

ALGEBRA

Lesson 10 Graphing Inequalities

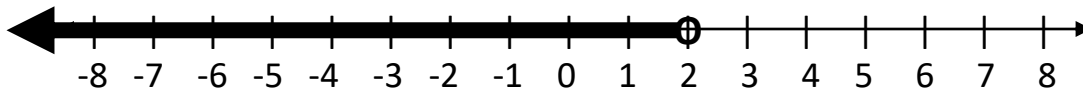
1. GRAPHING SIMPLE INEQUALITIES

Inequalities with variables can be depicted on a number line by darkening all the points that make up the entire solution. This can be referred to as representing an inequality on a number line, representing an inequality on a graph, or graphing an inequality.

Example 1

Graph $x < 2$ “ x is less than 2”

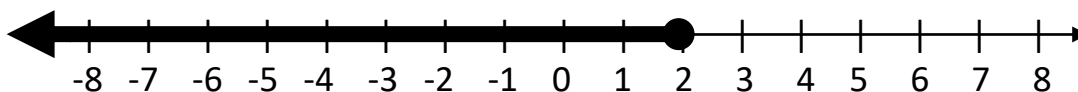
Darken all possible values for x , which are all the numbers less than 2, but not the number 2. To show that 2 is not included, use an open circle on the 2. Use an arrow on the other end of the darkened line to show that the numbers that satisfy $x < 2$ include all the numbers to the left of 2, going on forever.



Example 2

Graph $x \leq 2$ “ x is less than or equal to 2”

Darken all possible values for x , which are the numbers less than 2, and also the number 2. To show that 2 is included, use a solid circle on the 2.



$x \leq 2$ means: x is less than or equal to 2.

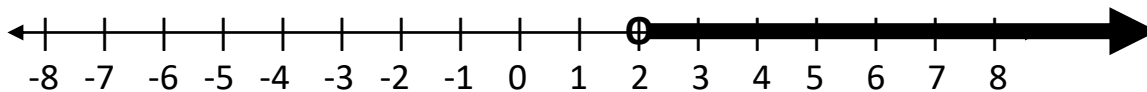
$x \leq 2$ can also be written as: x is no more than 2.

Both phrases mean that 2 is the largest number that x can be.

Example 3

Graph $x > 2$ “ x is greater than 2”

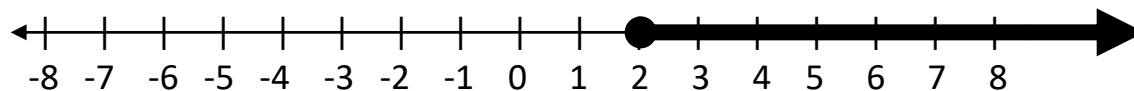
Darken all possible values for x , which are the numbers greater than 2, but not the number 2. To show that 2 is not included, use an open circle on the 2.



Example 4

Graph $x \geq 2$ “ x is greater than or equal to 2”

Darken all possible values for x , which are the numbers greater than 2, and also the number 2. To show that 2 is included, use a solid circle on the 2.



$x \geq 2$ means: x is greater than or equal to 2.

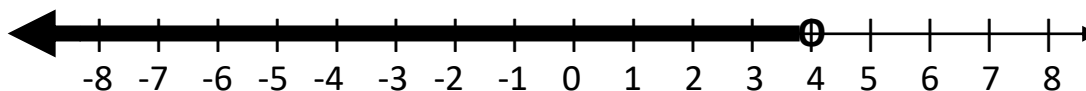
$x \geq 2$ can also be written as: x is at least 2.

Both phrases mean that 2 is the smallest number that x can be.

Example 5

Graph $x < 4$ “ x is less than 4”

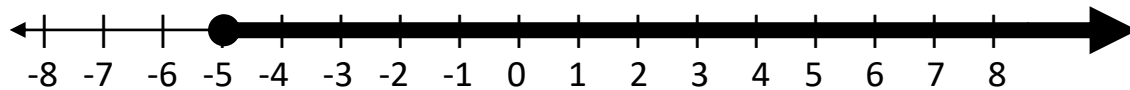
Darken all the numbers less than 4. Use an open circle on 4 to show that it is not part of the solution.



Example 6

Graph $x \geq -5$ “ x is greater than or equal to -5 ”

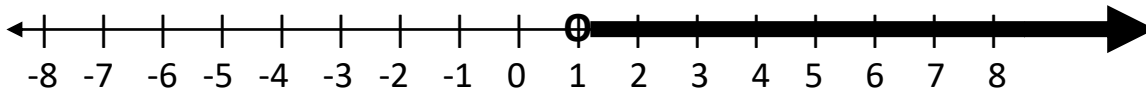
Darken all the numbers greater than or equal to -5 . Use a solid circle on -5 to show that it is part of the solution.



Example 7

Graph $x > 1$ “ x is greater than 1”

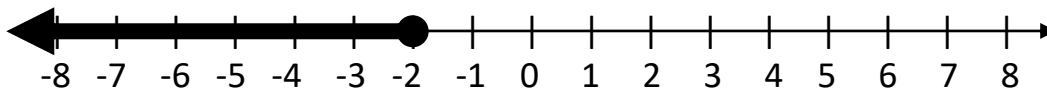
Darken all the numbers greater than 1. Use an open circle on 1 to show that it is not part of the solution.



Example 8

Graph $x \leq -2$ “ x is less than or equal to -2 ”

Darken all the numbers less than or equal to -2 . Use a solid circle on -2 to show that it is part of the solution.

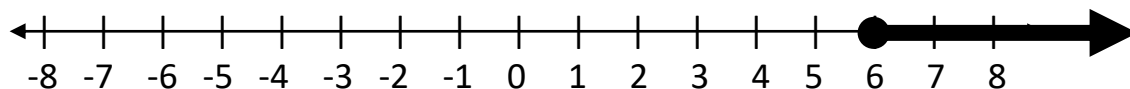


Example 9

Graph “ x is at least 6”

x is at least 6 means that 6 is the smallest number x can be.

Darken all the numbers larger than 6, and use a solid circle on 6 to show that it is part of the solution.



NOTE that “ x is at least 6” and “ x is less than 6” **ARE NOT** the same. If you find this terminology confusing, think of “ x is at least 6” in terms of something you are doing.

Let's say that x is the number of push-ups you have to do.

If the number of push-ups you have to do is “at least 6”

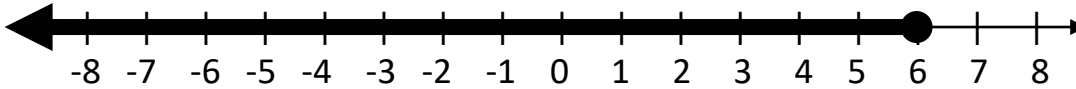
then 6 is the smallest number of push-ups that is acceptable.

Example 10

Graph “ x is no more than 6”

x is no more than 6 means that 6 is the largest number x can be.

Darken all the numbers smaller than 6, and use a solid circle on 6 to show that it is part of the solution.



NOTE that “ x is no more than 6” and “ x is greater than 6” **ARE NOT** the same. If you find this terminology confusing, think of “ x is no more than 6” in terms of something you are doing.

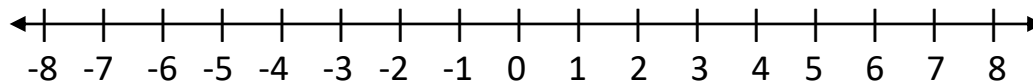
Let’s say that x is the number of cookies you can take.

If the number of cookies you can take is “no more than 6” then 6 is the largest number of cookies that is acceptable.

