Blue Pelican Algebra I

First Semester

Teacher Version 1.01

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Alg1 Syllabus (First Semester)

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Lesson 02: Negative numbers, opposites, absolute values
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Semester summary

Semester review
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Enrichment Topics

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Topic B: Inequality conjunctions and disjunctions
Topic C: Two dimensional inequalities
Topic D: Combining direct and indirect variations
Topic E: Scientific notation
Topic F: Greatest common factor (GCF) and least common multiple (LCM)
Topic G: Derivation of the Quadratic Formula
Topic H: Completing the square
Topic I: Statistics
Topic J: Real-world applications of parabolas and the other three conic sections

Alg 1, Unit 1

Basic Operations

Unit 1: Lesson 01 Order of operations (PEMDAS)

In arithmetic expressions it is important to know the **order** in which to do the operations. The correct order is given by **PEMDAS**:

- PEMDAS is a memory aid for the correct order: **parentheses, exponents, multiplication, division, addition, and subtraction**.
- Even though multiplication is listed before division, they are actually of the **same** priority.
- Even though addition is listed before subtraction, they are actually of the **same** priority.
- When deciding which of two operations of the same priority to do first, do them in a **left-to-right order**.

In the following examples, perform the arithmetic operations in the correct order to produce a final value for the expression.

Example 1: $2 \cdot 8 + 5 - 6 + 1 \cdot 3$

$= 16 + 5 - 6 + 1 \cdot 3$
$= 16 + 5 - 6 + 3$
$= 21 - 6 + 3$
$= 15 + 3 = \boxed{18}$

Example 2: $17 + 6 \cdot 3 \div 2$

$= 17 + 18 \div 2$
$= 17 + 9$
$= \boxed{26}$

Example 3: $2 \cdot (7 + 2) + 1 - 8/2$

$= 2(9) + 1 - 8/2$
$= 18 + 1 - 8/2$
$= 18 + 1 - 4$
$= 19 - 4 = \boxed{15}$

Example 4: $2 \cdot 3^2 - 15/3$

$= 2 \cdot 9 - 15/3$
$= 18 - 15/3$
$= 18 - 5 = \boxed{13}$

Example 5: $24 \div 2^2 \cdot 10 - 2(3 \cdot 5)$

$= 24 \div 2^2 \cdot 10 - 2(15)$
$= 24 \div 4 \cdot 10 - 30$
$= 6 \cdot 10 - 30$
$= 60 - 30$
$= \boxed{30}$

Example 6: $(18 - (12/2) + 3)/(4 + 1)$

$= (18 - 6 + 3)/(4+1)$
$= (12+3)/(5)$
$= 15/5$
$= \boxed{3}$

As a special case of parentheses, consider a fraction written in this form:

$$\frac{\mathrm{a} + \mathrm{b}}{\mathrm{c} + \mathrm{d}}$$

Rewrite with parentheses in this form $(\mathrm{a} + \mathrm{b})/(\mathrm{c} + \mathrm{d})$ and simplify in the parentheses first.

Example 7: $\dfrac{3 \cdot 2 + 6 \cdot 5}{28 - 25}$

$= (3 \cdot 2 + 6 \cdot 5)/(28 - 25)$
$= (6 + 6 \cdot 5)/3$
$= (6 + 30)/3$
$= 36/3 = \boxed{12}$

Assignment: In the following examples, perform the arithmetic operations in the correct order to produce a final value for the expression.

1. $8 + 4(7 - 2)$

$= 8 + 4(5)$

$= 8 + 20$

$= \boxed{28}$

2. $3(4 + 1) - 12 \div 2^2$

$= 3(5) - 12 \div 2^2$

$= 3 \cdot 5 - 12 \div 4$

$= 15 - 12/4$

$= 15 - 3 = \boxed{12}$

3. $11 - 22/11 + 2^3 \cdot 6$

$= 11 - 22/11 + 8 \cdot 6$

$= 11 - 2 + 48$

$= 9 + 48$

$= \boxed{57}$

4. $40 - 25 \div 5$

$= 40 - 5$

$= \boxed{35}$

5. $(6 \cdot 5)/(11 - 8)$

$= 30/3$

$= \boxed{10}$

6. $\dfrac{4 \cdot 3^2}{18 - 2 \cdot 3}$

$= (4 \cdot 3^2)/(18 - 2 \cdot 3)$

$= (4 \cdot 9)/(18 - 6)$

$= 36/12$

$= \boxed{3}$

7. $11 + 1 \cdot 2 - 4 \cdot 1 + 36 \div 3$

$= 11 + 2 - 4 \cdot 1 + 36 \div 3$
$= 11 + 2 - 4 + 36 \div 3$
$= 11 + 2 - 4 + 12$
$= 13 - 4 + 12$
$= 9 + 12 = \boxed{21}$

8. $200/2/2 \cdot 3 + 1$

$= 100/2 \cdot 3 + 1$
$= 50 \cdot 3 + 1$
$= \boxed{151}$

9. $\dfrac{10 \cdot 2 + 1 \cdot 12}{1 + 2 \cdot 3 - 3}$

$= (10 \cdot 2 + 1 \cdot 12)/(1 + 2 \cdot 3 - 3)$
$= (20 + 1 \cdot 12)/(1 + 6 - 3)$
$= (20 + 12)/(7 - 3)$
$= 32/4 = \boxed{8}$

10. $8 \cdot 5 - 2(22 \div 2) + 3(5 - 2)$

$= 8 \cdot 5 - 2(11) + 3(5 - 2)$
$= 8 \cdot 5 - 2(11) + 3(3)$
$= 40 - 2(11) + 3(3)$
$= 40 - 22 + 3(3)$
$= 40 - 22 + 9$
$= 18 + 9$
$= \boxed{27}$

11. $3(36 \div 9) + 2(80 - 60) - 3 \cdot 4$

$= 3(4) + 2(20) - 3 \cdot 4$
$= 12 + 2(20) - 3 \cdot 4$
$= 12 + 40 - 3 \cdot 4$
$= 12 + 40 - 12$
$= 52 - 12 = \boxed{40}$

12. $\dfrac{5 \cdot 2 + 48 \div 12}{9 - 2 - 5}$

$= (5\cdot 2+48\div 12)/(9-2-5)$
$= (10+48\div 12)/(7-5)$
$= (10+4)/2$
$= 14/2 = \boxed{7}$

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*13. $\{\, 72 - 4[11 - 3(12/4)]\ \}/2$

$= \{72-4[11-3(3)]\}/2$
$= \{72-4[11-9]\}/2$
$= \{72-4[2]\}/2$
$= \{72-8\}/2 = 64/2 = \boxed{32}$

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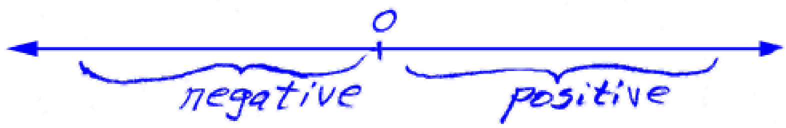
*14. $\dfrac{15[\,5 + 3(8 \div 4 + 2)\,] + 15}{7-45 \div [5 + 2(6 \div 3)]}$

