

## ALGEBRA

### Lesson 9 Inequalities

#### 1. WHAT IS AN INEQUALITY?

$2 + 3 = 5$  This is an **EQUALITY** where the quantities on both sides of the equal sign **have the same value**.

$2 + 3 < 10$  This is an **INEQUALITY** where the quantities on both sides **do not have the same value**.

We can show relationships that are not equal using the “less than” and “greater than” signs.

$<$  is the less than sign.

$>$  is the greater than sign.

$5 < 10$  means 5 is less than 10.

$6 > 2$  means 6 is greater than 2.

Notice that the less than sign  $<$  is shaped like a capital letter L that has been tilted a little. This may help you to remember which sign is less than and which sign is greater than.

Another way to remember is that in an inequality using  $<$  or  $>$ , the point of the  $<$  or  $>$  always points to the smaller number.

There are two more symbols that are used:

$\geq$  which means greater than or equal to.

$\leq$  which means less than or equal to.

$3 \leq 5$  means 3 is less than or equal to 5.

$3 \leq 5$  is a true statement because  $3 < 5$ .

$5 \leq 5$  is a true statement because  $5 = 5$ .

However,  $5 < 5$  is not a true statement because 5 is not less than 5.

$25 \geq 16$  means 25 is greater than or equal to 16.

$25 \geq 16$  is a true statement because  $25 > 16$ .

$16 \geq 16$  is a true statement because  $16 = 16$ .

However,  $16 > 16$  is not a true statement because 16 is not greater than 16.

**Practice One** Answers – p. 20

**True or False**

- |                      |                       |                        |
|----------------------|-----------------------|------------------------|
| 1. $6 < 12$ _____    | 6. $7 \geq 7$ _____   | 11. $7 > 0$ _____      |
| 2. $6 > 12$ _____    | 7. $16 < 16$ _____    | 12. $18 > 18$ _____    |
| 3. $3 \leq 17$ _____ | 8. $25 \geq 24$ _____ | 13. $18 \geq 18$ _____ |
| 4. $4 \geq 5$ _____  | 9. $14 > 22$ _____    | 14. $4 < 5$ _____      |
| 5. $7 > 7$ _____     | 10. $0 \leq 0$ _____  | 15. $17 \leq 17$ _____ |

**2. INEQUALITIES WITH VARIABLES**

$x < 6$  means that  $x$  represents any number that is less than 6.

What are some values of  $x$  that would make this inequality true?

5   4   0   5.9    $3\frac{1}{2}$    -6   -900

Would 6 as a value of  $x$  make it true?

No, because 6 is not less than 6.

How many values of  $x$  would make this inequality true?

There are an infinite number of values that would make this inequality true. Every number less than 6 is a possible solution to  $x < 6$ .

How is this different from the equality  $x = 6$  ?

There is only one value for  $x$  that makes the equality true.

$x \geq 26$  means that  $x$  represents any number that is greater than or equal to 26.

What are some values of  $x$  that would make this inequality true?

27    $52\frac{1}{2}$    26   857   1,354,697   42.695   121

How many values of  $x$  would make this inequality true?

There are an infinite number of values that would make this inequality true. Every number that is greater than or equal to 26 is a possible solution to  $x \geq 26$ .

$15 > x$  means that  $x$  represents any number where 15 is greater than that number.

What are some values of  $x$  that would make this inequality true?

14   10   0   -1   -15   -6,582   14.999    $11\frac{3}{4}$

Would 15 as a value of  $x$  make it true?

No, because 15 is not greater than 15.

How many values of  $x$  would make this inequality true?

There are an infinite number of values that would make this inequality true. Every number where 15 is greater than that number is a possible solution to  $15 > x$ .

Notice that in the first two examples above,  $x$  is on the left side of the inequality, and in the third example,  $x$  is on the right side of the inequality. Most people find it easier to think about inequalities when  $x$  is on the left side of the inequality. If you want to switch  $x$  from the right side to the left side of an inequality, you also have to change the inequality sign.

$$\begin{aligned} 15 > x & \text{ is the same as } x < 15 \\ 6 \leq x & \text{ is the same as } x \geq 6 \end{aligned}$$

### **Example 1**

Which number is a solution to  $x < 22$  ?

- A. 30      B. 22      C. 23      D. 18      E. 24

A solution to  $x < 22$  means to find a value of  $x$  that makes the inequality true.

Use trial and error. Test each multiple choice answer. Substitute the number for  $x$ , and see if the inequality is true.

Note that in this type of problem, there are infinite possible solutions, but only one of the multiple choice answers will be correct.

Try A. 30      Substitute 30 for  $x$ .  
 $x < 22 \rightarrow 30 < 22$       Ask: Is 30 less than 22? No.  
So, 30 *is not* a solution to  $x < 22$ .

Try B. 22      Substitute 22 for  $x$ .  
 $x < 22 \rightarrow 22 < 22$       Ask: Is 22 less than 22? No.  
So, 22 *is not* a solution to  $x < 22$ .

Try C. 23      Substitute 23 for  $x$ .  
 $x < 22 \rightarrow 23 < 22$       Ask: Is 23 less than 22? No.  
So, 23 *is not* a solution to  $x < 22$ .

Try D. 18      Substitute 18 for  $x$ .  
 $x < 22 \rightarrow 18 < 22$       Ask: Is 18 less than 22? Yes.  
So, 18 *is* a solution to  $x < 22$ .

**Answer: D. 18**

This formal step by step process for testing each multiple choice answer may not be necessary when working with simple inequalities like  $x < 22$ . You can scan through the multiple choice answers quickly, looking for the one answer that is less than 22. However, when working with more complex inequalities, the step by step process will be needed.

### **Example 2**

Which is a solution to  $x \geq 5$  ?

- A. 2      B. 4      C. 1      D. 7      E. 0

A solution to  $x \geq 5$  means to find a value of  $x$  that makes the inequality true.

Use trial and error. Test each multiple choice answer. Substitute the number for  $x$ , and see if the inequality is true.

Try A. 2      Substitute 2 for  $x$ .

$$x \geq 5 \rightarrow 2 \geq 5$$

Ask: Is 2 greater than 5? No.

Is 2 equal to 5? No.

So, 2 *is not* a solution to  $x \geq 5$ .

Try B. 4      Substitute 4 for  $x$ .

$$x \geq 5 \rightarrow 4 \geq 5$$

Ask: Is 4 greater than 5? No.

Is 4 equal to 5? No.

So, 4 *is not* a solution to  $x \geq 5$ .

Try C. 1      Substitute 1 for  $x$ .

$$x \geq 5 \rightarrow 1 \geq 5$$

Ask: Is 1 greater than 5? No.

Is 1 equal to 5? No.

So, 1 *is not* a solution to  $x \geq 5$ .

Try D. 7      Substitute 7 for  $x$ .

$$x \geq 5 \rightarrow 7 \geq 5$$

Ask: Is 7 greater than 5? Yes.

So, 7 *is* a solution to  $x \geq 5$ .

**Answer: D. 7**

### **Example 3**

Which of the following is a solution to  $8 - x > 2$  ?

- A. 7      B. 8      C. 6      D. 5      E. 9

A solution to  $8 - x > 2$  means to find a value of  $x$  that makes the inequality true.

Use trial and error. Test each multiple choice answer. Substitute the number for  $x$ , and see if the inequality is true.

Try A. 7      Substitute 7 for  $x$  and do the math.

$$8 - x > 2 \rightarrow 8 - 7 > 2$$

$1 > 2$       Ask: Is 1 greater than 2? No.

So, 7, the tested number,

*is not* a solution to  $8 - x > 2$ .

Try B. 8      Substitute 8 for  $x$  and do the math.

$$8 - x > 2 \rightarrow 8 - 8 > 2$$

$$0 > 2 \quad \text{Ask: Is 0 greater than 2? No.}$$

So, 8, the tested number,  
*is not* a solution to  $8 - x > 2$ .

Try C. 6      Substitute 6 for  $x$  and do the math.

$$8 - x > 2 \rightarrow 8 - 6 > 2$$

$$2 > 2 \quad \text{Ask: Is 2 greater than 2? No.}$$

So, 6, the tested number,  
*is not* a solution to  $8 - x > 2$ .