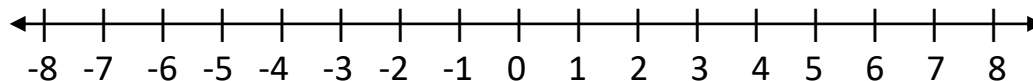
Practice One Answers – p. 19

Graph each inequality or expression on the number line provided.

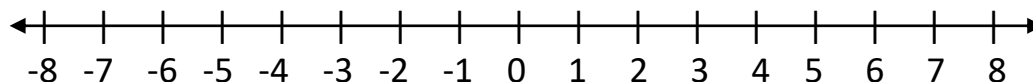
1. $x < 6$



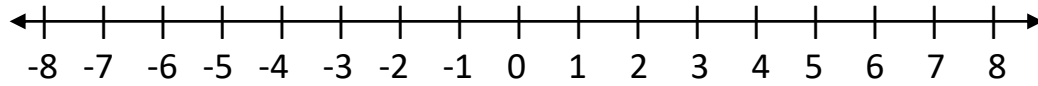
2. $x \geq -3$



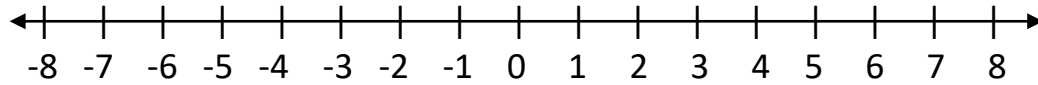
3. $x > 5$



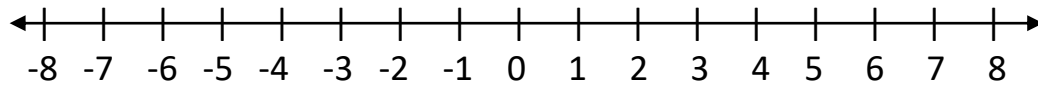
4. $x \leq -4$



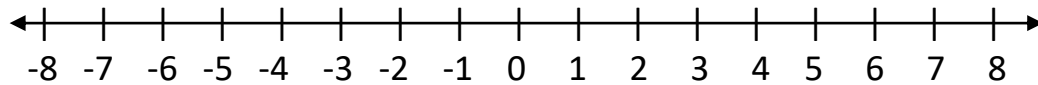
5. x is at least 5



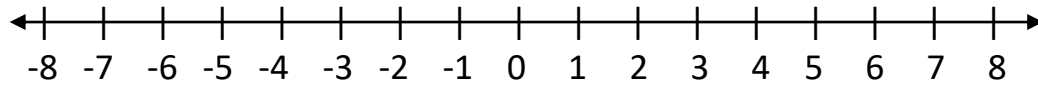
6. x is no more than -2



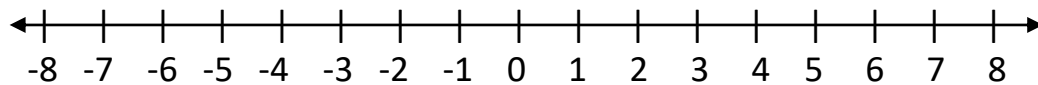
7. 7 is greater than x



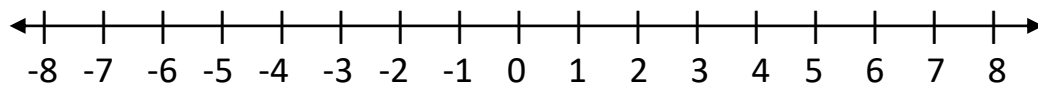
8. -3 is less than x



9. x is no more than 7



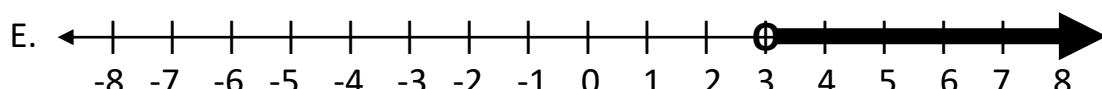
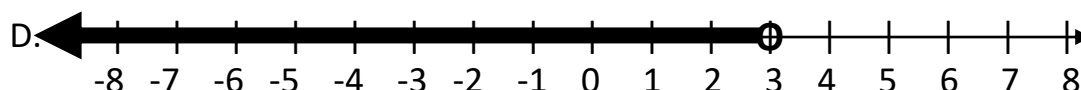
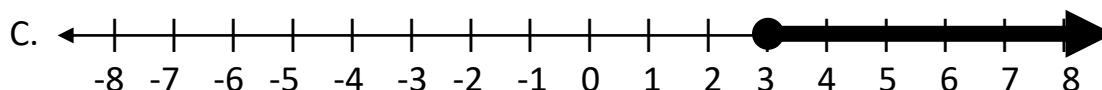
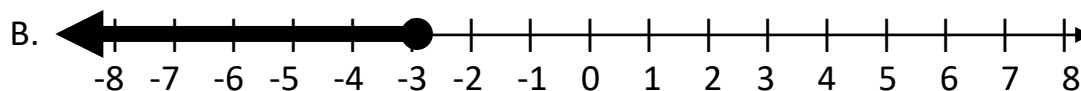
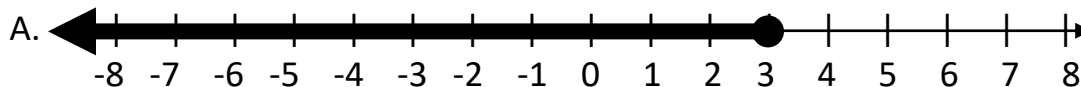
10. x is at least 1



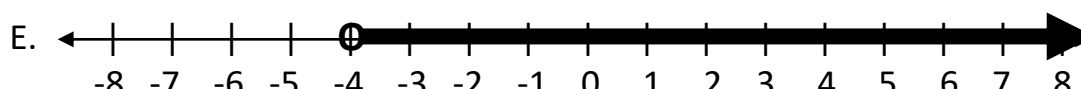
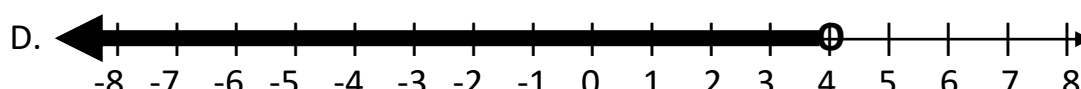
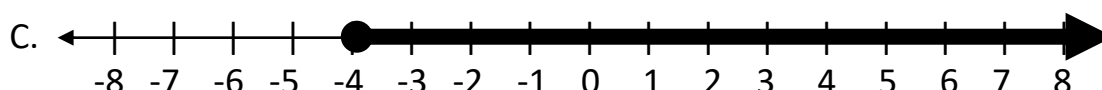
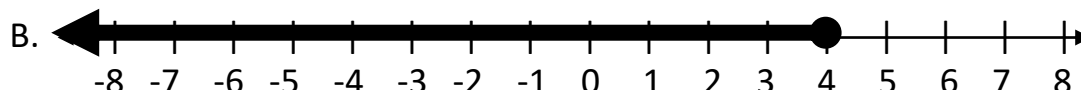
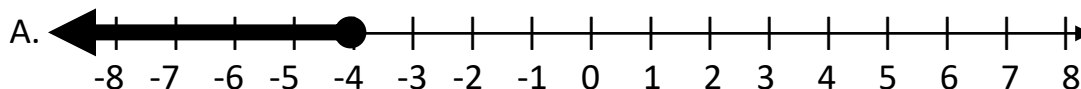
Practice Two Answers – p. 20

Chose the graph that correctly represents each inequality or expression.