$= (15[5+3(2+2)]+15)/(7-45\div[5+2\cdot 2])$
$= (15[5+3(4)]+15)/(7-45\div[5+4])$
$= (15[5+12]+15)/(7-45\div 9)$
$= (15[17]+15)/(7-5)$
$= (255+15)/2$
$= 270/2 = \boxed{135}$

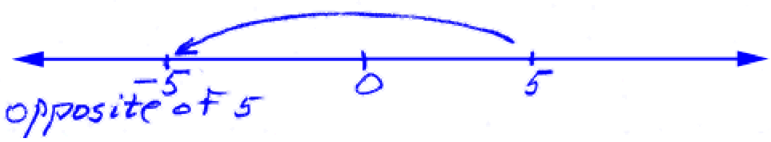
Unit 1: Lesson 02

Negative numbers, opposites, absolute value
Inequalities

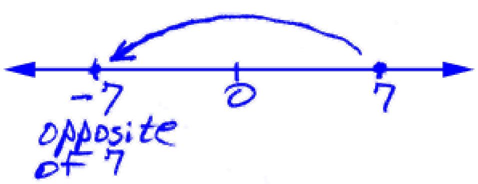
Negative numbers are to the left of the origin (0) while positive numbers are to the right.



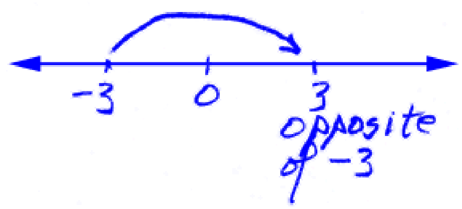
Opposite numbers are mirror images of each other across the origin.



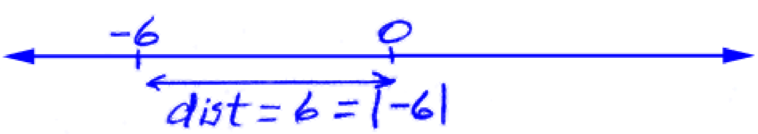
Example 1: Locate 7 on a number line and then locate its opposite.



Example 2: Locate –3 on a number line and then locate its opposite.

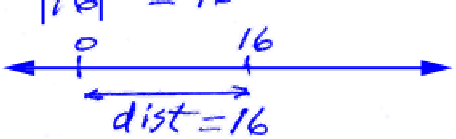


The **absolute value** of a number (indicated with vertical bars, |4|) is the distance of a number from the origin. The absolute value of a number is **always positive**.



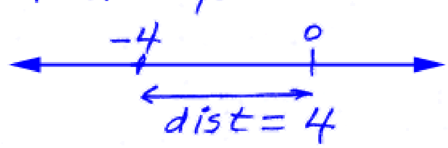
Example 3: $|\mathbf{16}| = ?$

$|16| = 16$



Example 4: $|-\mathbf{4}| = ?$

$|-4| = 4$



When an expression is inside an absolute value,

- simplify the expression with PEMDAS (down to a **single number**),
- and then take the absolute value of that number.

Example 5: $|9 - 2 \cdot 3|$

$$|9-2\cdot3| = |9-6| = |3| = \boxed{3}$$

Example 6: In the following table, fill in the blank areas with the appropriate integer that best describes the phrase, its opposite, and its absolute value.

Description	Integer	Opposite	Absolute value
A price **increase** of $4	**4**	**– 4**	**4**
Ten degrees **below** freezing	**– 10**	**10**	**10**
A bank **deposit** of $40	**40**	**–40**	**40**
3 points **off** on a test question	**–3**	**3**	**3**
A five point **bonus** on a test	**5**	**–5**	**5**

Any number, *a*, that lies to the **left** on a number line of another number, *b*, is said to be **less** than *b*:

a < b (read this as, "*a* is less than *b*.")

Any number, *c*, that lies to the **right** on a number line of another number, *d*, is said to be **greater** than *d*:

c > d (read this as, "*c* is greater than *d*.")

An easy way to remember the **symbols** of these **inequality** relationships is, "The alligator eats the big one."

Use the number line above to fill in the appropriate symbol (< , >, or =) in the blanks in the examples below. Give the reasons for your choices.

Example 7: -4 <u><</u> -2 *because -4 lies to the left of -2*

Example 8: 1 <u>></u> -2 *because 1 lies to the right of -2*

Example 9: b <u>></u> a *because b lies to the right of a*

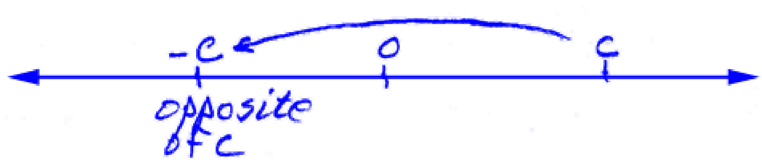
Example 10: a <u><</u> c *because a lies to the left of c*

Example 11: $|-2|$ <u>=</u> 2 *because absolute value is always positive*

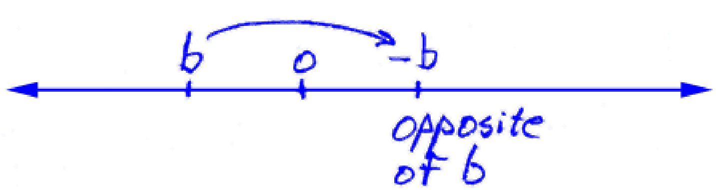
Consider –2 on a number line as seen at the top of this page. It is represented to the **left** of the origin since it is a negative number. The point *b* is also to the left of the origin, so what would be the meaning of –b?

The meaning of the **negative of a variable** is that it is the **opposite** of that variable.

Example 12: Redraw the number line at the top of this page and locate – c.

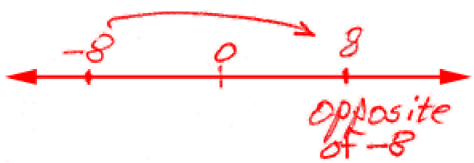


Example 13: Redraw the number line at the top of this page and locate -b.

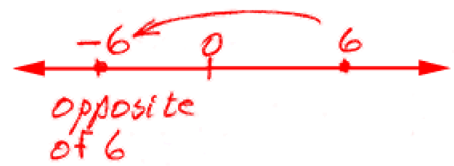


Assignment:

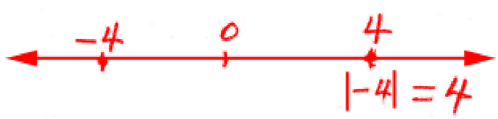
1. Locate –8 on a number line and then locate its opposite.



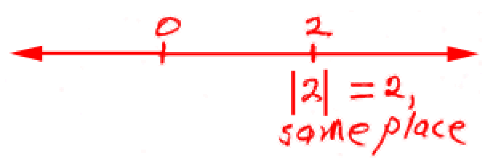
2. Locate 6 on a number line and then locate its opposite.