Try D. 5      Substitute 5 for  $x$  and do the math.

$$8 - x > 2 \rightarrow 8 - 5 > 2$$

$$3 > 2 \quad \text{Ask: Is 3 greater than 2? Yes.}$$

So, 5, the tested number,  
*is* a solution to  $8 - x > 2$ .

**Answer: D. 5**

#### **Example 4**

Which of the following is a solution to  $x + 7 \leq 10$  ?

A. 10      B. 7      C. 3      D. 4      E. 17

A solution to  $x + 7 \leq 10$  means to find a value of  $x$  that makes the inequality true.

Use trial and error. Test each multiple choice answer. Substitute the number for  $x$ , and see if the inequality is true.

Try A. 10      Substitute 10 for  $x$  and do the math.

$$x + 7 \leq 10 \rightarrow 10 + 7 \leq 10$$

$$17 \leq 10 \quad \text{Ask: Is 17 less than 10? No.}$$

$$\text{Ask: Is 17 equal to 10? No.}$$

So, 10, the tested number,  
*is not* a solution to  $x + 7 \leq 10$ .

Try B. 7      Substitute 7 for  $x$  and do the math.

$$x + 7 \leq 10 \rightarrow 7 + 7 \leq 10$$

$$14 \leq 10 \quad \text{Ask: Is 14 less than 10? No.}$$

$$\text{Ask: Is 14 equal to 10? No.}$$

So, 7, the tested number,  
*is not* a solution to  $x + 7 \leq 10$ .

Try C. 3      Substitute 3 for  $x$  and do the math.

$$x + 7 \leq 10 \rightarrow 3 + 7 \leq 10$$

$$10 \leq 10$$

Ask: Is 10 less than 10? No.

Ask: Is 10 equal to 10? Yes.

So, 3, the tested number,  
*is* a solution to  $x + 7 \leq 10$ .

**Answer: C. 3**

### Example 5

Which of the following is a solution to  $6x + 7 < 30$  ?

A. 6      B. 5      C. 4      D. 3      E. 8

A solution to  $6x + 7 < 30$  means to find a value of  $x$  that makes the inequality true.

Use trial and error. Test each multiple choice answer. Substitute the number for  $x$ , and see if the inequality is true.

Try A. 6      Substitute 6 for  $x$  and do the math.

$$6x + 7 < 30 \rightarrow (6 \times 6) + 7 < 30$$

$$36 + 7 < 30$$

$$43 < 30$$

Ask: Is 43 less than 30? No.

So, 6, the tested number,

*is not* a solution to  $6x + 7 < 30$ .

Try B. 5      Substitute 5 for  $x$  and do the math.

$$6x + 7 < 30 \rightarrow (6 \times 5) + 7 < 30$$

$$30 + 7 < 30$$

$$37 < 30$$

Ask: Is 37 less than 30? No.

So, 5, the tested number,

*is not* a solution to  $6x + 7 < 30$ .

Try C. 4      Substitute 4 for  $x$  and do the math.

$$6x + 7 < 30 \rightarrow (6 \times 4) + 7 < 30$$

$$24 + 7 < 30$$

$$31 < 30$$

Ask: Is 31 less than 30? No.

So, 4, the tested number,

*is not* a solution to  $6x + 7 < 30$ .

Try D. 3      Substitute 3 for  $x$  and do the math.

$$6x + 7 < 30 \rightarrow (6 \times 3) + 7 < 30$$

$$18 + 7 < 30$$

$$25 < 30$$

Ask: Is 25 less than 30? Yes.

So, 3, the tested number,

*is* a solution to  $6x + 7 < 30$ .

**Answer: D. 3**

**Practice Two** Answers – p. 20

1. Which is a solution to  $x \geq 9$  ?

- A. 8      B. 4      C. 12      D. 7      E. 0

2. Which number is a solution to  $x < 14$  ?

- A. 14      B. 15      C. 24      D. 12      E. 21

3. Which of the following is a solution to  $x + 4 \leq 12$  ?

- A. 10      B. 8      C. 16      D. 11      E. 12

4. Which number is a solution to  $x - 5 < 5$  ?

- A. 20      B. 15      C. 10      D. 5      E. 12

5. Which of the following is a solution to  $16 - 2x > 2$  ?

- A. 7      B. 8      C. 4      D. 14      E. 16

6. Which is a solution to  $2x + 2 \geq 10$  ?

- A. 4      B. 3      C. 2      D. 1      E. 0

7. Which of the following is a solution to  $3x - 4 \leq 12$  ?

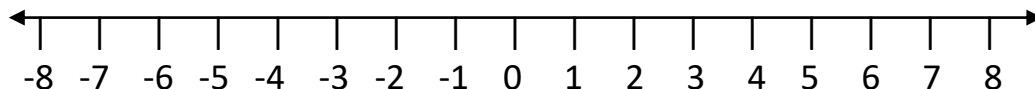
- A. 10      B. 5      C. 6      D. 8      E. 12

8. Which of the following is a solution to  $x^2 - 2x > 22$  ?

- A. 3      B. 2      C. 6      D. 4      E. 5

### 3. INEQUALITIES WITH NEGATIVE NUMBERS

When comparing two negative numbers to see which is greater, it can be helpful to visualize them on a number line. Everything to the right of a given number is greater than the number, and everything to the left is less than the number.



**$-6 < -2$  is true** because  $-6$  is to the left of  $-2$  on the number line.

Another way to think about this is:  $-6$  is more negative than  $-2$ , so  $-6$  is less than  $-2$ .

Note that the number 6 is not less than the number 2, so if you look at  $-6 < -2$  quickly without thinking about it, you may think that the inequality is false.

Visualize a number line when deciding  $<$  and  $>$  with negative numbers to avoid this type of error.

**$-7 < 6$  is true** because  $-7$  is to the left of 6 on the number line.

It can be helpful to think of negative numbers in terms of dollars.  $-7$  means you owe 7 dollars and 6 means you have 6 dollars, so clearly  $-7$  is less than 6.

Again, the number 7 is not less than the number 6, so if you look at  $-7 < 6$  quickly without thinking about it or visualizing a number line, you may think it is false.

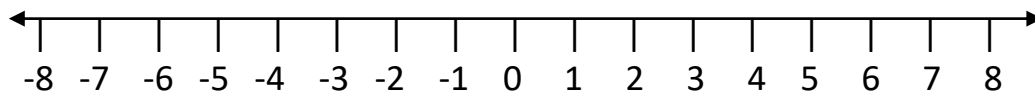
**$-8 > 4$  is false** because  $-8$  is not to the right of 4 on the number line.

If you look at  $-8 > 4$  quickly without really thinking about it or visualizing a number line, you might mistakenly decide that  $-8 > 4$  is true because your brain is used to thinking 8 is greater than 4.

#### **Practice Three** Answers – p. 24

##### True or False

- |                        |                      |                       |
|------------------------|----------------------|-----------------------|
| 1. $5 < -2$ _____      | 5. $-5 > -1$ _____   | 9. $3 \leq -7$ _____  |
| 2. $-1 < 4$ _____      | 6. $-4 < 8$ _____    | 10. $-3 < 4$ _____    |
| 3. $-8 \geq -10$ _____ | 7. $-6 \geq 6$ _____ | 11. $0 \geq -3$ _____ |
| 4. $6 > -8$ _____      | 8. $-2 < -6$ _____   | 12. $-20 > 5$ _____   |





## 4. INEQUALITIES WITH NEGATIVE NUMBERS AND VARIABLES

### Example 1

Which number is a solution to  $x > -4$  ?

- A.  $-4$       B.  $-5$       C.  $-8$       D.  $-2$       E.  $-6$

A solution to  $x > -4$  means to find a value of  $x$  that makes the inequality true.

*Hint: find the number that is to the right of  $-4$  on a number line.*

$-2$  is the only choice that is to the right of  $-4$  on a number line.

**Answer: D.  $-2$**

**OR** – Test each answer using trial and error.

Try A.  $-4$       Substitute  $-4$  for  $x$ .

$$x > -4 \rightarrow -4 > -4$$

Ask: Is  $-4$  greater than  $-4$ ? No.

So,  $-4$  **is not** a solution to  $x > -4$ .

Try B.  $-5$       Substitute  $-5$  for  $x$ .

$$x > -4 \rightarrow -5 > -4$$

Ask: Is  $-5$  greater than  $-4$ ? No. ( $-5$  is not to the right of  $-4$  on a number line.)