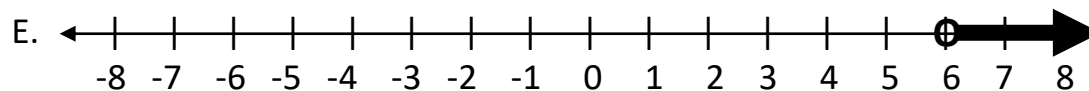
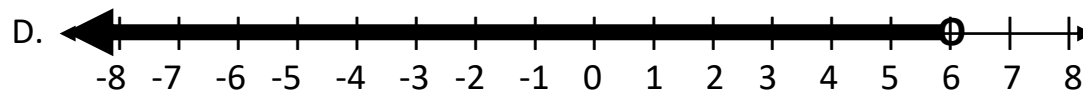
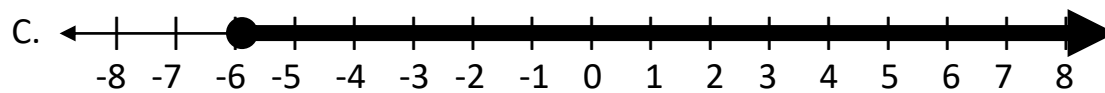
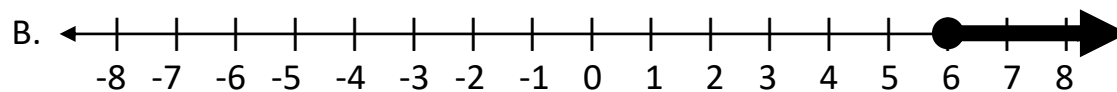
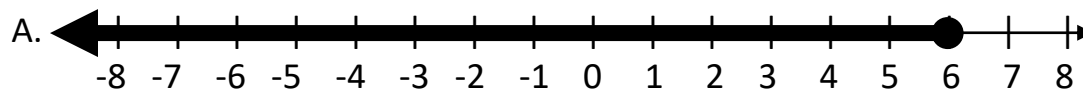
1. $x < 3$



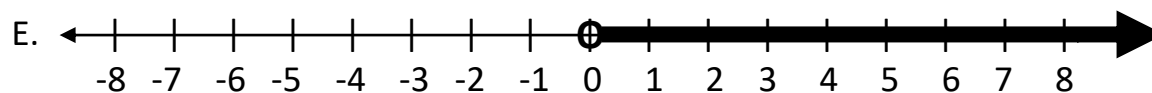
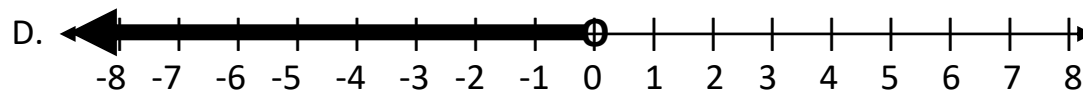
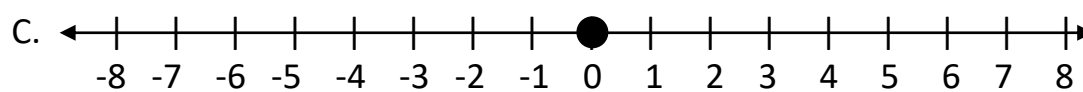
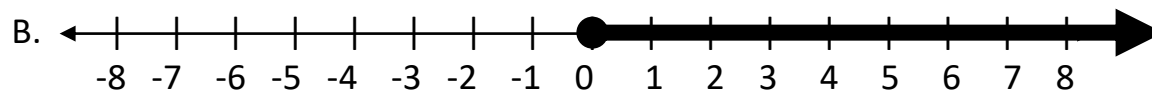
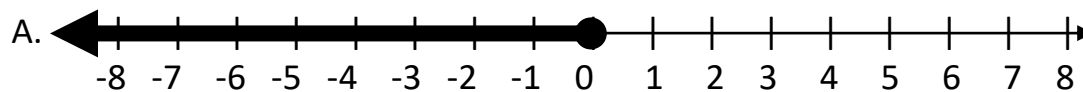
2. $x \geq -4$



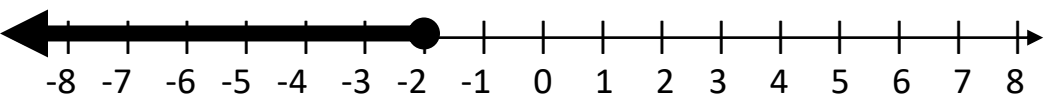
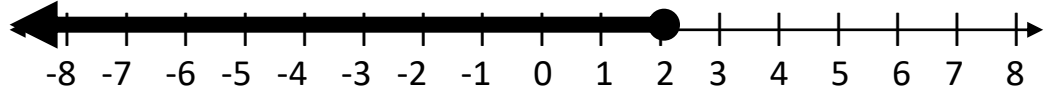
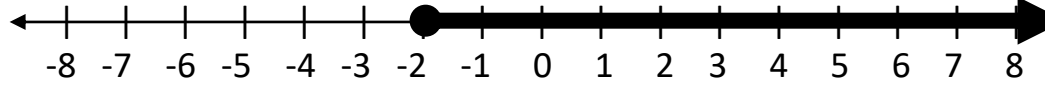
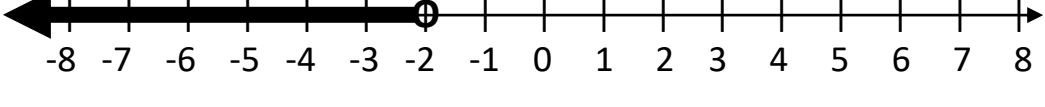
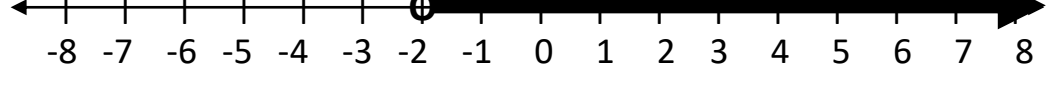
3. $x > 6$



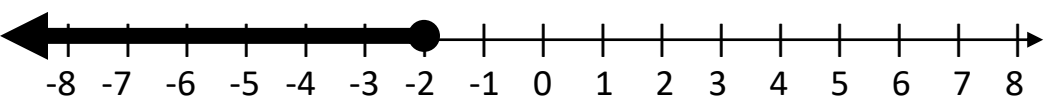
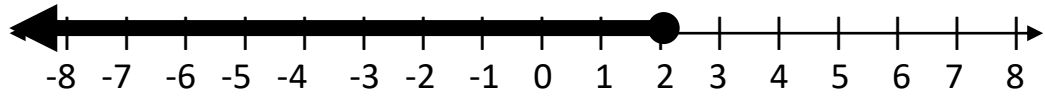
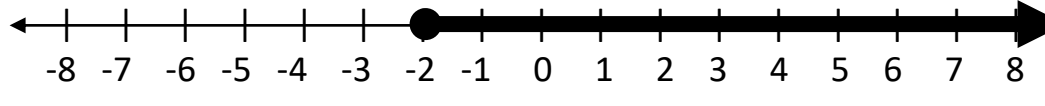
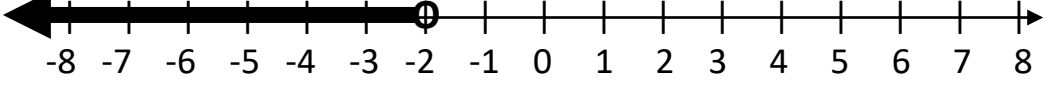
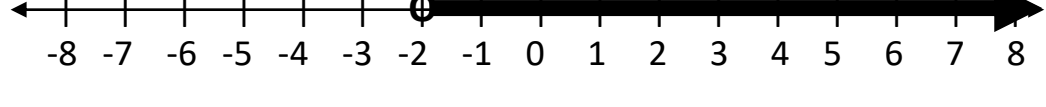
4. $x \leq 0$



5. x is at least -2

- A. 
- B. 
- C. 
- D. 
- E. 