3. Locate –4 on a number line and then locate its absolute value.



4. Locate 2 on a number line and then locate its absolute value.



5. How far from the origin is |–10|?

$\boxed{10}$

6. What is the value of 7 – |–7|?

$$7 - |-7| = 7 - 7$$
$$= \boxed{0}$$

7. Simplify |17 – 6 – 1|.

$$|17-6-1| = |11-1|$$
$$= |10|$$
$$= \boxed{10}$$

8. Simplify |(17 – 6 – 1)/2|.

$$|(17-6-1)/2|$$
$$= |(11-1)/2|$$
$$= |10/2| = |5|$$
$$= \boxed{5}$$

9. Simplify |–2| + 6 – 7

$|-2| + 6 - 7$
$= 2 + 6 - 7$
$= 8 - 7 = \boxed{1}$

10. Simplify (5 + |–17|) –3^2

$(5 + |-17|) - 3^2$
$= (5 + 17) - 3^2$
$= 22 - 9$
$= \boxed{13}$

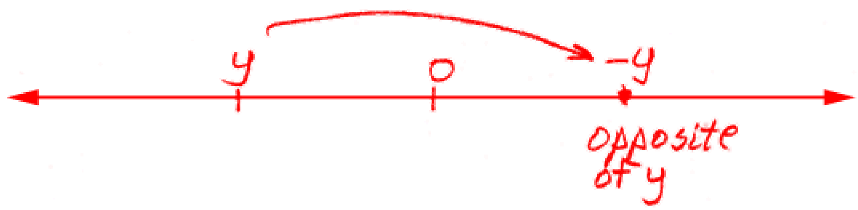
11. In the following table, fill in the blank areas with the appropriate integer that best describes the phrase, its opposite, and its absolute value.

Description	Integer	Opposite	Absolute value
A 15 yard penalty	**–15**	**15**	**15**
An 11 yard gain	**11**	**–11**	**11**
A bank **withdrawal** of $36	**–36**	**36**	**36**
8 points **off** on a test question	**–8**	**8**	**8**
Thrown for a loss of 3 yards	**–3**	**3**	**3**
4 points above average	**4**	**–4**	**4**

Use the number line above to fill in the appropriate symbol (< , >, or =) in the blanks in the examples below. Give the reasons for your choices.

12.	5 __>__ –15	*because 5 lies to the right of -15*
13.	–15 __<__ –10	*because -15 lies to the left of -10*
14.	x __<__ y	*because x lies to the left of y*
15.	z __>__ 0	*because z lies to the right of 0*
16.	|–10| __>__ –10	*Because |-10| = 10 & is to the right of -10*
17.	0 __>__ x	*because 0 is to the right of x*
18.	|y| __=__ 5	*Because |y| is 5 units to the left of 0 & = 5*
*19.	–x __>__ y	*because -x is the opposite of x*

20. Redraw the number line given on the previous page and locate – y.



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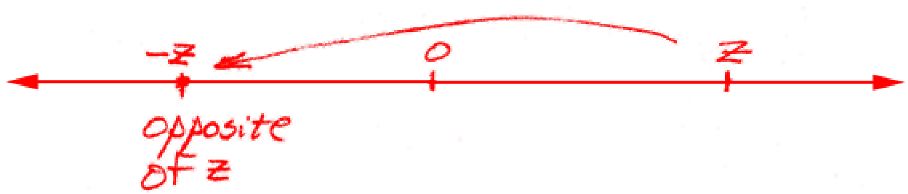
21. Redraw the number line given on the previous page and locate – z.



Unit 1: Lesson 03

Review of sign rules for arithmetic operations
Unit multipliers

Rules for addition and subtraction:

If signs are alike: Add the two numbers and apply their sign.

Example group 1:

3 + (+4) = ***+7*** (-5) – 4 = ***-9***

5 + 8 = ***+13*** -4 + (-6) = ***-10***

-9 –2 = ***-11***

If signs are different: Subtract and give the answer the sign of the largest number.

Examples group 2:

3 + (-7) = ***-4*** 14 – 8 = ***6***

9 – 11 = ***-2*** 22 + (-1) = ***21***

Rules for multiplication:

If signs are alike: Multiply and give the answer a positive sign.

Example group 3:

3(4) = ***12***

-3(-12) = ***36***

(-5)(-3) = ***15***

If signs are different: Multiply and give the answer a negative sign.

Example group 4:

(-3)4 = ***-12***

5(-2) = ***-10***

Rules for division (same as for multiplication):

If signs are alike: Divide and give the answer a positive sign.

Example group 5:

12 / (4) = *3*　　　-12 / (-3) = *4*

6 / 2 = *3*　　　(-15) / (-3) = *5*

If signs are different: Divide and give the answer a negative sign.

Example group 6:

(-30) / 5 = *-6*　　　-8 / 2 = *-4*

16 / (-2) = *-8*

Unit multipliers:

Now consider the various ways in which we could express 1 as any number over itself. For example:

$$\frac{189}{189} = 1, \quad \frac{\pi}{\pi} = 1, \text{ etc.}$$

Consider an unusual way in which we could multiply by 1. Since 12 inches = 1 foot, when we "stack" them as follows, the quotient is exactly 1:

$$\frac{12\text{ in}}{1\text{ ft}} = 1 \quad \text{or} \quad \frac{1\text{ ft}}{12\text{ in}} = 1$$

Some other ways to "build *1*" are:

$$\frac{2\text{ pints}}{1\text{ quart}}, \quad \frac{1\text{ yd}}{36''}, \quad \frac{100\text{ cm}}{1\text{ meter}}$$

These quantities that are equivalent to *1* are known as **unit multipliers**. They are useful in converting a number expressed in one type of units to an **equivalent number of different types of units**. . .for example, from inches to yards.

Example 7: Convert 108.19 inches to yards.

$$\frac{108.19\,\cancel{in}}{1}\ \frac{1\,yd}{36\,\cancel{in}} = \frac{108.19}{36}\,yd$$
$$= \boxed{3.0052\bar{7}\,yd}$$

Example 8: Convert 22.8 feet into inches.

$$\frac{22.8\,\cancel{ft}}{1}\ \frac{12\,in}{1\,\cancel{ft}} = 22.8(12)\,in$$
$$= \boxed{273.6\,in}$$

Example 9: Convert 450 cm into meters.

$$\frac{450\,\cancel{cm}}{1}\ \frac{1\,m}{100\,\cancel{cm}} = \frac{450\,m}{100}$$
$$= \boxed{4.5\,m}$$

Example 10: Use the fact that 1 inch = 2.54 cm to convert 19 cm into inches.

$$\frac{19\,\cancel{cm}}{1}\ \frac{1\,in}{2.54\,\cancel{cm}} = \frac{19}{2.54}\,in$$
$$= \boxed{7.4803\,in}$$

Multiple applications of unit multipliers:

It is possible to apply **more than one unit multiplier in succession** in order to achieve the desired conversion.