So,  $-5$  **is not** a solution to  $x > -4$ .

Try C.  $-8$       Substitute  $-8$  for  $x$ .

$$x > -4 \rightarrow -8 > -4$$

Ask: Is  $-8$  greater than  $-4$ ? No.

So,  $-8$  **is not** a solution to  $x > -4$ .

Try D.  $-2$       Substitute  $-2$  for  $x$ .

$$x > -4 \rightarrow -2 > -4$$

Ask: Is  $-2$  greater than  $-4$ ? Yes.

So,  $-2$  **is** a solution to  $x > -4$ .

**Answer: D.  $-2$**

### Example 2

Which of the following is a solution to  $x \leq -9$  ?

- A.  $-8$       B.  $-4$       C.  $-12$       D.  $0$       E.  $9$

A solution to  $x \leq -9$  means to find a value of  $x$  that makes the inequality true.

*Hint: find the number that is equal to  $-9$  or to the left of  $-9$  on a number line.*

$-12$  is the only choice that is to the left of  $-9$  on a number line.

**Answer: C.  $-12$**

**OR** – Test each answer using trial and error.

Try A.  $-8$     Substitute  $-8$  for  $x$ .  
 $x \leq -9 \rightarrow -8 \leq -9$     Ask: Is  $-8$  less than  $-9$ ? No. ( $-8$  is not to the left of  $-9$  on a number line.)  
 Is  $-8$  equal to  $-9$ ? No.  
 So,  $-8$  **is not** a solution to  $x \leq -9$ .

Try B.  $-4$     Substitute  $-4$  for  $x$ .  
 $x \leq -9 \rightarrow -4 \leq -9$     Ask: Is  $-4$  less than  $-9$ ? No.  
 Is  $-4$  equal to  $-9$ ? No.  
 So,  $-4$  **is not** a solution to  $x \leq -9$ .

Try C.  $-12$     Substitute  $-12$  for  $x$ .  
 $x \leq -9 \rightarrow -12 \leq -9$     Ask: Is  $-12$  less than  $-9$ ? Yes.  
 So,  $-12$  **is** a solution to  $x \leq -9$ .

**Answer: C.  $-12$**

### Example 3

Which of the following is a solution to  $x + 2 \leq -10$  ?

A.  $8$     B.  $14$     C.  $-12$     D.  $-8$     E.  $0$

A solution to  $x + 2 \leq -10$  means to find a value of  $x$  that makes the inequality true.  
 Test each answer using trial and error.

Try A.  $8$     Substitute  $8$  for  $x$  and do the math.  
 $x + 2 \leq -10 \rightarrow 8 + 2 \leq -10$   
 $10 \leq -10$     Ask: Is  $10$  less than  $-10$ ? No.  
 Is  $10$  equal to  $-10$ ? No.  
 So,  $8$ , the tested number,  
**is not** a solution to  $x + 2 \leq -10$ .

Try B.  $14$     Substitute  $14$  for  $x$  and do the math.  
 $x + 2 \leq -10 \rightarrow 14 + 2 \leq -10$   
 $16 \leq -10$     Ask: Is  $16$  less than  $-10$ ? No.  
 Is  $16$  equal to  $-10$ ? No.  
 So,  $14$ , the tested number,  
**is not** a solution to  $x + 2 \leq -10$ .

Try C.  $-12$     Substitute  $-12$  for  $x$  and do the math.  
 $x + 2 \leq -10 \rightarrow -12 + 2 \leq -10$   
 $-10 \leq -10$     Ask: Is  $-10$  less than  $-10$ ? No.  
 Is  $-10$  equal to  $-10$ ? Yes.  
 So,  $-12$ , the tested number,  
**is** a solution to  $x + 2 \leq -10$ .

**Answer: C.  $-12$**

### **Example 4**

Which number is a solution to  $2x + 4 > -2$  ?

- A.  $-8$       B.  $-5$       C.  $-4$       D.  $-1$       E.  $-7$

A solution to  $2x + 4 > -2$  means to find a value of  $x$  that makes the inequality true.  
Test each answer using trial and error.

Try A.  $-8$       Substitute  $-8$  for  $x$  and do the math.

$$2x + 4 > -2 \rightarrow (2)(-8) + 4 > -2$$

$$-16 + 4 > -2$$

$$-12 > -2$$

Ask: Is  $-12$  greater than  $-2$ ? No.

So,  $-8$ , the tested number,

**is not** a solution to  $2x + 4 > -2$ .

Try B.  $-5$       Substitute  $-5$  for  $x$  and do the math.

$$2x + 4 > -2 \rightarrow (2)(-5) + 4 > -2$$

$$-10 + 4 > -2$$

$$-6 > -2$$

Ask: Is  $-6$  greater than  $-2$ ? No.

So,  $-5$ , the tested number,

**is not** a solution to  $2x + 4 > -2$ .

Try C.  $-4$       Substitute  $-4$  for  $x$  and do the math.

$$2x + 4 > -2 \rightarrow (2)(-4) + 4 > -2$$

$$-8 + 4 > -2$$

$$-4 > -2$$

Ask: Is  $-4$  greater than  $-2$ ? No.

So,  $-4$ , the tested number,

**is not** a solution to  $2x + 4 > -2$ .

Try D.  $-1$       Substitute  $-1$  for  $x$  and do the math.

$$2x + 4 > -2 \rightarrow (2)(-1) + 4 > -2$$

$$-2 + 4 > -2$$

$$2 > -2$$

Ask: Is  $2$  greater than  $-2$ ? Yes.

So,  $-1$ , the tested number,

**is** a solution to  $2x + 4 > -2$ .

**Answer: D.  $-1$**

### Example 5

Which of the following numbers is a solution to  $16 - 4x < 29$  ?

A. -10      B. -5      C. -4      D. -9      E. -3

A solution to  $16 - 4x < 29$  means to find a value of  $x$  that makes the inequality true. Test each answer using trial and error.

Try A. -10    Substitute -10 for  $x$  and do the math.

$$16 - 4x < 29 \rightarrow 16 - (4)(-10) < 29$$

$$16 - (-40) < 29$$

$$56 < 29$$

(multiplication comes before subtraction, so first multiply  $(4)(-10)$ , then subtract from 16)

Ask: Is 56 less than 29? No.

So, -10, the tested number,

**is not** a solution to

$$16 - 4x < 29.$$

Try B. -5    Substitute -5 for  $x$  and do the math.

$$16 - 4x < 29 \rightarrow 16 - (4)(-5) < 29$$

$$16 - (-20) < 29$$

$$36 < 29$$

Ask: Is 36 less than 29? No.

So, -5, the tested number,

**is not** a solution to

$$16 - 4x < 29.$$

Try C. -4    Substitute -4 for  $x$  and do the math.

$$16 - 4x < 29 \rightarrow 16 - (4)(-4) < 29$$

$$16 - (-16) < 29$$

$$32 < 29$$

Ask: Is 32 less than 29? No.

So, -4, the tested number,

**is not** a solution to

$$16 - 4x < 29.$$

Try D. -9    Substitute -9 for  $x$  and do the math.

$$16 - 4x < 29 \rightarrow 16 - (4)(-9) < 29$$

$$16 - (-36) < 29$$

$$52 < 29$$

Ask: Is 52 less than 29? No.

So, -9, the tested number,

**is not** a solution to

$$16 - 4x < 29.$$

Try E. -3    Substitute -3 for  $x$  and do the math.

$$16 - 4x < 29 \rightarrow 16 - (4)(-3) < 29$$

$$16 - (-12) < 29$$

$$28 < 29$$

Ask: Is 28 less than 29? Yes.