6. x is no more than -2

- A. 
- B. 
- C. 
- D. 
- E. 

2. GRAPHING COMPOUND INEQUALITIES

A *compound inequality* contains two inequalities that are connected with “and” “but” or “or”.

Connected with “**and**” or “**but**” means values of x must satisfy **both** inequalities.

Connected with “**or**” means values of x must satisfy **one** of the inequalities.

Example 1

x is greater than 5 and less than 10

which is the same as

x is greater than 5 but less than 10

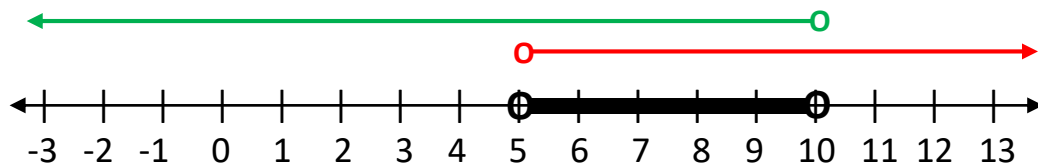
To graph this compound inequality, think of it as 2 inequalities.

x is greater than 5 and x is less than 10
shown below in red *shown below in green*

The word and is used so x must satisfy both inequalities.

The solution is all the values of x that are found on **both** the red and the green graphs, shown below by the heavy black line.

These are all the values of x that are greater than 5 **and also** less than 10.



Compound inequalities can be expressed in words or in symbols.

x is greater than 5 and less than 10 expresses the compound inequality in words.

It can also be expressed two ways using only numbers and symbols:

$$5 < x < 10 \quad \text{and} \quad 10 > x > 5$$

$5 < x < 10$ is read as “5 is less than x and x is less than 10” and can be thought of as any number between 5 and 10, but not including the 5 and 10 endpoints.

$10 > x > 5$ is read as “10 is greater than x and x is greater than 5” and can be thought of as any number between 10 and 5, but not including the 10 and 5 endpoints.

Example 2

x is at least 5 and no more than 10

which is the same as

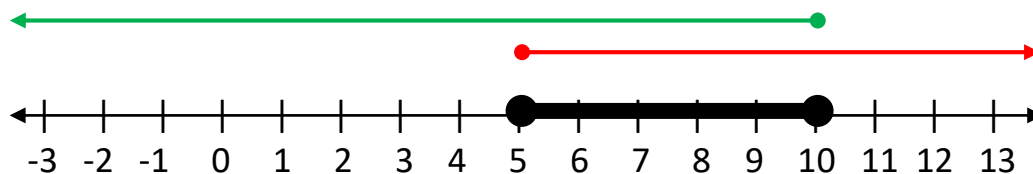
x is at least 5 but no more than 10

Think of this as 2 inequalities.

x is at least 5	<u>and</u>	x is no more than 10
<i>means 5 is the smallest number x can be</i>		<i>means 10 is the biggest number x can be</i>
<i>shown below in red</i>		<i>shown below in green</i>

The word **and** is used so x must satisfy both inequalities. The solution is all the values of x that are found on both the red and the green graphs, shown below by the heavy black line.

The smallest x can be is 5 **and** the biggest x can be is 10.



x is at least 5 and no more than 10 expresses the compound inequality in words. It can also be expressed two ways using only numbers and symbols:

$$5 \leq x \leq 10 \quad \text{and} \quad 10 \geq x \geq 5$$

$5 \leq x \leq 10$ is read as “5 is less than or equal to x and x is less than or equal to 10” and can be thought of as any number that goes from 5 to 10, including the 5 and 10 endpoints.

$10 \geq x \geq 5$ is read as “10 is greater than or equal to x and x is greater than or equal to 5” and can be thought of as any number that goes from 10 to 5, including the 10 and 5 endpoints.

NOTE that a compound inequality written in this form is an **AND** type of compound inequality. For a number to be part of the solution, it must satisfy both parts of the inequality.

For example, in the inequality above, $5 \leq x \leq 10$, the number 20 is not part of the solution. If we substitute 20 for x to get $5 \leq 20 \leq 10$, we can see that the first part of the compound inequality, $5 \leq 20$ is true, but the second part, $20 \leq 10$ is not true. So, 20 is not part of the solution because it only satisfies half of the compound inequality.

Example 3

x is greater than 5 or less than -2

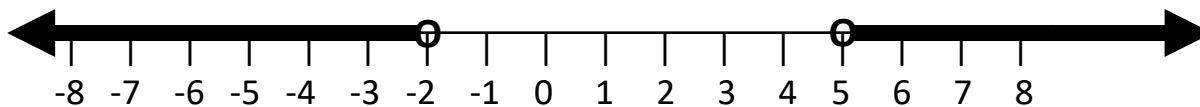
Think of this as 2 inequalities.

$$x > 5$$

$$x < -2$$

The word **or** is used so x must satisfy either one of the inequalities. The solution is all the values of x that are found on the graphs of either inequality.

Graph both inequalities on the same number line.



Example 4

x is at least 5 or less than -2

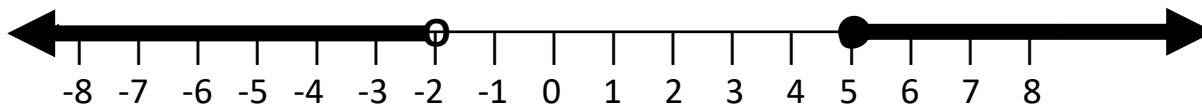
Think of this as 2 inequalities.

$$x \geq 5 \quad (\text{remember, “}x \text{ is at least 5” means 5 is the smallest } x \text{ can be)}$$

$$x < -2$$

The word **or** is used so x must satisfy either one of the inequalities. The solution is all the values of x that are found on the graphs of either inequality.

Graph both inequalities on the same number line.



Example 5

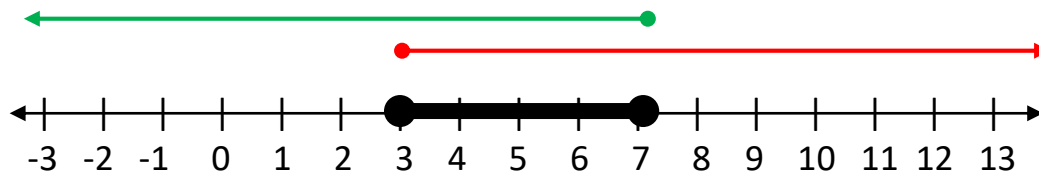
x is at least 3 and no more than 7

x is at least 3
means 3 is the smallest
number x can be
shown below in red

and

x is no more than 7
means 7 is the biggest
number x can be
shown below in green

The black line show the solution, all the numbers that satisfy both inequalities.



x is at least 3 and no more than 7 means x goes from 3 to 7, and includes the 3 and 7 endpoints.

