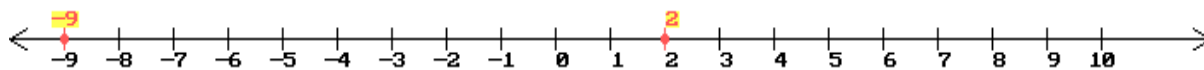
**Questions on the test will involve one of the following skills:**

- **Operations with real numbers**
- **Operations with algebraic expressions**
- **Solutions of equations and inequalities**
- **Applications**

Example 1: Find  $6 - (-2)$   
 To subtract, change the sign of the second number and add.  
 $6 - (-2) = 6 + 2 = 8$

Example 2: Evaluate  $\frac{5m+n}{m-n}$  if  $m = -4$  and  $n = 2$ .  
 Replace  $m$  with  $-4$  and  $n$  with  $2$ .  
 $\frac{5(-4)+2}{-4-2} = \frac{-20+2}{-4+(-2)} = \frac{-18}{-6} = 3$

Example 3: Choose the smaller number:  $-9, 2$   
 The smaller number is to the left on a number line.  
 Place  $-9$  and  $2$  on a number line.



Since  $-9$  is farther to the left, it is smaller.

Example 4: Choose the smaller number:  $-3, -7$   
 Use a number line.



$-7$  is smaller, since it is further to the left.

Example 5: Choose the smaller number:  $|2|, |-7|$ .  
 $|x|$  means the absolute value of  $x$ . Since  $|x|$  is always non-negative,  $|2| = 2$  and  $|-7| = 7$   
 $|2|$  is smaller.

## SIMPLIFY:

Example 6:  $8x - 3x + x$   
 Use the distributive property and the fact that  $x = 1x$   
 $8x - 3x + x = (8 - 3 + 1)x$   
 $= 6x$

Example 7:  $2(3m - 5) - (2 - m)$   
 Use the distributive property.  
 $2(3m - 5) - (2 - m) = 2(3m - 5) - 1(2 - m)$   
 $= 6m - 10 - 2 + m$   
 $= 7m - 12$

SOLVE EACH EQUATION:

Example 8:

$$3p - 7 = 23$$

Add 7 to both sides.

$$3p - 7 + (7) = 23 + (7)$$

$$3p = 30$$

Multiply both sides by  $\frac{1}{3}$ .

$$\frac{1}{3} \times 3p = \frac{1}{3} \times 30$$

$$p = 10$$

Example 9:

$$2p - (7p + 3) = 2$$

Simplify:

$$2p - 7p - 3 = 2$$

$$-5p - 3 = 2$$

Add 3 to both sides.

$$-5p - 3 + (3) = 2 + (3)$$

$$-5p = 5$$

Multiply both sides by  $-\frac{1}{5}$ .

$$-\frac{1}{5} \times (-5p) = -\frac{1}{5} \times 5$$

$$p = -1$$

Example 10:

$$-6m + 2 < -10$$

Add -2 to both sides.

$$-6m + 2 + (-2) < -10 + (-2)$$

$$-6m < -12$$

Multiply both sides by  $-\frac{1}{6}$ . Recall that when multiplying

both sides of an inequality by a negative number, the direction of the inequality symbol must be reversed.

$$-\frac{1}{6}(-6m) < -\frac{1}{6}(-12)$$

$$m > 2$$

Example 11:

Multiply:  $8p(p^2 + 7p + 2)$

Use the distributive property.

$$8p(p^2 + 7p + 2) = 8p(p^2) + 8p(7p) + 8p(2)$$

$$= 8p^3 + 56p^2 + 16p$$

Example 12: Add:  $(9y^3 + 2y^2 + 3y + 2) + (8y^3 + 5y - 7)$   
 Add only like terms (those with the same exponents).  
 $(9y^3 + 8y^3) + (2y^2) + (3y + 5) + (2 - 7)$   
 $17y^3 + 2y^2 + 8y - 5$

Example 13: Multiply:  $(8k - 1)(2k + 3)$   
 Multiply the first terms.  $(8k)(2k) = 16k^2$   
 Multiply the outside terms.  $(8k)(3) = 24k$   
 Multiply the inside terms.  $(-1)(2k) = -2k$   
 Multiply the last terms.  $(-1)(3) = -3$   
 Add together.  
 $16k^2 + 24k + (-2k) + (-3)$   
 $= 16k^2 + 22k - 3$