So, -3, the tested number,

**is** a solution to  $16 - 4x < 29$ .

**Answer: E. -3**

**Practice Four** Answers – p. 24

1. Which number is a solution to  $x > -6$  ?  
A. -10      B. -9      C. -8      D. -6      E. -5
  
2. Which of the following is a solution to  $x \leq -7$  ?  
A. -8      B. 2      C. -2      D. 0      E. 9
  
3. Which of the following is a solution to  $x \leq -16$  ?  
A. 15      B. -15      C. 17      D. -17      E. 12
  
4. Which number is a solution to  $x + 4 \geq -2$  ?  
A. -8      B. -6      C. -7      D. -9      E. -10
  
5. Which of the following is a solution to  $x - 5 < -12$  ?  
A. 7      B. -7      C. -17      D. 17      E. -2
  
6. Which of the following is a solution to  $14 - 3x < 29$  ?  
A. -15      B. -12      C. -9      D. -5      E. -2
  
7. Which number is a solution to  $12 - 2x \geq 25$  ?  
A. -2      B. -7      C. -5      D. -3      E. -6
  
8. Which number is a solution to  $2x + 12 > -2$  ?  
A. -10      B. -12      C. -6      D. -8      E. -9

**5. EXPRESSING THE ENTIRE SOLUTION TO AN INEQUALITY**

Previous examples have shown one out of the many possible solutions to an inequality, but inequalities have an infinite number of solutions. The entire range of solutions to an inequality is expressed as another inequality.

**NOTICE** that with inequality problems, “**the solution**” means the entire solution which is all the values that make the inequality true. If a problem asks for “**a solution**” or “**one solution**” it means any single number that makes the inequality true.

### **Example 1**

Find the solution to  $12 - x > 2$ .

- A.  $x = 10$     B.  $x \leq 10$     C.  $x < 10$     D.  $x > 10$     E.  $x \geq 10$

Which answer represents all the possible solutions to  $12 - x > 2$  ?

The correct answer will include all values that make the inequality true, and will not include any values that make the inequality false.

All the answer choices are some variation of:     $x > 10$      $x < 10$      $x = 10$

So test one number for each possibility.

### **Step 1 Test $x > 10$**

Choose any number that is greater than 10, and see if it is a solution to  $12 - x > 2$ .

Let's try 11, which is greater than 10.

$$12 - x > 2 \rightarrow 12 - 11 > 2$$

$$1 > 2 \quad \text{Ask: Is 1 greater than 2? No.}$$

So, the tested range,  $x > 10$ ,

**is not correct** for  $12 - x > 2$ .

We only tested one number, but if you test any number that satisfies  $x > 10$ , you will get the same result. It will produce an inequality that is not true.

### **Step 2 Test $x < 10$**

Choose any number that is less than 10, and see if it is a solution to  $12 - x > 2$ .

Let's try 5, which is less than 10.

$$12 - x > 2 \rightarrow 12 - 5 > 2$$

$$7 > 2 \quad \text{Ask: Is 7 greater than 2? Yes.}$$

So, the range we tested,  $x < 10$ ,

**is correct** for  $12 - x > 2$ .

### **Step 3 Test $x = 10$**

Now we know that  $x < 10$  is correct, but we still have to test  $x = 10$ . This will determine whether C.  $x < 10$  or B.  $x \leq 10$  is the solution to  $12 - x > 2$ .

Test  $x = 10$ .

$$12 - x > 2 \rightarrow 12 - 10 > 2$$

$$2 > 2 \quad \text{Ask: Is 2 greater than 2? No.}$$

So  $x = 10$  **is not** part of the solution to  $12 - x > 2$ .

**Answer: C.  $x < 10$**

Why did we choose to test the number 11 in Step 1?

We were testing  $x > 10$ , so could have chosen any number greater than 10. It's best to choose a small number that is easy to work with. We could have chosen 765 or  $10 \frac{1}{2}$  or 98 or 16.73 or any other number greater than 10, but we chose 11 because it is easy to work with.

## **Example 2**

What is the solution to  $x + 7 \leq 10$  ?

A.  $x < 3$       B.  $x \leq 3$       C.  $x > 3$       D.  $x \geq 3$       E.  $x = 3$

Which answer represents all the possible solutions to  $x + 7 \leq 10$  ?

The correct answer will include all values that make the inequality true, and will not include any values that make the inequality false.

All the answer choices are some variation of:     $x < 3$      $x > 3$      $x = 3$

So test one number for each possibility.

### **Step 1 Test $x < 3$**

Choose any number that is less than 3, and see if it is a solution to  $x + 7 \leq 10$ .

Let's try 2, which is less than 3.

$$x + 7 \leq 10 \rightarrow 2 + 7 \leq 10$$

$$9 \leq 10$$

Ask: Is 9 less than or equal to 10? Yes.

So the range we tested,  $x < 3$ ,

**is correct** for  $x + 7 \leq 10$ .

### **Step 2 Test $x > 3$**

If you are sure about the result to Step 1 above, you don't really need to test  $x > 3$ .

If  $x < 3$  **is correct**, then  $x > 3$  **cannot be correct**.

We found the correct inequality in Step 1, and they can't both be correct.

### **Step 3 Test $x = 3$**

We know that  $x < 3$  is correct, but we still have to test  $x = 3$ . This will determine whether A.  $x < 3$  or B.  $x \leq 3$  is the solution to  $x + 7 \leq 10$ .

Test  $x = 3$ .

$$x + 7 \leq 10 \rightarrow 3 + 7 \leq 10$$

$$10 \leq 10$$

Ask: Is 10 less than or equal to 10? Yes.

So  $x = 3$  **is** part of the solution to  $x + 7 \leq 10$ .

**Answer: B.  $x \leq 3$**

Why isn't A.  $x < 3$  correct?

Why isn't E.  $x = 3$  correct?

Both are part of the solution, but neither is the complete solution. The correct answer has to include every value that will make the inequality true.

### **Example 3**

Which of the following is the solution to  $3x + 4 \geq 16$  ?

- A.  $x = 4$       B.  $x \leq 4$       C.  $x < 4$       D.  $x > 4$       E.  $x \geq 4$

#### **Step 1 Test $x < 4$**

Pick any number that is less than 4. Let's try 2.

$$3x + 4 \geq 16 \rightarrow (3 \times 2) + 4 \geq 16$$

$$6 + 4 \geq 16$$

$$10 \geq 16$$

Ask: Is 10 greater than or equal to 16? No.

So the range we tested,  $x < 4$ ,

*is not correct* for  $3x + 4 \geq 16$ .

#### **Step 2 Test $x > 4$**

If you are sure about the result to Step 1 above, you don't really need to test  $x > 4$ .

If  $x < 4$  *is not correct*, then  $x > 4$  *has to be correct*.

Both inequalities can't be correct, but one of them has to be correct.

#### **Step 3 Test $x = 4$**

We know that  $x > 4$  is correct, but we still have to test  $x = 4$ . This will determine whether D.  $x > 4$  or E.  $x \geq 4$  is the solution to  $3x + 4 \geq 16$ .

Test  $x = 4$

$$3x + 4 \geq 16 \rightarrow (3 \times 4) + 4 \geq 16$$

$$12 + 4 \geq 16$$

$$16 \geq 16$$

Ask: Is 16 greater than or equal to 16? Yes.

So  $x = 4$  *is* part of the solution

to  $3x + 4 \geq 16$ .

**Answer: E.  $x \geq 4$**

### **SHORTCUT:**

The solution to an inequality that uses  $\leq$  or  $\geq$  will also be an inequality that uses  $\leq$  or  $\geq$ .

The solution to an inequality that uses  $<$  or  $>$  will also be an inequality that uses  $<$  or  $>$ .

So, you can always skip Step 3.

For example, if you are solving  $x + 9 < 20$ , your answer will use either  $<$  or  $>$ .

It will not use  $\leq$  or  $\geq$ .

Similarly, if you are solving  $7x - 8 \geq 16$ , your answer will use either  $\leq$  or  $\geq$ .

It will not use  $<$  or  $>$ .



#### **Example 4**

Find the solution to  $22 - 3x < 7$ .

- A.  $x = 5$       B.  $x \leq 5$       C.  $x < 5$       D.  $x > 5$       E.  $x \geq 5$

#### **Step 1 Test $x < 5$**

Pick any number that is less than 5. Let's try 2.

$$22 - 3x < 7 \rightarrow 22 - (3 \times 2) < 7$$

$$22 - 6 < 7$$

$$16 < 7$$

Ask: Is 16 less than 7? No.

So the range we tested,  $x < 5$ ,  
*is not correct* for  $22 - 3x < 7$ .

#### **Step 2 Test $x > 5$**

No need to test. Since  $x < 5$  *is not correct*,  $x > 5$  *has to be correct*.