This can be expressed as: $3 \leq x \leq 7$ and $7 \geq x \geq 3$

Example 6

x is greater than -2 but less than 3

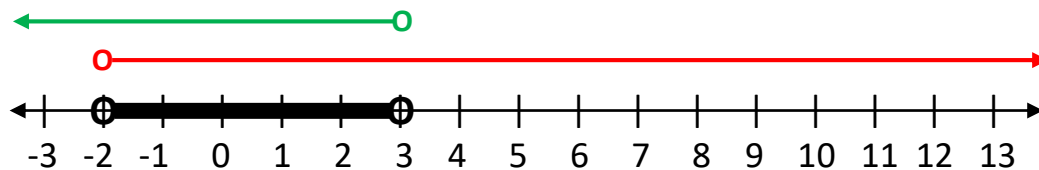
x is greater than -2
shown below in red

but

x is less than 3
shown below in green

The black line show the solution, all the numbers that satisfy both inequalities.

NOTE that with compound inequalities, ***but*** means the same as ***and***.



x is greater than -2 but less than 3 means x is between -2 and 3, and does not include the -2 and 3 endpoints.

This can be expressed as: $-2 < x < 3$ and $3 > x > -2$

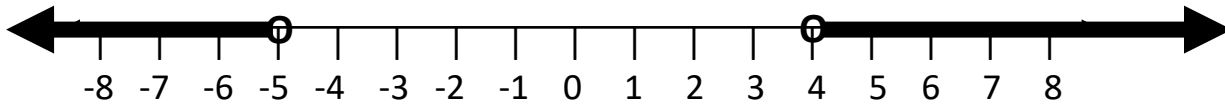
Example 7

x is greater than 4 or less than -5

$$x > 4 \quad \text{or} \quad x < -5$$

The word or is used so x must satisfy either one of the inequalities. The solution is all the values of x that are found on the graphs of either inequality.

Graph both inequalities on the same number line.

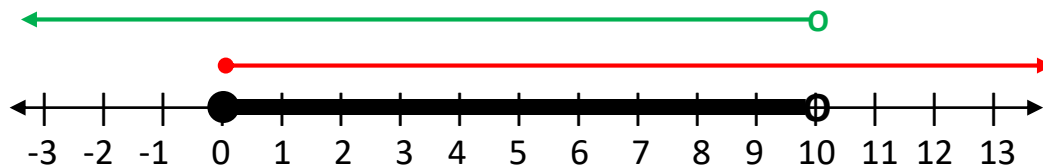


Example 8

x is at least 0 and less than 10

x is at least 0 and x is less than 10
means 0 is the smallest number x can be shown below in red *shown below in green*

The black line show the solution, all the numbers that satisfy both inequalities.



x is at least 0 and less than 10 means x goes from 0 to 10. It includes the 0 endpoint, but does not include the 10 endpoint.

This can be expressed as: $0 \leq x < 10$ and $10 > x \geq 0$

Example 9

$$2 < x < 6$$

2 is less than x *and* x is less than 6.

x is between 2 and 6, and does not include the 2 and 6 endpoints.



Example 10

$$10 \geq x \geq 3$$

10 is greater than or equal to x *and* x is greater than or equal to 3.

x is between 10 and 3 and includes the 10 and 3 endpoints.



Practice Three Answers – p. 21

Graph each compound inequality on the number line provided.

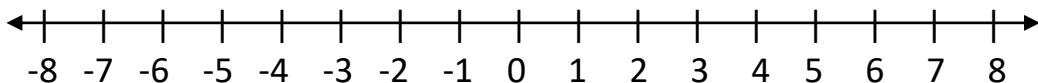
1. x is at least 1 and no more than 9



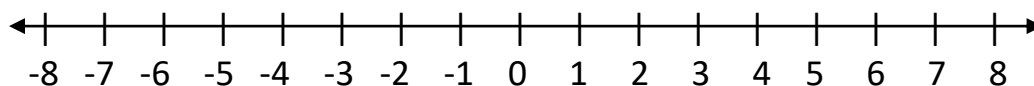
2. x is greater than 2 but less than 12



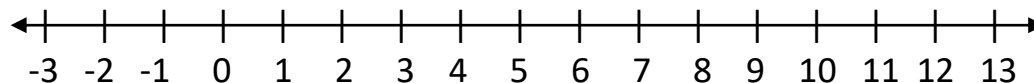
3. x is greater than 5 or x is less than 0



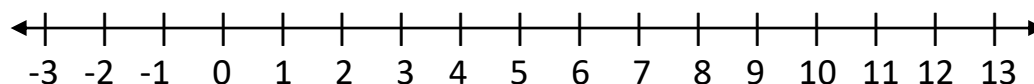
4. x is at least 7 or x is less than -2



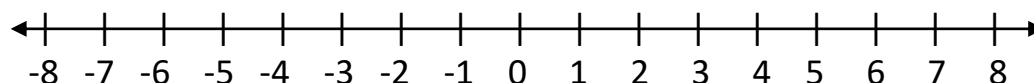
5. x is at least -1 but no more than 6



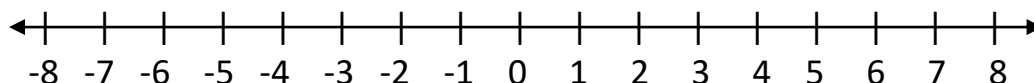
6. x is greater than -2 and less than 7



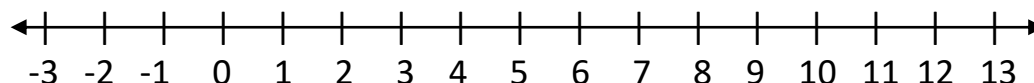
7. x is at least 4 or x is less than -4



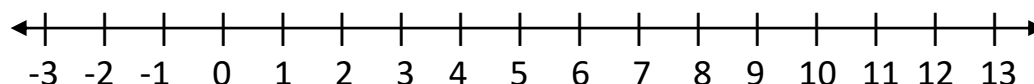
8. x is at least -1 or x is less than -2



9. $3 \leq x \leq 4$



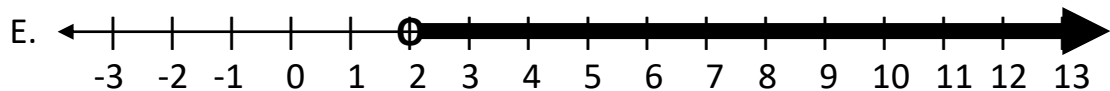
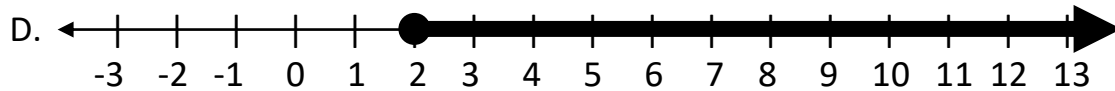
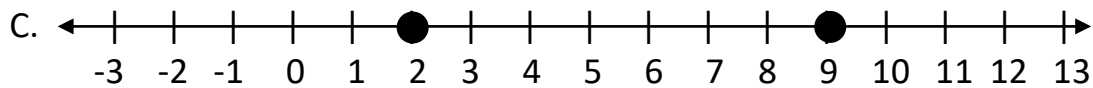
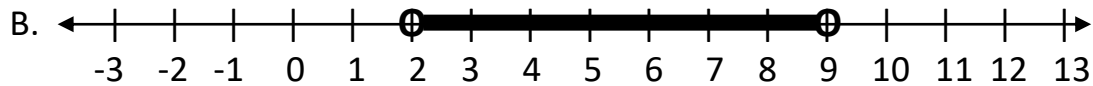
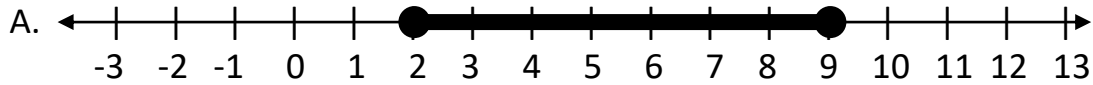
10. $0 \geq x > -2$