***Example 11:** Convert 150 meters into inches.

$$\frac{150\,\cancel{m}}{1}\;\frac{100\,cm}{1\,\cancel{m}} = 15{,}000\,\cancel{cm}\;\frac{1\,in}{2.54\,\cancel{cm}}$$

$$= \frac{15{,}000}{2.54}\,in$$

$$= \boxed{5{,}905.5118\,in}$$

Assignment:

1. 5(-3) = *-15*	**2.** 8(5) = *40*	**3.** -9/(-3) = *3*
4. -2(-6) = *12*	**5.** 22(-1) = *-22*	**6.** -12(-2) = *24*
7. 3 + (-8) = *-5*	**8.** (-50)/10 = *-5*	**9.** 2 + (19) = *21*
10. 16(2) = *32*	**11.** 23 + (-2) = *21*	**12.** -8/4 = *-2*
13. 15 – 6 = *9*	**14.** 16/(-2) = *-8*	**15.** 36/4 = *9*
16. (-3)(-8) = *24*	**17.** 5(-4) = *-20*	**18.** -3(-22) = *66*
19. 9 – 12 = *-3*	**20.** 5 + (8) = *13*	**21.** -6 + (-7) = *-13*
22. 8 + (-11) = *-3*	**23.** (-2) – 4 = *-6*	**24.** -19(-2) = *38*
***25.** (400 – 20)/(-10) = *- 38*	***26.** -4 + (-2)(-6) = *8*	***27.** (-5)(-4)(-3) = *-60*

28. Use a unit multiplier to convert 24.1 quarts to pints (1 quart = 2 pints).

$$\frac{24.1\,q}{1}\cdot\frac{2\,p}{1\,q} = (24.1)\,2\text{ pints}$$

$$= \boxed{48.2\text{ pints}}$$

29. Use a unit multiplier to convert 80.9 millimeters to meters (1000 mm = 1 m).

$$\frac{80.9\ \cancel{mm}}{1}\ \frac{1\,m}{1000\ \cancel{mm}} = \frac{80.9}{1000}\,m$$
$$= \boxed{.0809\ m}$$

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30. Use a unit multiplier to convert 11.28 inches to centimeters (2.54 cm = 1 in).

$$\frac{11.28\ \cancel{in}}{1}\ \frac{2.54\ cm}{1\ \cancel{in}} = 11.28(2.54)\ cm$$
$$= \boxed{28.6512\ cm}$$

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31. Use a unit multiplier to convert 102 centimeters to inches.

$$\frac{102\ \cancel{cm}}{1}\ \frac{1\ in}{2.54\ \cancel{cm}} = \frac{102}{2.54}\ in$$
$$= \boxed{40.15748\ in}$$

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32. Use a unit multiplier to convert 82,000 feet to miles (5280 ft = 1 mi).

$$\frac{82{,}000\ \cancel{ft}}{1}\ \frac{1\ mi}{5280\ \cancel{ft}} = \frac{82{,}000}{5280}\ mi$$
$$= \boxed{15.5\overline{303}\ mi}$$

***33.** Use multiple unit multipliers to convert 82,000 inches to meters.

$$\frac{82{,}000\ \cancel{in}}{1}\ \frac{2.54\ cm}{1\ \cancel{in}} = \frac{82{,}000(2.54)\ \cancel{cm}}{1}\ \frac{1\ m}{100\ \cancel{cm}}$$
$$= \frac{82{,}000(2.54)}{100}\ m = \boxed{2082.8\ m}$$

Unit 1: Lesson 04

Evaluating algebraic expressions
Combining like terms

Example 1: Evaluate x + y – 2 if x = 3 and y = 11.

$$x+y-2 = 3+11-2$$
$$= 14-2 = \boxed{12}$$

Example 2: Evaluate $\frac{a\,b\,c}{a-c}$ if a = –10, b = 2, and c = 5.

$$\frac{abc}{a-c} = \frac{-10\cdot2\cdot5}{-10-5} = \frac{-100}{-15}$$
$$= \frac{100}{15} = \boxed{\frac{20}{3}}$$

Example 3: Evaluate |z – x/2 + y| if x = 6, y = 10, z = 15.

$$\left|z-\frac{x}{2}+y\right| = \left|15-\frac{6}{2}+10\right|$$
$$= |15-3+10| = |12+10| = |22|$$
$$= \boxed{22}$$

Like terms are those that contain exactly the same variables and with corresponding variables having the same exponent.

Example 4: (like terms)

$3x, -7x$ like

$5ax^2, 12ax^2$ like

Example 5: (unlike terms)

$4x,\ 4y$ unlike

$8z^2,\ -3z^3$ unlike

Simplify algebraic expressions by adding or subtracting the coefficients of **like terms** according to the rules of addition and subtraction given in Lesson 3.

Example 6: Simplify 4x – 3z – 8x + 12z

$$4x - 3z - 8x + 12z = \boxed{-4x + 9z}$$

Example 7: Simplify $3a^2 - 5a + 6a^2 + a - 2a$

$$3a^2 - 5a + 6a^2 + a - 2a$$

$$= 9a^2 - 4a - 2a = \boxed{9a^2 - 6a}$$

Example 8: Combine like terms and then evaluate 6ap –11q + 4q – 3ap at a = 1, p = 2 and q = 15.

$$6ap - 11q + 4q - 3ap = 3ap - 7q$$

$$= 3 \cdot 1 \cdot 2 - 7 \cdot 15$$

$$= 6 - 105 = \boxed{-99}$$

Assignment:

1. Evaluate x – y – z if x = 8, y = 3, and z = 1.

$$x-y-z = 8-3-1$$
$$= 5-1$$
$$= \boxed{4}$$

2. Evaluate 3x/y at x = 12 and y = 2.

$$\frac{3x}{y} = \frac{3\cdot 12}{2}$$
$$= \frac{36}{2} = \boxed{18}$$

3. Evaluate |–4a – 2b| where a = 10 and b = –8.

$$|-4a-2b| = |-4\cdot 10-2(-8)|$$
$$= |-40+16|$$
$$= |-24|$$
$$= \boxed{24}$$

4. Evaluate $\frac{4x+y-z}{x}$ where x = 7, y = 2, and z = 1.

$$\frac{4x+y-z}{x} = \frac{4\cdot 7+2-1}{7}$$
$$= \frac{28+2-1}{7}$$
$$= \frac{30-1}{7}$$
$$= \boxed{\frac{29}{7}}$$