#### **Step 3 Test $x = 5$**

We know that  $x > 5$  is correct, but, is the complete correct answer D.  $x > 5$  or E.  $x \geq 5$  ?

No need to test. We are looking for the solution to  $22 - 3x < 7$ . Since that inequality does not include the "or equal to" sign, the answer will not include the "or equal to" sign.

**Answer: D.  $x > 5$**

#### **Example 5**

What is the solution to  $x + 4 \leq 12$  ?

- A.  $x = 8$       B.  $x \leq 8$       C.  $x < 8$       D.  $x > 8$       E.  $x \geq 8$

#### **Step 1 Test $x < 8$**

Pick any number that is less than 8. Let's try 5.

$$x + 4 \leq 12 \rightarrow 5 + 4 \leq 12$$

$$9 \leq 12$$

Ask: Is 9 less than or equal to 12? Yes.

So the range we tested,  $x < 8$ ,  
*is correct* for  $x + 4 \leq 12$ .

#### **Step 2 Test $x > 8$**

No need to test. Since  $x < 8$  *is correct*,  $x > 8$  *cannot be correct*.

#### **Step 3 Test $x = 8$**

No need to test. We are looking for the solution to  $x + 4 \leq 12$ . Since that inequality includes the "or equal to" sign, the answer has to include the "or equal to" sign.

**Answer: B.  $x \leq 8$**

### **Example 6**

Which of the following is the solution to  $10 + 2x \leq 6$  ?

- A.  $x < -2$     B.  $x \leq -2$     C.  $x > -2$     D.  $x \geq -2$     E.  $x = -2$

#### **Step 1 Test $x > -2$**

Pick any number that is greater than  $-2$ . Let's try 4.

$$10 + 2x \leq 6 \rightarrow 10 + (2 \times 4) \leq 6$$

$$10 + 8 \leq 6$$

$$18 \leq 6 \quad \text{Ask: Is 18 less than or equal to 6? No.}$$

So the range we tested,  $x > -2$ ,

**is not correct** for  $10 + 2x \leq 6$ .

#### **Step 2 Test $x < -2$**

No need to test. Since  $x > -2$  **is not correct**,  $x < -2$  **has to be correct**.

#### **Step 3 Test $x = -2$**

No need to test. We are looking for the solution to  $10 + 2x \leq 6$ . Since that inequality includes the "or equal to" sign, the answer has to include the "or equal to" sign.

**Answer: B.  $x \leq -2$**

**NOTICE** that we started by testing  $x > -2$ , and not  $x < -2$ . Why?

Most people find it easier to work with positive numbers, and by choosing to test  $x > -2$ , we can pick a positive number to work with (any positive number is greater than  $-2$ ).

If we had chosen to test  $x < -2$ , we would have to work with a negative number (the only numbers less than  $-2$  are negative numbers).

### **Practice Five**    *Answers – p. 29*

1. What is the solution to  $x + 4 \leq 6$  ?

- A.  $x < 2$     B.  $x \leq 2$     C.  $x > 2$     D.  $x \geq 2$     E.  $x = 2$

2. Find the solution to  $15 - 2x < 11$ .

- A.  $x = 2$     B.  $x \leq 2$     C.  $x < 2$     D.  $x > 2$     E.  $x \geq 2$

3. Which of the following is the solution to  $2x + 1 \geq 11$  ?

- A.  $x = 5$     B.  $x \leq 5$     C.  $x < 5$     D.  $x > 5$     E.  $x \geq 5$

4. What is the solution to  $3x - 4 < 14$  ?

- A.  $x = 6$     B.  $x \leq 6$     C.  $x < 6$     D.  $x > 6$     E.  $x \geq 6$

5. What is the solution to  $7 - x > 10$  ?

- A.  $x < -3$     B.  $x \leq -3$     C.  $x > -3$     D.  $x \geq -3$     E.  $x = -3$

6. Find the solution to  $14 - x \geq 5$ .

- A.  $x = 9$     B.  $x \leq 9$     C.  $x < 9$     D.  $x > 9$     E.  $x \geq 9$

7. Which of the following is the solution to  $3x + 3 > 21$  ?

- A.  $x = 6$     B.  $x \leq 6$     C.  $x < 6$     D.  $x > 6$     E.  $x \geq 6$

8. What is the solution to  $20 - 2x \leq 30$  ?

- A.  $x = -5$     B.  $x \leq -5$     C.  $x < -5$     D.  $x > -5$     E.  $x \geq -5$

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## ANSWER KEY Lesson 9 Inequalities

### Practice One

#### True or False

- |                         |                          |                           |
|-------------------------|--------------------------|---------------------------|
| 1. $6 < 12$ <u>T</u>    | 6. $7 \geq 7$ <u>T</u>   | 11. $7 > 0$ <u>T</u>      |
| 2. $6 > 12$ <u>F</u>    | 7. $16 < 16$ <u>F</u>    | 12. $18 > 18$ <u>F</u>    |
| 3. $3 \leq 17$ <u>T</u> | 8. $25 \geq 24$ <u>T</u> | 13. $18 \geq 18$ <u>T</u> |
| 4. $4 \geq 5$ <u>F</u>  | 9. $14 > 22$ <u>F</u>    | 14. $4 < 5$ <u>T</u>      |
| 5. $7 > 7$ <u>F</u>     | 10. $0 \leq 0$ <u>T</u>  | 15. $17 \leq 17$ <u>T</u> |

### Practice Two

1. Which is a solution to  $x \geq 9$ ? **Answer: C. 12**

- A. 8      B. 4      C. 12      D. 7      E. 0

Try A. 8      Substitute 8 for  $x$ .

$$x \geq 9 \rightarrow 8 \geq 9$$

Ask: Is 8 greater than 9? No.

Is 8 equal to 9? No.

So, 8 *is not* a solution to  $x \geq 9$ .

Try B. 4      Substitute 4 for  $x$ .

$$x \geq 9 \rightarrow 4 \geq 9$$

Ask: Is 4 greater than 9? No.

Is 4 equal to 9? No.

So, 4 *is not* a solution to  $x \geq 9$ .

Try C. 12      Substitute 12 for  $x$ .

$$x \geq 9 \rightarrow 12 \geq 9$$

Ask: Is 12 greater than 9? Yes.

So, 12 *is* a solution to  $x \geq 9$ .

**Answer: C. 12**

2. Which number is a solution to  $x < 14$ ? **Answer: D. 12**

- A. 14      B. 15      C. 24      D. 12      E. 21

Try A. 14      Substitute 14 for  $x$ .

$$x < 14 \rightarrow 14 < 14$$

Ask: Is 14 less than 14? No.

So, 14 *is not* a solution to  $x < 14$ .

Try B. 15      Substitute 15 for  $x$ .

$$x < 14 \rightarrow 15 < 14$$

Ask: Is 15 less than 14? No.

So, 15 *is not* a solution to  $x < 14$ .

Try C. 24      Substitute 24 for  $x$ .

$$x < 14 \rightarrow 24 < 14$$

Ask: Is 24 less than 14? No.

So, 24 *is not* a solution to  $x < 14$ .

Try D. 12      Substitute 12 for  $x$ .  
 $x < 14 \rightarrow 12 < 14$       Ask: Is 12 less than 14? Yes.  
So, 12 *is* a solution to  $x < 14$ .  
**Answer: D. 12**

3. Which of the following is a solution to  $x + 4 \leq 12$ ? **Answer: B. 8**

A. 10      B. 8      C. 16      D. 11      E. 12

Try A. 10      Substitute 10 for  $x$  and do the math.  
 $x + 4 \leq 12 \rightarrow 10 + 4 \leq 12$   
 $14 \leq 12$       Ask: Is 14 less than 12? No.  
Ask: Is 14 equal to 12? No.  
So, 10, the tested number,  
*is not* a solution to  $x + 4 \leq 12$ .

Try B. 8      Substitute 8 for  $x$  and do the math.  
 $x + 4 \leq 12 \rightarrow 8 + 4 \leq 12$   
 $12 \leq 12$       Ask: Is 12 less than 12? No.  
Ask: Is 12 equal to 12? Yes.  
So, 8, the tested number,  
*is* a solution to  $x + 4 \leq 12$ .  
**Answer: B. 8**

4. Which number is a solution to  $x - 5 < 5$ ? **Answer: D. 5**

A. 20      B. 15      C. 10      D. 5      E. 12

Try A. 20      Substitute 20 for  $x$  and do the math.  
 $x - 5 < 5 \rightarrow 20 - 5 < 5$   
 $15 < 5$       Ask: Is 15 less than 5? No.  
So, 20, the tested number,  
*is not* a solution to  $x - 5 < 5$ .