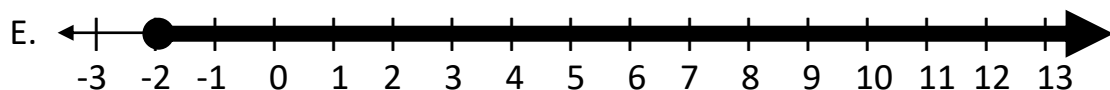
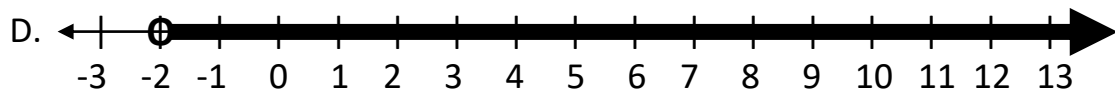
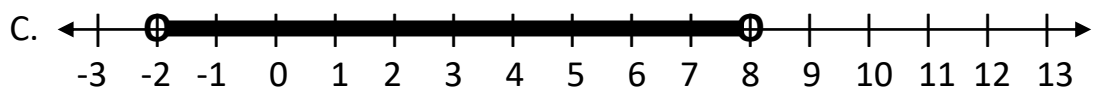
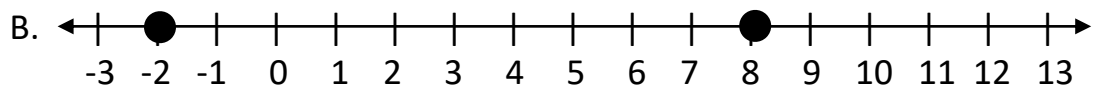
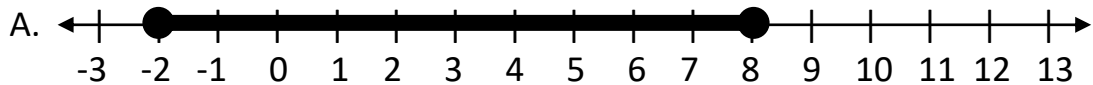
Practice Four Answers – p. 22

Chose the graph that correctly represents each compound inequality.

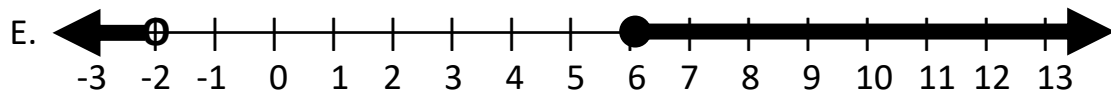
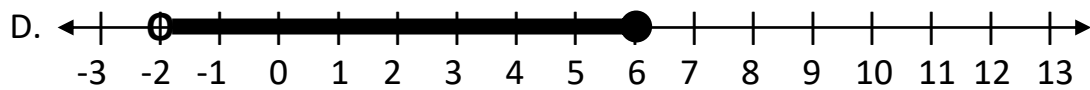
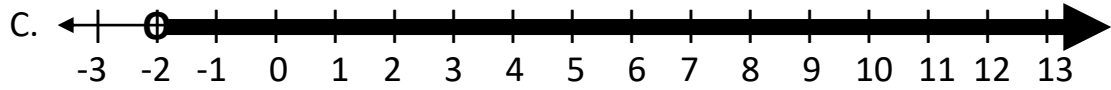
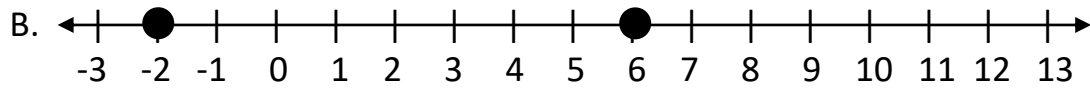
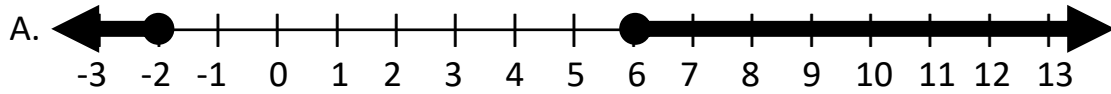
1. x is at least 2 and no more than 9



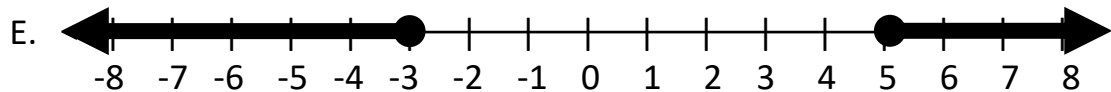
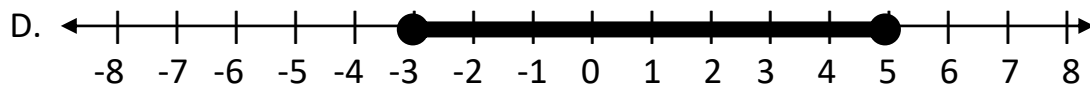
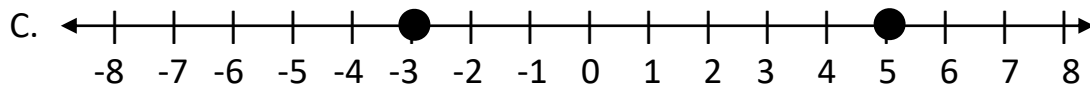
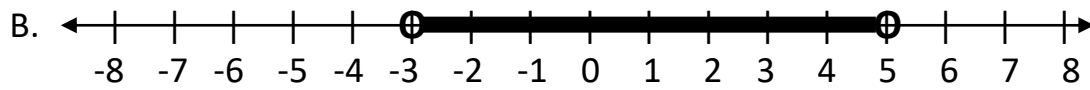
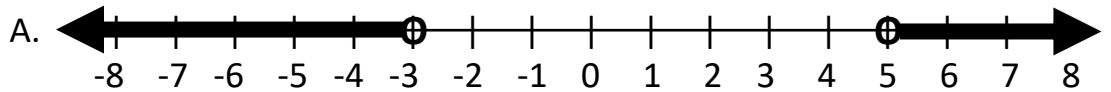
2. x is greater than -2 but less than 8



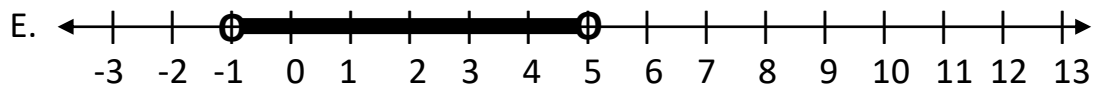
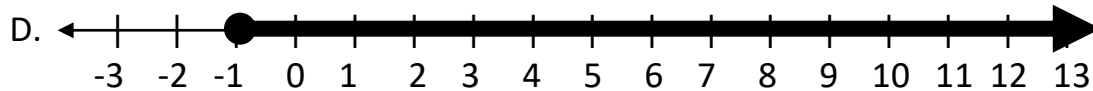
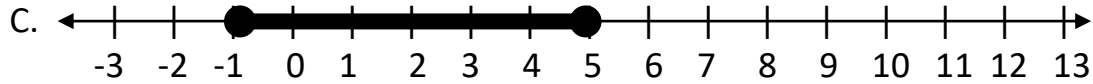
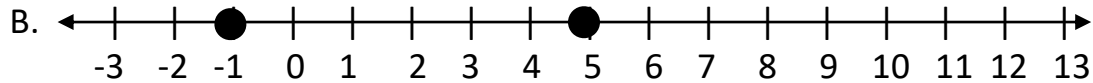
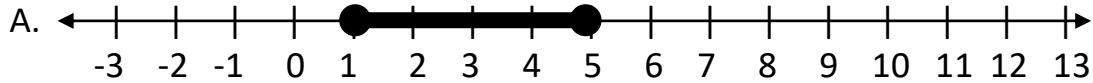
3. x is at least 6 or x is less than -2