Example 14: Multiply:  $(3m - 5)^2$   
 Separate the terms.  $(3m - 5)(3m - 5)$   
 Multiply the first terms.  $(3m)(3m) = 9m^2$   
 Multiply the outside terms.  $(3m)(-5) = -15m$   
 Multiply the inside terms.  $(-5)(3m) = -15m$   
 Multiply the last terms.  $(-5)(-5) = 25$   
 Add together.  $9m^2 - 15m - 15m + 25$   
 Combine like terms.  $9m^2 - 30m + 25$

Example 15: Divide:  $x^3 - 6x^2 + 16x - 15$  by  $x - 2$

$$\begin{array}{r} x^2 - 4x + 8 \\ x - 2 \overline{) x^3 - 6x^2 + 16x - 15} \\ \underline{x^3 - 2x^2} \phantom{+ 16x - 15} \\ -4x^2 + 16x \phantom{- 15} \\ \underline{-4x^2 + 8x} \phantom{- 15} \\ 8x - 15 \\ \underline{8x - 16} \\ 1 \end{array}$$

Answer:  $x^2 - 4x + 8 + \frac{1}{x - 2}$

## FACTOR

Example 16:  $16m^2 - 25$   
 Use the difference of two squares,  $x^2 - y^2 = (x + y)(x - y)$   
 $16m^2 - 25 = (4m)^2 - (5)^2 = (4m + 5)(4m - 5)$

Example 17:

$$x^2 + 12x + 20$$

Since the coefficient of the  $x^2$  term is 1, find two numbers whose product is 20 and whose sum is 12.

$$20 \times 1 = 20 \quad 20 + 1 = 21 \quad \text{no}$$

$$10 \times 2 = 20 \quad 10 + 2 = 12 \quad \text{yes}$$

Therefore:

$$x^2 + 12x + 20 = (x + 10)(x + 2)$$

Example 18:

$$2p^2 - p - 21$$

Use trial and error.

$$(2p - 3)(p + 7) = 2p^2 + 11p - 21 \quad \text{wrong}$$

$$(2p + 7)(p - 3) = 2p^2 + p - 21 \quad \text{wrong}$$

$$(2p - 7)(p + 3) = 2p^2 - p - 21 \quad \text{correct}$$

Example 19:

Multiply: 
$$\frac{9m^2}{2(m-4)} \times \frac{8m-32}{6m}$$

Factor: 
$$\frac{9m^2}{2(m-4)} \times \frac{8(m-4)}{6m}$$

Cancel out  $(m - 4)$ : 
$$\frac{9m^2}{2} \times \frac{8}{6m}$$

Cancel out  $m$ : 
$$\frac{9m}{2} \times \frac{8}{6}$$

Multiply: 
$$\frac{9m}{2} \times \frac{8}{6} = \frac{72m}{12} = 6m$$

Example 20:

Divide: 
$$\frac{6r^2}{r^2 + 2r - 15} \div \frac{3r}{r^2 - r - 6}$$

Factor:

$$\frac{6r^2}{(r+5)(r-3)} \div \frac{3r}{(r-3)(r+2)}$$

Invert the second fraction, change from division to multiplication, and cancel out like terms.

$$\frac{6r^2}{(r+5)(r-3)} \times \frac{(r-3)(r+2)}{3r}$$
$$\frac{2r}{(r+5)} \times \frac{(r+2)}{1} = \frac{2r(r+2)}{r+5}$$

Example 21: Write as a single fraction:  $\frac{4}{m} + \frac{3}{2m} - \frac{5}{7m}$

The least common denominator is  $14m$ .

$$\begin{aligned}\frac{4}{m} + \frac{3}{2m} - \frac{5}{7m} &= \frac{14 \cdot 4}{14 \cdot m} + \frac{7 \cdot 3}{7 \cdot 2m} - \frac{2 \cdot 5}{2 \cdot 7m} \\ &= \frac{56}{14m} + \frac{21}{14m} - \frac{10}{14m} \\ &= \frac{56 + 21 - 10}{14m} \\ &= \frac{67}{14m}\end{aligned}$$

Example 22: Solve:  $x^2 - 3x = 10$

Set the equation equal to zero.

$$x^2 - 3x - 10 = 0$$

Factor.

$$(x - 5)(x + 2) = 0$$

Set each factor equal to zero.

$$\begin{array}{l}x - 5 = 0 \qquad x + 2 = 0 \\ x = 5 \qquad \qquad x = -2\end{array}$$

The two solutions are 5 and  $-2$ .