Try B. 15      Substitute 15 for  $x$  and do the math.  
 $x - 5 < 5 \rightarrow 15 - 5 < 5$   
 $10 < 5$       Ask: Is 10 less than 5? No.  
So, 15, the tested number,  
*is not* a solution to  $x - 5 < 5$ .

Try C. 10      Substitute 10 for  $x$  and do the math.  
 $x - 5 < 5 \rightarrow 10 - 5 < 5$   
 $5 < 5$       Ask: Is 5 less than 5? No.  
So, 10, the tested number,  
*is not* a solution to  $x - 5 < 5$ .

Try D. 5      Substitute 5 for  $x$  and do the math.

$$x - 5 < 5 \rightarrow 5 - 5 < 5$$

$$0 < 5$$

Ask: Is 0 less than 5? Yes.

So, 5, the tested number,  
*is* a solution to  $x - 5 < 5$ .

**Answer: D. 5**

5. Which of the following is a solution to  $16 - 2x > 2$ ? **Answer: C. 4**

A. 7      B. 8      C. 4      D. 14      E. 16

Try A. 7      Substitute 7 for  $x$  and do the math.

$$16 - 2x > 2 \rightarrow 16 - (2 \times 7) > 2$$

$$16 - 14 > 2$$

$$2 > 2$$

Ask: Is 2 greater than 2? No.

So, 7, the tested number,

*is not* a solution to  $16 - 2x > 2$ .

Try B. 8      Substitute 8 for  $x$  and do the math.

$$16 - 2x > 2 \rightarrow 16 - (2 \times 8) > 2$$

$$16 - 16 > 2$$

$$0 > 2$$

Ask: Is 0 greater than 2? No.

So, 8, the tested number,

*is not* a solution to  $16 - 2x > 2$ .

Try C. 4      Substitute 4 for  $x$  and do the math.

$$16 - 2x > 2 \rightarrow 16 - (2 \times 4) > 2$$

$$16 - 8 > 2$$

$$8 > 2$$

Ask: Is 8 greater than 2? Yes.

So, 4, the tested number,

*is* a solution to  $16 - 2x > 2$ .

**Answer: C. 4**

6. Which is a solution to  $2x + 2 \geq 10$ ? **Answer: A. 4**

A. 4      B. 3      C. 2      D. 1      E. 0

Try A. 4      Substitute 4 for  $x$  and do the math.

$$2x + 2 \geq 10 \rightarrow (2 \times 4) + 2 \geq 10$$

$$8 + 2 \geq 10$$

$$10 \geq 10$$

Ask: Is 10 greater than 10? No.

Is 10 equal to 10? Yes.

So, 4, the tested number,

*is* a solution to  $2x + 2 \geq 10$ .

**Answer: A. 4**

7. Which of the following is a solution to  $3x - 4 \leq 12$ ? **Answer: B. 5**

A. 10      B. 5      C. 6      D. 8      E. 12

Try A. 10      Substitute 10 for  $x$  and do the math.

$$3x - 4 \leq 12 \rightarrow (3 \times 10) - 4 \leq 12$$

$$30 - 4 \leq 12$$

$$26 \leq 12$$

Ask: Is 26 less than 12? No.

Ask: Is 26 equal to 12? No.

So, 10, the tested number,

*is not* a solution to  $3x - 4 \leq 12$ .

Try B. 5      Substitute 5 for  $x$  and do the math.

$$3x - 4 \leq 12 \rightarrow (3 \times 5) - 4 \leq 12$$

$$15 - 4 \leq 12$$

$$11 \leq 12$$

Ask: Is 11 less than 12? Yes.

So, 5, the tested number,

*is* a solution to  $3x - 4 \leq 12$ .

**Answer: B. 5**

8. Which of the following is a solution to  $x^2 - 2x > 22$ ? **Answer: C. 6**

A. 3      B. 2      C. 6      D. 4      E. 5

Try A. 3      Substitute 3 for  $x$  and do the math.

$$x^2 - 2x > 22 \rightarrow 3^2 - (2 \times 3) > 22$$

$$9 - 6 > 22$$

$$3 > 22$$

Ask: Is 3 greater than 22? No.

So, 3, the tested number,

*is not* a solution to  $x^2 - 2x > 22$ .

Try B. 2      Substitute 2 for  $x$  and do the math.

$$x^2 - 2x > 22 \rightarrow 2^2 - (2 \times 2) > 22$$

$$4 - 4 > 22$$

$$0 > 22$$

Ask: Is 0 greater than 22? No.

So, 2, the tested number,

*is not* a solution to  $x^2 - 2x > 22$ .

Try C. 6      Substitute 6 for  $x$  and do the math.

$$x^2 - 2x > 22 \rightarrow 6^2 - (2 \times 6) > 22$$

$$36 - 12 > 22$$

$$24 > 22$$

Ask: Is 24 greater than 22? Yes.

So, 6, the tested number,

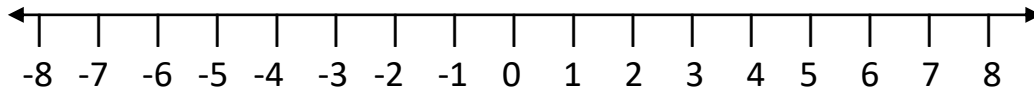
*is* a solution to  $x^2 - 2x > 22$ .

**Answer: C. 6**

**Practice Three**

**True or False**

- |                                  |                                |                                 |
|----------------------------------|--------------------------------|---------------------------------|
| 1. $5 < -2$ <u><b>F</b></u>      | 5. $-5 > -1$ <u><b>F</b></u>   | 9. $3 \leq -7$ <u><b>F</b></u>  |
| 2. $-1 < 4$ <u><b>T</b></u>      | 6. $-4 < 8$ <u><b>T</b></u>    | 10. $-3 < 4$ <u><b>T</b></u>    |
| 3. $-8 \geq -10$ <u><b>T</b></u> | 7. $-6 \geq 6$ <u><b>F</b></u> | 11. $0 \geq -3$ <u><b>T</b></u> |
| 4. $6 > -8$ <u><b>T</b></u>      | 8. $-2 < -6$ <u><b>F</b></u>   | 12. $-20 > 5$ <u><b>F</b></u>   |



**Practice Four**

1. Which number is a solution to  $x > -6$ ? **Answer: E. -5**

- A. -10    B. -9    C. -8    D. -6    E. -5

Find the number that is to the right of -6 on a number line.

-5 is the only choice that is to the right of -6 on a number line.

**Answer: E. -5**

**OR** – Test each answer using trial and error.

Try A. -10    Substitute -10 for  $x$ .  
 $x > -6 \rightarrow -10 > -6$     Ask: Is -10 greater than -6? No. (-10 is not to the right of -6 on a number line.)  
So, -10 *is not* a solution to  $x > -6$ .

Try B. -9    Substitute -9 for  $x$ .  
 $x > -6 \rightarrow -9 > -6$     Ask: Is -9 greater than -6? No.  
So, -9 *is not* a solution to  $x > -6$ .

Try C. -8    Substitute -8 for  $x$ .  
 $x > -6 \rightarrow -8 > -6$     Ask: Is -8 greater than -6? No.  
So, -8 *is not* a solution to  $x > -6$ .

Try D. -6    Substitute -6 for  $x$ .  
 $x > -6 \rightarrow -6 > -6$     Ask: Is -6 greater than -6? No.  
So, -6 *is not* a solution to  $x > -6$ .

Try E. -5    Substitute -5 for  $x$ .  
 $x > -6 \rightarrow -5 > -6$     Ask: Is -5 greater than -6? Yes.  
So, -5 *is* a solution to  $x > -6$ .

**Answer: E. -5**



2. Which of the following is a solution to  $x \leq -7$ ? **Answer: A. -8**

A. -8      B. 2      C. -2      D. 0      E. 9

Find the number that is equal to  $-7$ , or to the left of  $-7$  on a number line.