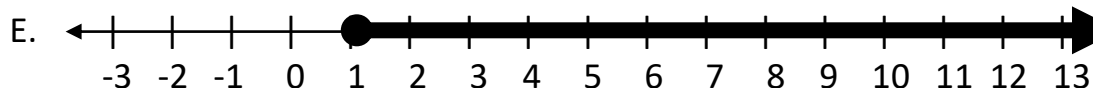
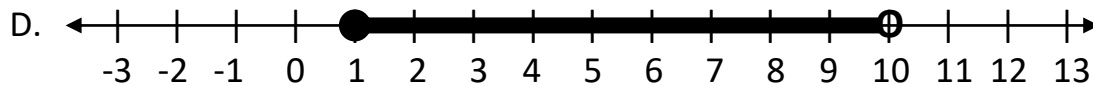
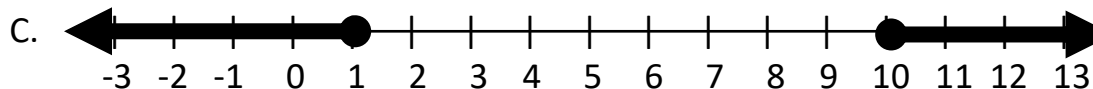
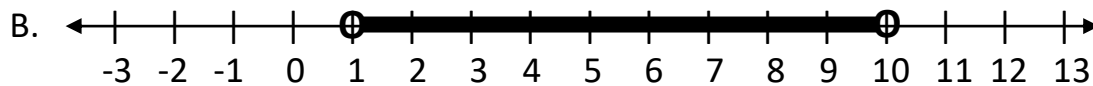
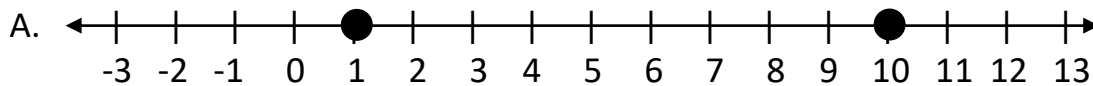
4. $-3 < x < 5$



5. $5 \geq x \geq -1$



6. x is less than 10 but at least 1



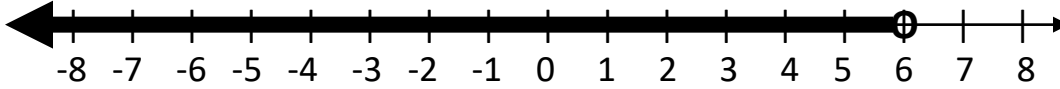
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ANSWER KEY Lesson 10 Graphing Inequalities

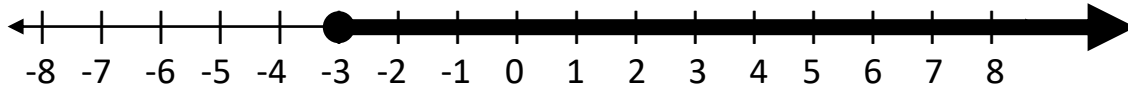
Practice One

Graph each inequality or expression on the number line provided.