Example 23: Solve:  $\frac{6}{m} + \frac{8}{m} = 1$

Multiply through by  $m$ .

$$\begin{aligned}m \cdot \frac{6}{m} + m \cdot \frac{8}{m} &= m \cdot 1 \\ 6 + 8 &= m \\ 14 &= m\end{aligned}$$

Example 24:

Solve the system:

$$2x - 3y = -8$$

$$3x + 5y = 7$$

Multiply the top equation by  $-3$  and the bottom equation by  $2$ .

$$-3(2x - 3y) = -3 * (-8)$$

$$2(3x + 5y) = 2 * 7$$

Add:  $-6x + 9y = 24$

$$\underline{6x + 10y = 14}$$

$$19y = 38$$

$$y = 2$$

To find  $x$ , replace  $y$  with  $2$  in the first equation.

$$2x - 3(2) = -8$$

$$2x - 6 = -8$$

$$2x = -2$$

$$x = -1$$

The solution is the ordered pair  $(-1, 2)$ .

Example 25:

Solve for  $r$ :  $p = \frac{3k}{7r}$

Multiply both sides by  $7r$ .

$$7r * p = 7r * \frac{3k}{7r}$$

$$7pr = 3k$$

Multiply by  $\frac{1}{7p}$ .

$$\frac{1}{7p} * 7pr = \frac{1}{7p} * 3k$$

$$r = \frac{3k}{7p}$$

Example 26:

The square roots of  $144$  are  $12$  and  $-12$ , since  $12^2 = 144$  and  $(-12)^2 = 144$ . Also, the roots of  $144m^8$  are  $12m^4$  and  $-12m^4$ .

Example 27:

Multiply  $\sqrt{7} * 5\sqrt{3}$

Since:  $\sqrt{a} * \sqrt{b} = \sqrt{ab}$

Therefore:  $5\sqrt{7*3} = 5\sqrt{21}$

Example 28:

Simplify:  $-7\sqrt{32} + 8\sqrt{50}$

To simplify  $\sqrt{32}$ , work as follows:  $\sqrt{32} = \sqrt{16 * 2}$   
 $\sqrt{16 * 2} = \sqrt{16} * \sqrt{2} = 4\sqrt{2}$

Also,  $\sqrt{50} = \sqrt{25} * \sqrt{2} = 5\sqrt{2}$

Therefore:  $-7\sqrt{32} + 8\sqrt{50} = -7(4\sqrt{2}) + 8(5\sqrt{2})$   
 $= -28\sqrt{2} + 40\sqrt{2}$   
 $= 12\sqrt{2}$

Example 29:

Solve  $3^2 * 3^4$

Since  $a^m * a^n = a^{m+n}$   
 $3^2 * 3^4 = 3^{2+4}$   
 $= 3^6$

Example 30:

Solve:  $(x^2)^3$

Since:  $(a^n)^m = a^{n*m}$

Therefore:  $(x^2)^3 = x^{2*3} = x^6$

Example 31:

The total cost of 3 items is \$40.00. If the first item costs \$15.00 and the second item costs \$18.00, how much does the third item cost?

Solution:

The equation is:  $x + y + z = 40$

Since the cost of the two items is known, we can substitute those values in the equation.

$$15 + 18 + z = 40$$

Now solve for z.

$$33 + z = 40$$

$$z = 40 - 33$$

$$z = \$7.00$$

Example 32: If  $\frac{2}{3}$  of a number is 30, what is the number?

Solution:

The equation is:  $\frac{2}{3}x = 30$

To solve for  $x$ , multiply both sides by  $\frac{3}{2}$ .

$$\begin{aligned}\left(\frac{3}{2}\right)\left(\frac{2}{3}\right)x &= 30 * \left(\frac{3}{2}\right) \\ x &= 30 * \left(\frac{3}{2}\right)\end{aligned}$$

Cancel the 2 on the bottom and reduce 30 to 15 on top.

$$\begin{aligned}x &= 15 * 3 \\ x &= 45\end{aligned}$$

Example 33: Simplify:  $\sqrt[4]{48}$

$$\sqrt[4]{48} = \sqrt[4]{16 * 3} = \sqrt[4]{2^4 * 3}$$

Since:  $\sqrt[n]{a^n} = a$  and  $\sqrt[n]{ab} = \sqrt[n]{a} * \sqrt[n]{b}$

$$\text{Therefore: } \sqrt[4]{48} = \sqrt[4]{2^4 * 3} = \sqrt[4]{2^4} * \sqrt[4]{3} = 2\sqrt[4]{3}$$

## SAMPLE ALGEBRA TEST

Complete the following.