5. Simplify 8m – 6 + 9m + 5 + m

$$8m-6+9m+5+m$$
$$= 17m-1+m$$
$$= \boxed{18m-1}$$

6. Simplify a + 2b – 22a + 17b – 1

$$a+2b-22a+17b-1$$
$$= \boxed{-21a+19b-1}$$

7. Simplify $6x - 2y + z - 3z + x + 13y$

$$6x - 2y + z - 3z + x + 13y$$

$$= \boxed{7x + 11y - 2z}$$

8. Simplify $5z^2 - 6y^3 + 20z^2 + y^3 + 14$

$$5z^2 - 6y^3 + 20z^2 + y^3 + 14$$

$$= \boxed{25z^2 - 5y^3 + 14}$$

9. Simplify $|-5|(x - 5x) + 2x$

$$|-5|(x - 5x) + 2x$$

$$= 5(-4x) + 2x = -20x + 2x$$

$$= \boxed{-18x}$$

10. Evaluate $-2(x - m)(x + m)$ if $x = 8$ and $m = 9$.

$$-2(x-m)(x+m)$$

$$= -2(8-9)(8+9) = -2(-1)(17)$$

$$= 2(17) = \boxed{34}$$

11. Simplify –5x + 2y + 4 + 6x – y + 11and then evaluate at x = 4 and y = –9.

$$-5x + 2y + 4 + 6x - y + 11$$
$$= x + y + 15$$
$$= 4 + (-9) + 15 = -5 + 15$$
$$= \boxed{10}$$

---

*12. Combine like terms in $3^2z + 2^3 + 7z - |18a|$ and then evaluate at a = –2 and z = –1.

$$3^2z + 2^3 + 7z - |18a|$$
$$= 9z + 8 + 7z - |18a|$$
$$= 16z + 8 - |18a| = 16\cdot(-1) + 8 - |18(-2)|$$
$$= -16 + 8 - |-36| = -8 - 36 = \boxed{-44}$$

---

*13. Simplify $26xz^2 - 22x^2z + 4xz^2 + 3x^2z$

$$26xz^2 - 22x^2z + 4xz^2 + 3x^2z$$
$$= \boxed{30xz^2 - 19x^2z}$$

---

14. Evaluate $|1 - x/3 + j|$ if x = 12 and j = 2.

$$= \left|1 - \frac{12}{3} + 2\right| = |1 - 4 + 2|$$
$$= |-3 + 2| = |-1|$$
$$= \boxed{1}$$

Unit 1: Lesson 05 — Evaluating expressions that distribute negative numbers
Nested groups

Using the **distributive property**, we can write:

$$a(b - c + d) = ab - ac + ad$$

Be especially careful when *a* is negative as in some of the following examples.

Example 1: Simplify 2p – 6(5 – 4p)

$2p - 6(5 - 4p)$
$= 2p - 30 + 24p$
$= \boxed{26p - 30}$

Example 2: Simplify 3(5y – 1) – 2(4 + y)

$3(5y - 1) - 2(4 + y)$
$= 15y - 3 - 8 - 2y$
$= \boxed{13y - 11}$

A lone negative sign in front of a parenthesis means to **distribute in –1**.

$$-(a - b) = -a + b$$

Example 3: Simplify 7x – (4 – 3x) + 1

$7x - 1(4 - 3x) + 1 = 7x - 4 + 3x + 1$
$= \boxed{10x - 3}$

Example 4: Simplify 11m – (– m + n) – 12n and then evaluate at m = 2 and n = 7.

$11m - 1(-m + n) - 12n$
$= 11m + m - n - 12n = 12m - 13n$
$= 12 \cdot 2 - 13 \cdot 7 = 24 - 91 = \boxed{-67}$

Grouping can be indicated with:

{. . .}, [. . .], (. . .), or |. . .| .

Nested grouping occurs when a group appears inside another group. For example:

{ [. . .] . . .] ,   [. . .(. . .)] , etc.

For such expression, simplify **the innermost group** first and work your way out.

Example 5: Simplify –x[–x(y – b) + xb]

$$-x[-x(y-b)+xb]$$
$$=-x[-xy+xb+xb]$$
$$=-x[-xy+2xb] = \boxed{x^2y-2x^2b}$$

Do not distribute into an "absolute value" group.

If there is only a "+" in front of a parenthesis, simply drop the parenthesis pair (or any other grouping symbol pair except absolute value).

Example 6: Simplify –2x + (5x + 6) + 2|4 – 7|

$$-2x+(5x+6)+2|4-7|$$
$$=-2x+5x+6+2|-3|$$
$$=3x+6+2\cdot 3 = 3x+6+6 = \boxed{3x+12}$$

See **Calculator Appendix A** (and an associated video) for how to nest groups on the graphing calculator.

Assignment:

1. Simplify 10 – (6x + 7)

$10 - 1(6x + 7)$

$= 10 - 6x - 7$

$= \boxed{-6x + 3}$

2. Simplify –4(3z – 4) – (–10 + 5z)

$-4(3z - 4) - 1(-10 + 5z)$

$= -12z + 16 + 10 - 5z$

$= \boxed{-17z + 26}$

3. Simplify 2 – 8(5p – 3) – 9p and evaluate at p = –1.

$2 - 8(5p - 3) - 9p = 2 - 40p + 24 - 9p$

$= 26 - 49p$

$= 26 - 49(-1) = 26 + 49$

$= \boxed{75}$

4. Simplify 1 –2(2 – 5x) – (3x – 14) and evaluate if x = 2.

$1 - 2(2 - 5x) - 1(3x - 14)$

$= 1 - 4 + 10x - 3x + 14$

$= -3 + 7x + 14$

$= 11 + 7x = 11 + 7 \cdot 2 = 11 + 14 = \boxed{25}$

5. After simplifying –8y – (4y + 6) + 12y, evaluate at y = –1.

$-8y - 1(4y + 6) + 12y$
$= -8y - 4y - 6 + 12y$
$= \cancel{-12y} - 6 + \cancel{12y} = \boxed{-6}$

6. Simplify b[(–x – y) – (x – y)]

$b[-x - y - 1(x - y)]$
$= b[-x \cancel{- y} - x \cancel{+ y}]$
$= b[-2x]$
$= \boxed{-2bx}$

7. Simplify –5 – (–3) – { –[–6 + 1] }

$-5 - (-3) - \{-1[-6 + 1]\}$
$= -5 + 3 - \{6 - 1\}$
$= -5 + 3 - \{5\} = -2 - 5$
$= \boxed{-7}$

8. Simplify –2 – |–4 – 9| + (–4)(– 4 –2)

$-2 - |-4 - 9| + (-4)(-4 - 2)$
$= -2 - |-13| + (-4)(-6)$
$= -2 - 13 + 24 = -15 + 24 = \boxed{9}$

9. Simplify –7 –2[(6x – 3)2 – (5x – 7)]

$-7 - 2[(6x - 3)2 - 1(5x - 7)]$
$= -7 - 2[12x - 6 - 5x + 7] = -7 - 2[7x + 1]$
$= -7 - 14x - 2 = \boxed{-14x - 9}$

10. Simplify { x – 3[2(x + 4) – 1] }

$$x - 3[2(x+4) - 1] = x - 3[2x + \underbrace{8 - 1}]$$
$$= x - 3[2x + 7] = \underbrace{x - 6x} - 21$$
$$= \boxed{-5x - 21}$$