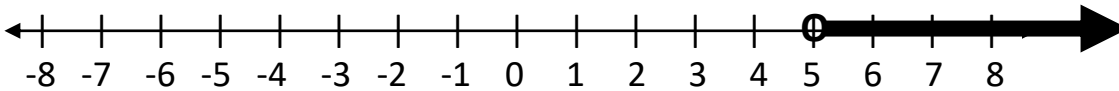
1. $x < 6$



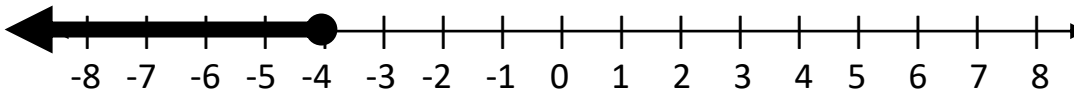
2. $x \geq -3$



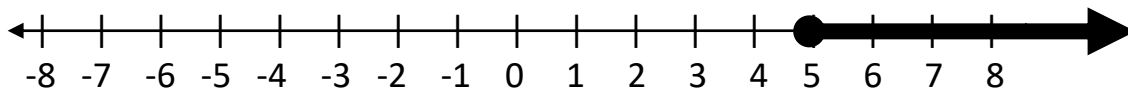
3. $x > 5$



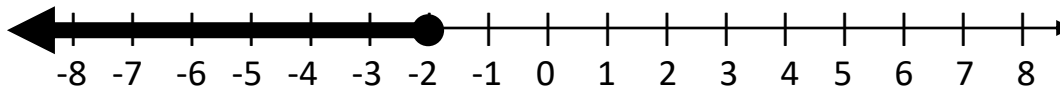
4. $x \leq -4$



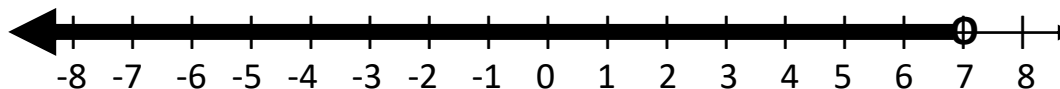
5. x is at least 5



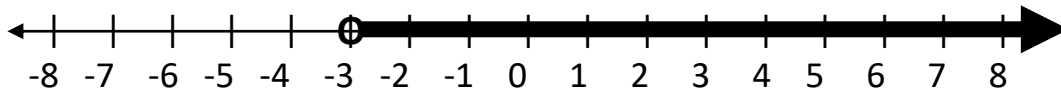
6. x is no more than -2



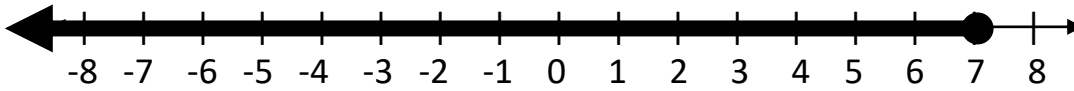
7. 7 is greater than x



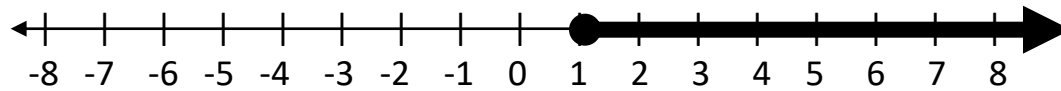
8. -3 is less than x



9. x is no more than 7

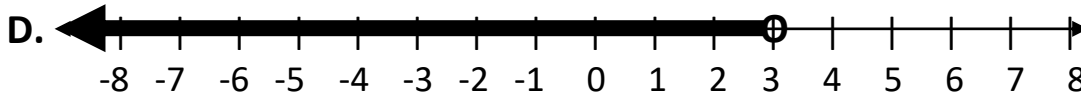


10. x is at least 1

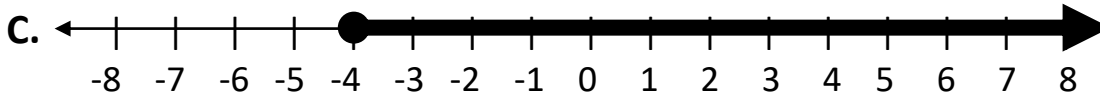


Practice Two

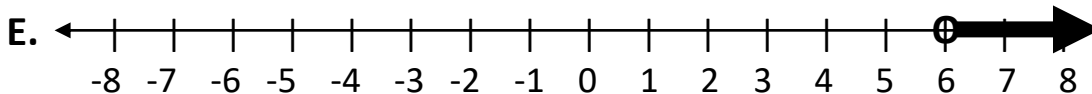
1. $x < 3$



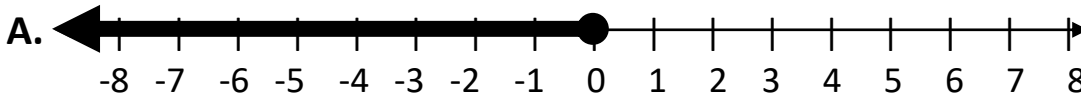
2. $x \geq -4$



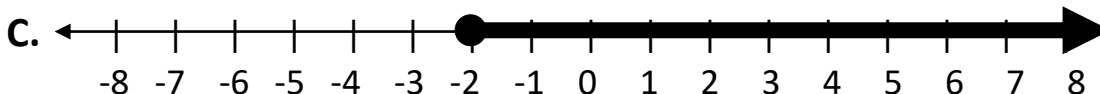
3. $x > 6$



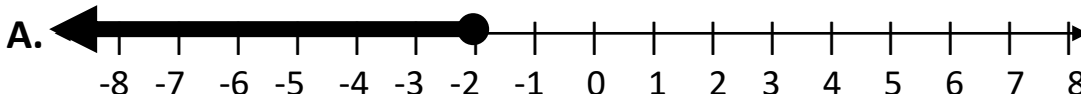
4. $x \leq 0$



5. x is at least -2

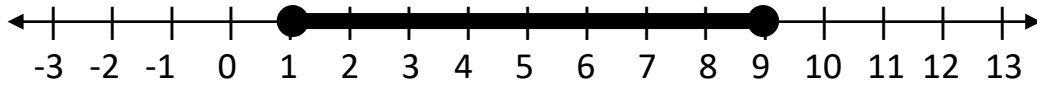


6. x is no more than -2



Practice Three

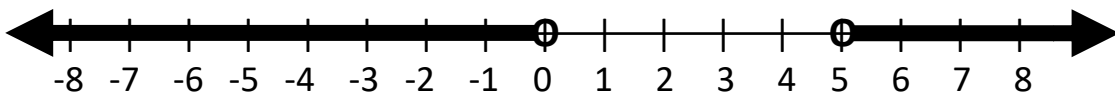
1. x is at least 1 and no more than 9



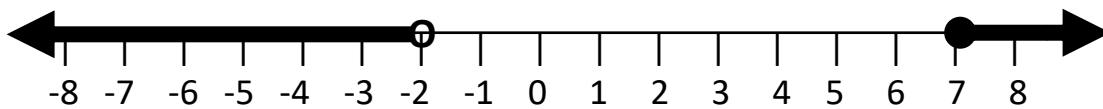
2. x is greater than 2 but less than 12



3. x is greater than 5 or x is less than 0



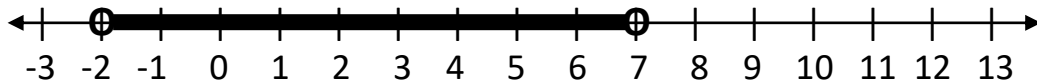
4. x is at least 7 or x is less than -2



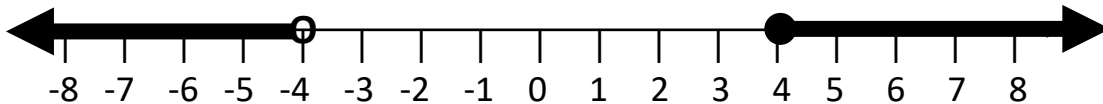
5. x is at least -1 but no more than 6



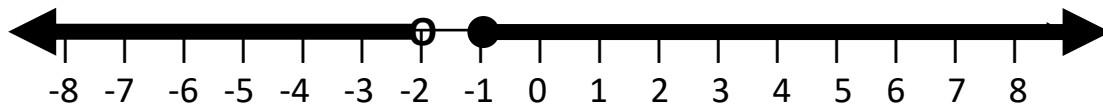
6. x is greater than -2 and less than 7



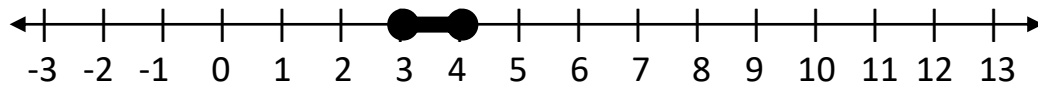
7. x is at least 4 or x is less than -4



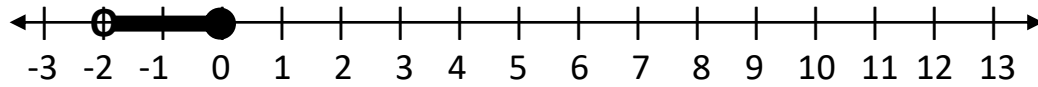
8. x is at least -1 or x is less than -2



9. $3 \leq x \leq 4$

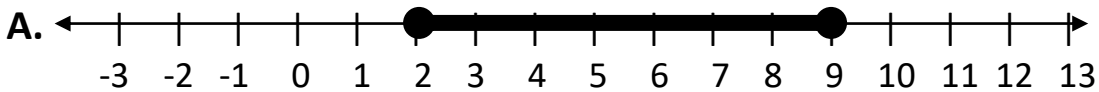


10. $0 \geq x > -2$

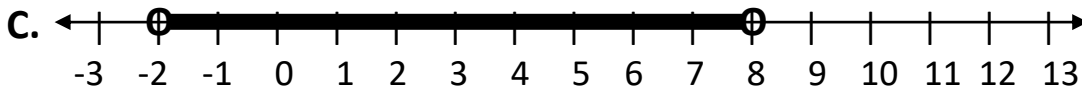


Practice Four

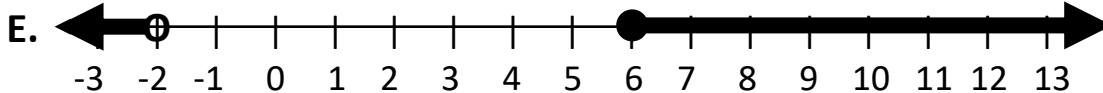
1. x is at least 2 and no more than 9



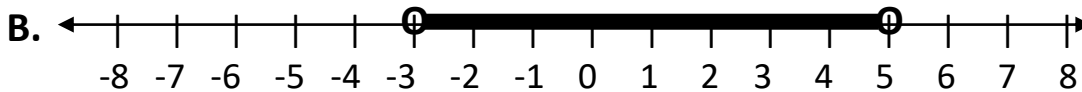
2. x is greater than -2 but less than 8



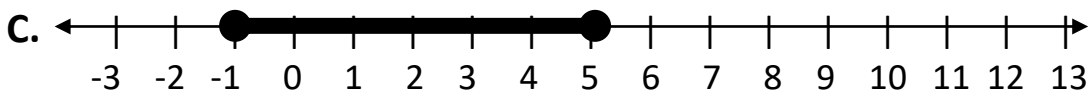
3. x is at least 6 or x is less than -2



4. $-3 < x < 5$



5. $5 \geq x \geq -1$



6. x is less than 10 but at least 1