1.  $-5 - 9 =$  1. \_\_\_\_\_

2. If  $a = 3$  and  $d = -2$ ,  $\frac{2ad}{a-d} =$  2. \_\_\_\_\_

Choose the smaller number.

3.  $-3, 1$  3. \_\_\_\_\_

4.  $-2, -5$  4. \_\_\_\_\_

5.  $|-2|, |-5|$  5. \_\_\_\_\_

Simplify.

6.  $-2x + 5x - 9x$  6. \_\_\_\_\_

7.  $4(2x+1) - (x-2)$  7. \_\_\_\_\_

Solve.

8.  $4x - 2 = 10$  8. \_\_\_\_\_

9.  $6y - (3y + 4) = y$  9. \_\_\_\_\_

10.  $-2x + 6 < 4$  10. \_\_\_\_\_

11. Multiply:  $5mn(3m^4n + 2m^3)$  11. \_\_\_\_\_

12. Add:  $(x-2) + (3x^2 + 2x - 4)$  12. \_\_\_\_\_

13. Multiply:  $(2x+3)(x-5)$  13. \_\_\_\_\_

14.  $(2x + 3y)^2$  14. \_\_\_\_\_

15. Divide:  $(x^3 + 4x^2 + 7x + 12) \div (x + 3)$  15. \_\_\_\_\_

Factor completely.

16.  $s^2 - t^2$  16. \_\_\_\_\_

17.  $x^2 + 6x + 8$  17. \_\_\_\_\_

18.  $5r^2 - 13r + 6$  18. \_\_\_\_\_

19. Multiply:  $\frac{3x^2}{x + y} * \frac{2(x + y)}{6}$  19. \_\_\_\_\_

20. Divide:  $\frac{6a^2b^2}{a^2 - b^2} \div \frac{3a^2b^2}{a^2 - 2ab + b^2}$  20. \_\_\_\_\_

21. Write as a single fraction:  $\frac{1}{x} + \frac{3}{y} - \frac{x}{xy}$  21. \_\_\_\_\_

Solve.

22.  $x^2 - 5x - 14 = 0$  22. \_\_\_\_\_

23.  $\frac{2}{x} + \frac{3}{x} = 10$  23. \_\_\_\_\_

24.  $x - 4y = -8$   
 $x + 2y = 10$  24. \_\_\_\_\_

25. Solve for D.  $R = \frac{K}{mD}$  25. \_\_\_\_\_

26. What are the square roots of  $16b^8$ ? 26. \_\_\_\_\_

27. Multiply:  $\sqrt{5} * 8\sqrt{3}$  27. \_\_\_\_\_

28. Simplify:  $3\sqrt{20} - 2\sqrt{5}$  28. \_\_\_\_\_

29.  $(3a^3b^3)^2 =$  29. \_\_\_\_\_

30.  $2^3 + 3^0 =$  30. \_\_\_\_\_

31. If  $a = 11$  and  $b = 4$ , what is the value of  $c$  if the sum of  $a$ ,  $b$  and  $c$  is 25? 31. \_\_\_\_\_

32. If  $\frac{4}{5}$  of a number is 24, what is the number? 32. \_\_\_\_\_

33.  $\sqrt[4]{32x^4y^4} =$  33. \_\_\_\_\_

### Sample Algebra Test Answers

1.  $-14$
2.  $-\frac{12}{5}$
3.  $-3$
4.  $-5$
5.  $|-2|$
6.  $-6x$
7.  $7x+6$
8.  $3$
9.  $2$
10.  $x > 1$
11.  $15m^5n^2 + 10m^4n$
12.  $3x^2 + 3x - 6$
13.  $2x^2 - 7x - 15$
14.  $4x^2 + 12xy + 9y^2$
15.  $x^2 + x + 4$
16.  $(s+t)(s-t)$
17.  $(x+2)(x+4)$
18.  $(5r-3)(r-2)$
19.  $x^2$
20.  $\frac{2(a-b)}{a+b}$
21.  $\frac{y+2x}{xy}$
22.  $\{-2, 7\}$
23.  $\frac{1}{2}$
24.  $4, 3$
25.  $D = \frac{K}{Rm}$
26.  $\pm 4b^4$
27.  $8\sqrt{15}$
28.  $4\sqrt{5}$
29.  $9a^6b^6$
30.  $9$
31.  $10$
32.  $30$
33.  $2\sqrt[4]{2}xy$