$-8$  is the only choice that is to the left of  $-7$  on a number line.

**Answer: A. -8**

**OR** – Test each answer using trial and error.

Try A. -8      Substitute  $-8$  for  $x$ .

$$x \leq -7 \rightarrow -8 \leq -7$$

Ask: Is  $-8$  less than  $-7$ ? Yes. ( $-8$  is to the left of  $-7$  on a number line.)

So,  $-8$  **is** a solution to  $x \leq -7$ .

**Answer: A. -8**

3. Which of the following is a solution to  $x \leq -16$ ? **Answer: D. -17**

A. 15      B. -15      C. 17      D. -17      E. 12

Find the number that is equal to  $-16$ , or to the left of  $-16$  on a number line.

$-17$  is the only choice that is to the left of  $-16$  on a number line.

**Answer: D. -17**

**OR** – Test each answer using trial and error.

Try A. 15      Substitute 15 for  $x$ .

$$x \leq -16 \rightarrow 15 \leq -16$$

Ask: Is 15 less than  $-16$ ? No.

Is 15 equal to  $-16$ ? No.

So, 15 **is not** a solution to  $x \leq -16$ .

Try B. -15      Substitute  $-15$  for  $x$ .

$$x \leq -16 \rightarrow -15 \leq -16$$

Ask: Is  $-15$  less than  $-16$ ? No.

Is  $-15$  equal to  $-16$ ? No.

So,  $-15$  **is not** a solution to  $x \leq -16$ .

Try C. 17      Substitute 17 for  $x$ .

$$x \leq -16 \rightarrow 17 \leq -16$$

Ask: Is 17 less than  $-16$ ? No.

Is 17 equal to  $-16$ ? No.

So, 17 **is not** a solution to  $x \leq -16$ .

Try D. -17      Substitute  $-17$  for  $x$ .

$$x \leq -16 \rightarrow -17 \leq -16$$

Ask: Is  $-17$  less than  $-16$ ? Yes.

So,  $-17$  **is** a solution to  $x \leq -16$ .

**Answer: D. -17**

4. Which number is a solution to  $x + 4 \geq -2$ ? **Answer: B. -6**

A. -8      B. -6      C. -7      D. -9      E. -10

Try A. -8      Substitute -8 for  $x$  and do the math.

$$x + 4 \geq -2 \rightarrow -8 + 4 \geq -2$$

$$-4 \geq -2$$

Ask: Is -4 greater than -2? No.

Is -4 equal to -2? No.

So, -8, the tested number,

**is not** a solution to  $x + 4 \geq -2$ .

Try B. -6      Substitute -6 for  $x$  and do the math.

$$x + 4 \geq -2 \rightarrow -6 + 4 \geq -2$$

$$-2 \geq -2$$

Ask: Is -2 greater than -2? No.

Is -2 equal to -2? Yes.

So, -6, the tested number,

**is** a solution to  $x + 4 \geq -2$ .

**Answer: B. -6**

5. Which of the following is a solution to  $x - 5 < -12$ ? **Answer: C. -17**

A. 7      B. -7      C. -17      D. 17      E. -2

Try A. 7      Substitute 7 for  $x$  and do the math.

$$x - 5 < -12 \rightarrow 7 - 5 < -12$$

$$2 < -12$$

Ask: Is 2 less than -12? No.

So, 7, the tested number,

**is not** a solution to  $x - 5 < -12$ .

Try B. -7      Substitute -7 for  $x$  and do the math.

$$x - 5 < -12 \rightarrow -7 - 5 < -12$$

$$-12 < -12$$

Ask: Is -12 less than -12? No.

So, -7, the tested number,

**is not** a solution to  $x - 5 < -12$ .

Try C. -17      Substitute -17 for  $x$  and do the math.

$$x - 5 < -12 \rightarrow -17 - 5 < -12$$

$$-22 < -12$$

Ask: Is -22 less than -12? Yes.

So, -17, the tested number,

**is** a solution to  $x - 5 < -12$ .

**Answer: C. -17**

6. Which of the following is a solution to  $14 - 3x < 29$ ? **Answer: E. -2**

A. -15      B. -12      C. -9      D. -5      E. -2

Try A. -15      Substitute -15 for  $x$  and do the math.

$$14 - 3x < 29 \rightarrow 14 - (3)(-15) < 29$$

$$14 - (-45) < 29$$

$$59 < 29$$

(multiplication comes before subtraction, so first multiply  $(3)(-15)$ , then subtract from 14)

Ask: Is 59 less than 29? No.

So, -15, the tested number,

**is not** a solution to

$$14 - 3x < 29.$$

Try B. -12      Substitute -12 for  $x$  and do the math.

$$14 - 3x < 29 \rightarrow 14 - (3)(-12) < 29$$

$$14 - (-36) < 29$$

$$50 < 29$$

Ask: Is 50 less than 29? No.

So, -12, the tested number,

**is not** a solution to

$$14 - 3x < 29.$$

Try C. -9      Substitute -9 for  $x$  and do the math.

$$14 - 3x < 29 \rightarrow 14 - (3)(-9) < 29$$

$$14 - (-27) < 29$$

$$41 < 29$$

Ask: Is 41 less than 29? No.

So, -9, the tested number,

**is not** a solution to

$$14 - 3x < 29.$$

Try D. -5      Substitute -5 for  $x$  and do the math.

$$14 - 3x < 29 \rightarrow 14 - (3)(-5) < 29$$

$$14 - (-15) < 29$$

$$29 < 29$$

Ask: Is 29 less than 29? No.

So, -5, the tested number,

**is not** a solution to

$$14 - 3x < 29.$$

Try E. -2      Substitute -2 for  $x$  and do the math.

$$14 - 3x < 29 \rightarrow 14 - (3)(-2) < 29$$

$$14 - (-6) < 29$$

$$20 < 29$$

Ask: Is 20 less than 29? Yes.

So, -2, the tested number,

**is** a solution to  $14 - 3x < 29$ .

**Answer: E. -2**

7. Which number is a solution to  $12 - 2x \geq 25$ ? **Answer: B. -7**

A. -2      B. -7      C. -5      D. -3      E. -6

Try A. -2      Substitute -2 for  $x$  and do the math.

$$12 - 2x \geq 25 \rightarrow 12 - (2)(-2) \geq 25$$

$$12 - (-4) \geq 25$$

$$16 \geq 25$$

Ask: Is 16 greater than 25? No.

Is 16 equal to 25? No.

So, -2, the tested number,

*is not* a solution to

$$12 - 2x \geq 25.$$

Try B. -7      Substitute -7 for  $x$  and do the math.

$$12 - 2x \geq 25 \rightarrow 12 - (2)(-7) \geq 25$$

$$12 - (-14) \geq 25$$

$$26 \geq 25$$

Ask: Is 26 greater than 25? Yes.

So, -7, the tested number,

*is* a solution to  $12 - 2x \geq 25$ .

**Answer: B. -7**

8. Which number is a solution to  $2x + 12 > -2$ ? **Answer: C. -6**

A. -10      B. -12      C. -6      D. -8      E. -9

Try A. -10      Substitute -10 for  $x$  and do the math.

$$2x + 12 > -2 \rightarrow (2)(-10) + 12 > -2$$

$$-20 + 12 > -2$$

$$-8 > -2$$

Ask: Is -8 greater than -2? No.

So, -10, the tested number,

*is not* a solution to

$$2x + 12 > -2.$$

Try B. -12      Substitute -12 for  $x$  and do the math.

$$2x + 12 > -2 \rightarrow (2)(-12) + 12 > -2$$

$$-24 + 12 > -2$$

$$-12 > -2$$

Ask: Is -12 greater than -2? No.

So, -12, the tested number,

*is not* a solution to

$$2x + 12 > -2.$$

Try C. -6      Substitute -6 for  $x$  and do the math.

$$2x + 12 > -2 \rightarrow (2)(-6) + 12 > -2$$

$$-12 + 12 > -2$$

$$0 > -2$$

Ask: Is 0 greater than -2? Yes.

So, -6, the tested number,

*is* a solution to  $2x + 12 > -2$ .