---

11. Simplify –8z + (2z + 10) + 2|5 – 8|

$$-\underbrace{8z + 2z} + 10 + 2|-3|$$
$$= -6z + 10 + 2(3)$$
$$= -6z + \underbrace{10 + 6}$$
$$= \boxed{-6z + 16}$$

---

12. Simplify $\frac{3(-x+4)}{-(-x-4)}$

$$\frac{3(-x+4)}{-1(-x-4)} = \boxed{\frac{-3x+12}{x+4}}$$

---

13. Simplify $-2 - |-4 - 6| + (-5)(-1 - 3)$

$$-2 - |-4-6| + (-5)(-1-3)$$
$$= -2 - |-10| + (-5)(-4)$$
$$= -2 - 10 + 20 = -12 + 20 = \boxed{8}$$

14. Simplify $-(g+4)+(9-g)$ and then evaluate if g = 10.

$-1(g+4)+9-g$

$= -g-4+9-g$

$= -2g+5 = -2(10)+5 = \boxed{-15}$

---

15. Simplify $7x-2(6x-7)+1$

$7x-2(6x-7)+1$

$= 7x-12x+14+1$

$= \boxed{-5x+15}$

---

16. Simplify $-5c-(8-c)-11$

$-5c-1(8-c)-11$

$= -5c-8+c-11$

$= \boxed{-4c-19}$

---

17. Simplify -4x + (5x – 6) – 2|3 – 8|

$-4x+5x-6-2|-5|$

$= 1x-6-2\cdot 5$

$= 1x-6-10 = \boxed{x-16}$

Unit 1: Lesson 06 *Putting it all together with fractions

When **adding or subtracting** fractions, find a **common denominator**.

Example 1: Simplify $3\left(\frac{3x}{4} - \frac{x}{3}\right)$

$$3\left(\frac{3x}{4}\frac{3}{3} - \frac{x}{3}\frac{4}{4}\right) = 3\left(\frac{9x}{12} - \frac{4x}{12}\right) = 3\left(\frac{5x}{12}\right)$$

$$= \frac{15x}{12} = \boxed{\frac{5x}{4}}$$

When **multiplying** fractions, **multiply numerators** to produce the new numerator. **Multiply denominators** to produce the new denominator.

$$\frac{a}{b}\frac{c}{d} = \frac{ac}{bd}$$

Example 2: $-\frac{4}{5}\left(\frac{3}{8}x - \frac{5}{6}y\right)$

$$-\frac{4}{5}\left(\frac{3}{8}\frac{x}{1} - \frac{5}{6}\frac{y}{1}\right) = \frac{-12x}{40} + \frac{20y}{30} = \boxed{\frac{-3x}{10} + \frac{2y}{3}}$$

When **dividing** by a fraction, multiply the numerator by the **reciprocal** of that fraction.

Example 3: Simplify $\frac{3x/(5y)}{4a/(20b)}$

$$\frac{\frac{3x}{5y}}{\frac{4a}{20b}} = \frac{3x}{5y}\frac{20b}{4a} = \frac{60xb}{20ay} = \boxed{\frac{3xb}{ay}}$$

***Example 4:** Combine like terms in 4[(3/4)x + (2/5)x – 2] and evaluate at x = 3.

$$4\left[\frac{3}{4}\,\frac{x}{1} + \frac{2}{5}\,\frac{x}{1} - 2\right] = 4\left[\frac{3x}{4} + \frac{2x}{5} - 2\right]$$

$$= 4\left[\frac{3x}{4}\,\frac{5}{5} + \frac{2x}{5}\,\frac{4}{4} - 2\right]$$

$$= 4\left[\frac{15x}{20} + \frac{8x}{20} - 2\right] = \frac{4}{1}\left[\frac{23x}{20} - 2\right]$$

$$= \frac{92x}{20} - 8 = \frac{23x}{5} - 8 = \frac{23\cdot 3}{5} - \frac{8}{1}\,\frac{5}{5} = \frac{69-40}{5} = \boxed{\frac{29}{5}}$$

Example 5: Simplify (11x – (5/4)x)/(2/3)

$$\left(\frac{11x}{1} - \frac{5}{4}\,\frac{x}{1}\right)\frac{3}{2} = \left(\frac{11x}{1}\,\frac{4}{4} - \frac{5x}{4}\right)\frac{3}{2}$$

$$= \left(\frac{44x}{4} - \frac{5x}{4}\right)\frac{3}{2} = \frac{39x}{4}\,\frac{3}{2} = \boxed{\frac{117x}{8}}$$

See **Calculator Appendix B** (and an associated video) for how to handle the grouping of numerators and denominators on a graphing calculator. Common pitfalls are discussed.

Assignment:

1. Simplify $\frac{7}{8} + \frac{2}{3}$

$$\frac{7}{8}\,\frac{3}{3} + \frac{2}{3}\,\frac{8}{8}$$

$$= \frac{21}{24} + \frac{16}{24} = \boxed{\frac{37}{24}}$$

2. Simplify $\frac{2}{7}\,\frac{3}{4} \div \frac{2}{3}$

$$\frac{2}{7}\,\frac{3}{4} \div \frac{2}{3} = \frac{6}{28}\,\frac{3}{2}$$

$$= \frac{18}{56} = \boxed{\frac{9}{28}}$$

3. Simplify $-\frac{5}{3}\left(\frac{1}{7}\text{m} - \frac{2}{3}\text{n}\right)$

$$-\frac{5}{3}\left(\frac{1}{7}\,\frac{m}{1} - \frac{2}{3}\,\frac{n}{1}\right) = \boxed{\frac{-5m}{21} + \frac{10n}{9}}$$

4. Simplify $\left(\frac{2\text{x}}{5} - \frac{\text{x}}{4}\right)$

$$\frac{2x}{5}\,\frac{4}{4} - \frac{x}{4}\,\frac{5}{5} = \frac{8x}{20} - \frac{5x}{20}$$

$$= \boxed{\frac{3x}{20}}$$

5. Simplify $-\left(\frac{2\text{x}}{5} - \frac{\text{x}}{3}\right) + 4\text{x}$

$$-\left(\frac{2x}{5}\,\frac{3}{3} - \frac{x}{3}\,\frac{5}{5}\right) + 4x = -\left(\frac{6x}{15} - \frac{5x}{15}\right) + 4x$$

$$= -\left(\frac{1x}{15}\right) + \frac{4x}{1} = \frac{-1x}{15} + \frac{4x}{1}\,\frac{15}{15} = \frac{-1x + 60x}{15}$$

$$= \boxed{\frac{59x}{15}}$$

6. Combine like terms in 5[(3/4)y + (5/3)y – 1] and evaluate at y = –3.

$$5\left[\frac{3}{4}\frac{y}{1}+\frac{5}{3}\frac{y}{1}-\frac{1}{1}\right]=5\left[\frac{3y}{4}\frac{3}{3}+\frac{5y}{3}\frac{4}{4}-\frac{1}{1}\frac{12}{12}\right]$$

$$=5\left[\frac{9y+20y-12}{12}\right]=\frac{5}{1}\left[\frac{29y-12}{12}\right]$$

$$=\frac{145y-60}{12}=\frac{145(-3)-60}{12}=\boxed{\frac{-165}{4}}$$

---

7. Simplify (11q – (7/3)q)/(-8)

$$\left(\frac{11q}{1}-\frac{7}{3}\frac{q}{1}\right)\left(-\frac{1}{8}\right)$$

$$=\left(\frac{11q}{1}\frac{3}{3}-\frac{7q}{3}\right)\left(-\frac{1}{8}\right)=\left(\frac{33q}{3}-\frac{7q}{3}\right)\left(-\frac{1}{8}\right)$$

$$=\left(\frac{26q}{3}\right)\left(-\frac{1}{8}\right)=-\frac{26q}{24}=\boxed{-\frac{13q}{12}}$$

---

8. Simplify $\frac{3x}{7} - \frac{1}{5} + \frac{2x}{3}$ and evaluate when x = –1.

$$\frac{3x}{7}\frac{3}{3}-\frac{1}{5}+\frac{2x}{3}\frac{7}{7}$$

$$=\frac{9x}{21}-\frac{1}{5}+\frac{14x}{21}=\frac{23x}{21}-\frac{1}{5}$$

$$=\frac{23(-1)}{21}-\frac{1}{5}=\frac{-23}{21}\frac{5}{5}-\frac{1}{5}\frac{21}{21}$$

$$=\frac{-115}{105}-\frac{21}{105}=\boxed{\frac{-136}{105}}$$

*9. Simplify (2/3) { –[1/5 – 1/2] + 2|1/3 + 2| }

$$\frac{2}{3}\left\{-\left[\frac{1}{5}\frac{2}{2}-\frac{1}{2}\frac{5}{5}\right] + 2\left|\frac{1}{3}+\frac{2}{1}\frac{3}{3}\right|\right\}$$

$$= \frac{2}{3}\left\{-1\left[\frac{-3}{10}\right] + \frac{2}{1}\left|\frac{7}{3}\right|\right\}$$

$$= \frac{2}{3}\left\{\frac{3}{10}+\frac{2}{1}\frac{7}{3}\right\} = \frac{2}{3}\left\{\frac{3}{10}+\frac{14}{3}\right\}$$

$$= \frac{2}{3}\left\{\frac{3}{10}\frac{3}{3}+\frac{14}{3}\frac{10}{10}\right\} = \frac{2}{3}\left\{\frac{9}{30}+\frac{140}{30}\right\} = \frac{2}{3}\,\frac{149}{30}$$

$$= \frac{298}{90} = \frac{149}{45}$$

---

*10. Combine like terms in $\frac{-4}{5x} - \frac{3}{2x} + 1$ and then evaluate at x = 2.

$$\frac{-4}{5x}\frac{2}{2} - \frac{3}{2x}\frac{5}{5} + 1 = \frac{-8}{10x} - \frac{15}{10x} + 1$$

$$= \frac{-8-15}{10x} + 1 = \frac{-23}{10x} + 1$$

$$= \frac{-23}{10(2)} + \frac{20}{20}$$

sub in 2

$$= \frac{-23+20}{20}$$

$$= \boxed{\frac{-3}{20}}$$

Unit 01: Review

Calculators are not permitted on this review.

1. Simplify $6 \cdot 3/(11-2)$

$6 \cdot 3/(11-2)$
$= 6 \cdot 3/9$
$= 18/9 = \boxed{2}$

2. Simplify $2(48 \div 4) + 2(5-2) - 1$

$2(12) + 2(3) - 1$
$= 24 + 2(3) - 1$
$= 24 + 6 - 1$
$= 30 - 1 = \boxed{29}$

3. Locate the opposite of –7 on a number line.

4. Simplify |4 – 6 + 1|

$|4-6+1|$
$= |-2+1|$
$= |-1| = \boxed{1}$

5. Locate |–5| on a number line.

6. Simplify 18(–2)

$18(-2) = \boxed{-36}$

7. Simplify –5(–6)

$-5(-6) = \boxed{30}$

8. Simplify 24/(–8)

$\frac{24}{-8} = \boxed{-3}$

9. Simplify –50/(–10)

$$\frac{-50}{-10} = \boxed{5}$$

10. Simplify –12 + 5

$$-12+5 = \boxed{-7}$$

11. Simplify –79 – 2

$$-79-2 = \boxed{-81}$$

12. Using the fact that 1 inch = 2.54 centimeters, use a unit multiplier to convert 8 inches into centimeters.

$$\frac{8\ \cancel{in}}{1}\ \frac{2.54\ cm}{1\ \cancel{in}}$$
$$= \boxed{20.32\ cm}$$

13. Using the fact that 2 nerds = 32 twerps, use a unit multiplier to convert 10 nerds to twerps.

$$\frac{10\ \cancel{nrd}}{1}\ \frac{32\ trp}{2\ \cancel{nrd}}$$
$$= \frac{10 \cdot 32}{2}\ trp$$
$$= \frac{320}{2}\ trp = \boxed{160\ twerps}$$

14. Using the fact that 1 centimeter = 10 millimeters, use a unit multiplier to convert 82 millimeters to centimeters.

$$\frac{82\ \cancel{mm}}{1}\ \frac{1\ cm}{10\ \cancel{mm}}$$
$$= \frac{82}{10}\ cm = \boxed{8.2\ cm}$$

15. Simplify 3x – 7y + 2x – 2y by combining like terms and then evaluate at x = 7 and y = – 6.

$$3x-7y+2x-2y = 5x-9y$$
$$= 5\cdot 7-9(-6) = 35+54 = \boxed{89}$$

16. Simplify 11x – 6 – 23x + 1

$11x - 6 - 23x + 1$

$= \boxed{-12x - 5}$

17. Evaluate |4b – 3c – 9| if b =3 and c = 2.

$|4b - 3c - 9|$

$= |4 \cdot 3 - 3 \cdot 2 - 9|$

$= |12 - 6 - 9|$

$= |6 - 9| = |-3| = \boxed{3}$

18. Simplify 3/4 – 1/6 + 2

$\frac{3}{4}\frac{3}{3} - \frac{1}{6}\frac{2}{2} + \frac{2}{1}\frac{12}{12}$

$= \frac{9}{12} - \frac{2}{12} + \frac{24}{12}$

$= \frac{9-2}{12} + \frac{24}{12}$

$= \frac{7+24}{12}$

$= \boxed{\frac{31}{12}}$

19. Simplify $\left(\frac{1}{5}x - \frac{7}{4}x\right) \div \frac{1}{2}$

$\left(\frac{1}{5}\frac{x}{1} - \frac{7}{4}\frac{x}{1}\right) \div \frac{1}{2}$

$= \left(\frac{x}{5}\frac{4}{4} - \frac{7x}{4}\frac{5}{5}\right)\frac{2}{1}$

$= \left(\frac{4x - 35x}{20}\right)\frac{2}{1}$

$= \frac{-31x}{20}\frac{2}{1} = \frac{-62x}{20}$

$= \boxed{\frac{-31x}{10}}$

20. Simplify 1 – 6(2x – 3) – 2(2 – x) and then evaluate at x = –5.

$1 - 6(2x - 3) - 2(2 - x)$

$= 1 - 12x + 18 - 4 + 2x$

$= 19 - 10x - 4$

$= 15 - 10x = 15 - 10 \cdot (-5) = 15 + 50 = \boxed{65}$

Alg 1, Unit 2

Solving Linear Equations

Unit 2: Lesson 01 **Solving one-step linear equations**

The **solution** to an equation is the value of the variable that makes the equation true.