**Answer: C. -6**

**Practice Five**

1. What is the solution to  $x + 4 \leq 6$ ? **Answer: B.  $x \leq 2$**   
A.  $x < 2$     B.  $x \leq 2$     C.  $x > 2$     D.  $x \geq 2$     E.  $x = 2$

**Step 1 Test  $x < 2$**

Pick any number that is less than 2. Let's try 1.

$$x + 4 \leq 6 \rightarrow 1 + 4 \leq 6$$
$$5 \leq 6$$

Ask: Is 5 less than or equal to 6? Yes.  
So the range we tested,  $x < 2$ ,  
*is correct* for  $x + 4 \leq 6$ .

**Step 2 Test  $x > 2$**

No need to test. Since  $x < 2$  *is correct*,  $x > 2$  *cannot be correct*.

**Step 3 Test  $x = 2$**

No need to test. We are looking for the solution to  $x + 4 \leq 6$ . Since that inequality includes the "or equal to" sign, the answer has to include the "or equal to" sign.

**Answer: B.  $x \leq 2$**

2. Find the solution to  $15 - 2x < 11$ . **Answer: D.  $x > 2$**   
A.  $x = 2$     B.  $x \leq 2$     C.  $x < 2$     D.  $x > 2$     E.  $x \geq 2$

**Step 1 Test  $x < 2$**

Pick any number that is less than 2. Let's try 1.

$$15 - 2x < 11 \rightarrow 15 - (2)(1) < 11$$
$$15 - 2 < 11$$
$$13 < 11$$

Ask: Is 13 less than 11? No.  
So the range we tested,  $x < 2$ ,  
*is not correct* for  $15 - 2x < 11$ .

**Step 2 Test  $x > 2$**

No need to test. Since  $x < 2$  *is not correct*,  $x > 2$  *has to be correct*.

**Step 3 Test  $x = 2$**

No need to test. We are looking for the solution to  $15 - 2x < 11$ . Since that inequality does not include the "or equal to" sign, the answer will not include the "or equal to" sign.

**Answer: D.  $x > 2$**

3. Which of the following is the solution to  $2x + 1 \geq 11$  ? **Answer: E.  $x \geq 5$**

A.  $x = 5$     B.  $x \leq 5$     C.  $x < 5$     D.  $x > 5$     E.  $x \geq 5$

**Step 1 Test  $x < 5$**

Pick any number that is less than 5. Let's try 3.

$$2x + 1 \geq 11 \rightarrow (2)(3) + 1 \geq 11$$

$$6 + 1 \geq 11$$

$$7 \geq 11 \quad \text{Ask: Is 7 greater than or equal to 11? No.}$$

So the range we tested,  $x < 5$ ,

*is not correct* for  $2x + 1 \geq 11$ .

**Step 2 Test  $x > 5$**

No need to test. Since  $x < 5$  *is not correct*,  $x > 5$  *has to be correct*.

**Step 3 Test  $x = 5$**

No need to test. We are looking for the solution to  $2x + 1 \geq 11$ . Since that inequality includes the "or equal to" sign, the answer has to include the "or equal to" sign.

**Answer: E.  $x \geq 5$**

4. What is the solution to  $3x - 4 < 14$  ? **Answer: C.  $x < 6$**

A.  $x = 6$     B.  $x \leq 6$     C.  $x < 6$     D.  $x > 6$     E.  $x \geq 6$

**Step 1 Test  $x < 6$**

Pick any number that is less than 6. Let's try 2.

$$3x - 4 < 14 \rightarrow (3)(2) - 4 < 14$$

$$6 - 4 < 14$$

$$2 < 14 \quad \text{Ask: Is 2 less than 14? Yes.}$$

So the range we tested,  $x < 6$ ,

*is correct* for  $3x - 4 < 14$ .

**Step 2 Test  $x > 6$**

No need to test. Since  $x < 6$  *is correct*,  $x > 6$  *cannot be correct*.

**Step 3 Test  $x = 6$**

No need to test. We are looking for the solution to  $3x - 4 < 14$ . Since that inequality does not include the "or equal to" sign, the answer will not include the "or equal to" sign.

**Answer: C.  $x < 6$**

5. What is the solution to  $7 - x > 10$ ? **Answer: A.  $x < -3$**   
A.  $x < -3$     B.  $x \leq -3$     C.  $x > -3$     D.  $x \geq -3$     E.  $x = -3$

**Step 1 Test  $x > -3$**

Pick any number that is greater than  $-3$ . Let's try 2.

Note that by choosing to test  $x > -3$  we can pick a positive number to test.

If we had chosen to test  $x < -3$ , we would have to pick a negative number to test.

$$7 - x > 10 \rightarrow 7 - 2 > 10$$

$$5 > 10 \quad \text{Ask: Is 5 greater than 10? No.}$$

So the range we tested,  $x > -3$ ,  
**is not correct** for  $7 - x > 10$ .

**Step 2 Test  $x < -3$**

No need to test. Since  $x > -3$  **is not correct**,  $x < -3$  **has to be correct**.

**Step 3 Test  $x = -3$**

No need to test. We are looking for the solution to  $7 - x > 10$ . Since that inequality does not include the "or equal to" sign, the answer will not include the "or equal to" sign.

**Answer: A.  $x < -3$**

6. Find the solution to  $14 - x \geq 5$ . **Answer: B.  $x \leq 9$**   
A.  $x = 9$     B.  $x \leq 9$     C.  $x < 9$     D.  $x > 9$     E.  $x \geq 9$

**Step 1 Test  $x < 9$**

Pick any number that is less than 9. Let's try 4.

$$14 - x \geq 5 \rightarrow 14 - 4 \geq 5$$

$$10 \geq 5 \quad \text{Ask: Is 10 greater than or equal to 5? Yes.}$$

So the range we tested,  $x < 9$ ,  
**is correct** for  $14 - x \geq 5$ .

**Step 2 Test  $x > 9$**

No need to test. Since  $x < 9$  **is correct**,  $x > 9$  **cannot be correct**.

**Step 3 Test  $x = 9$**

No need to test. We are looking for the solution to  $14 - x \geq 5$ . Since that inequality includes the "or equal to" sign, the answer has to include the "or equal to" sign.

**Answer: B.  $x \leq 9$**

7. Which of the following is the solution to  $3x + 3 > 21$  ? **Answer: D.  $x > 6$**

A.  $x = 6$     B.  $x \leq 6$     C.  $x < 6$     D.  $x > 6$     E.  $x \geq 6$

**Step 1 Test  $x < 6$**

Pick any number that is less than 6. Let's try 2.

$$3x + 3 > 21 \rightarrow (3)(2) + 3 > 21$$

$$6 + 3 > 21$$

$$9 > 21 \quad \text{Ask: Is 9 greater than 21? No.}$$

So the range we tested,  $x < 6$ ,  
*is not correct* for  $3x + 3 > 21$ .

**Step 2 Test  $x > 6$**

No need to test. Since  $x < 6$  *is not correct*,  $x > 6$  *has to be correct*.

**Step 3 Test  $x = 6$**

No need to test. We are looking for the solution to  $3x + 3 > 21$ . Since that inequality does not include the "or equal to" sign, the answer will not include the "or equal to" sign.

**Answer: D.  $x > 6$**

8. What is the solution to  $20 - 2x \leq 30$  ? **Answer: E.  $x \geq -5$**

A.  $x = -5$     B.  $x \leq -5$     C.  $x < -5$     D.  $x > -5$     E.  $x \geq -5$

**Step 1 Test  $x > -5$**

Pick any number that is greater than  $-5$ . Let's try 3.

Note that by choosing to test  $x > -5$  we can pick a positive number to test.

If we had chosen to test  $x < -5$ , we would have to pick a negative number to test.

$$20 - 2x \leq 30 \rightarrow 20 - (2)(3) \leq 30$$

$$20 - 6 \leq 30$$

$$14 \leq 30 \quad \text{Ask: Is 14 less than or equal to 30? Yes.}$$

So the range we tested,  $x > -5$ ,

*is correct* for  $20 - 2x \leq 30$ .

**Step 2 Test  $x < -5$**

No need to test. Since  $x > -5$  *is correct*,  $x < -5$  *cannot be correct*.

**Step 3 Test  $x = -5$**

No need to test. We are looking for the solution to  $20 - 2x \leq 30$ . Since that inequality includes the "or equal to" sign, the answer has to include the "or equal to" sign.

**Answer: E.  $x \geq -5$**