To **prove** that a number is the solution to an equation, substitute the number into the equation for each occurrence of the variable and show that the new equation is true (both sides equal each other).

Example 1: Show that x = 5 is a solution to 3x – 1 = 2x + 4

$$3x - 1 = 2x + 4$$
$$3 \cdot 5 - 1 = 2 \cdot 5 + 4$$
$$15 - 1 = 10 + 4$$
$$14 \overset{\checkmark}{=} 14$$

Solving an equation means, "getting *x* by itself."

To do this it is sometimes necessary to add a number (either negative or positive) to both sides of an equation. The result is a new equation that is still true.

Example 2: Solve x + 5 = 2

$$x + \cancel{5} = 2$$
$$\underline{-\cancel{5}} \quad \underline{-5}$$
$$x = \boxed{-3}$$

Example 3: Find the solution to x – 4 = 1.

$$x - \cancel{4} = 1$$
$$\underline{\cancel{4}} \quad \underline{4}$$
$$x = \boxed{5}$$

When finding the solution to some equations, it is necessary to multiply (or divide) both sides by a number in order to "get *x* by itself."

In the following examples, multiply both sides by the **reciprocal of the coefficient** of *x* to "get *x* by itself."

Recall that **a number times its reciprocal is 1**.

Example 4: Solve 18 = 6x

$$18 = 6x$$
$$\frac{1}{6}\cdot\frac{18}{1} = \left(\frac{1}{\cancel{6}}\right)\cancel{6}x$$
$$\frac{18}{6} = x$$
$$\boxed{3} = x$$

Example 5: Find the solution to $-\frac{3}{4}$ x = 15.

$$-\frac{3}{4}x = 15$$
$$\cancel{-\frac{3}{4}}\left(\cancel{-\frac{4}{3}}\right)x = \frac{15}{1}\left(-\frac{4}{3}\right)$$
$$x = \frac{-60}{3}$$
$$x = \boxed{-20}$$

Assignment:

1. Show that x = 3 is a solution of x + 2x + 1 = 10.

$$x + 2x + 1 = 10$$
$$3 + 2 \cdot 3 + 1 = 10$$
$$3 + 6 + 1 = 10$$
$$9 + 1 = 10$$
$$10 = 10 \checkmark$$

2. Prove that y = – 1 is a solution of –6y – 14 = –8.

$$-6y - 14 = -8$$
$$-6(-1) - 14 = -8$$
$$6 - 14 = -8$$
$$-8 = -8 \checkmark$$

In the following problems, solve each equation.

3. m + 12 = –3

$$m + \cancel{12} = -3$$
$$\underline{-\cancel{12}} \quad \underline{-12}$$
$$m = \boxed{-15}$$

4. – 6 + x = 8

$$-\cancel{6} + x = 8$$
$$\underline{\cancel{6}} \quad \underline{6}$$
$$x = \boxed{14}$$

5. x – 11 = –18

$$x - \cancel{11} = -18$$
$$\underline{\cancel{11}} \quad \underline{11}$$
$$x = \boxed{-7}$$

6. –36 = –17 + p

$$-36 = -\cancel{17} + p$$
$$\underline{17} \quad \underline{\cancel{17}}$$
$$\boxed{-19} = p$$

7. j + (–1) = 11

$$j - \cancel{1} = 11$$
$$\underline{\cancel{1}} \quad \underline{1}$$
$$j = \boxed{12}$$

8. x + 15 = 8

$$x + \cancel{15} = 8$$
$$\underline{-\cancel{15}} \quad \underline{-15}$$
$$x = \boxed{-7}$$

9. $-3x = 21$

$$-3x = 21$$
$$\cancel{-3}\left(\cancel{-\tfrac{1}{3}}\right)x = 21\left(-\tfrac{1}{3}\right)$$
$$x = \frac{21}{1}\left(-\frac{1}{3}\right)$$
$$x = -\frac{21}{3} = \boxed{-7}$$

10. $6x = -24$

$$6x = -24$$
$$\cancel{\tfrac{1}{6}}\,\cancel{6}x = -24\left(\tfrac{1}{6}\right)$$
$$x = -\frac{24}{1}\left(\frac{1}{6}\right)$$
$$x = -\frac{24}{6} = \boxed{-4}$$

11. $-115 = -5k$

$$-115 = -5k$$
$$-\frac{115}{1}\left(-\frac{1}{5}\right) = \cancel{-5}\left(\cancel{-\tfrac{1}{5}}\right)k$$
$$\frac{115}{5} = k$$
$$\boxed{23} = k$$

12. $36.3 = 12.1z$

$$36.3 = 12.1z$$
$$\frac{36.3}{1}\,\frac{1}{12.1} = \cancel{12.1}\left(\cancel{\tfrac{1}{12.1}}\right)z$$
$$\frac{36.3}{12.1} = z$$
$$\boxed{3} = z$$

13. $(2/5)x = 20$

$$\frac{2}{5}x = 20$$
$$\cancel{\tfrac{2}{5}}\,\cancel{\tfrac{5}{2}}\,x = 20\left(\tfrac{5}{2}\right)$$
$$x = \frac{20}{1}\,\frac{5}{2} = \frac{100}{2}$$
$$x = \boxed{50}$$

14. $(-1/3)p = -9$

$$-\frac{1}{3}p = -9$$
$$\cancel{-\tfrac{1}{3}}\left(\cancel{-\tfrac{3}{1}}\right)p = -\frac{9}{1}\left(-\frac{3}{1}\right)$$
$$p = \frac{27}{1}$$
$$p = \boxed{27}$$

15. $10h = -2/7$

$$10h = -\frac{2}{7}$$
$$\cancel{10}\left(\cancel{\tfrac{1}{10}}\right)h = -\frac{2}{7}\,\frac{1}{10}$$
$$h = -\frac{2}{70}$$
$$h = \boxed{-\frac{1}{35}}$$

16. $(9/10)x = -99$

$$\frac{9}{10}x = -99$$
$$\cancel{\tfrac{9}{10}}\,\cancel{\tfrac{10}{9}}\,x = -\frac{99}{1}\,\frac{10}{9}$$
$$x = -\frac{990}{9}$$
$$x = \boxed{-110}$$

*17. 12 + 2 = 2x

$$12+2=2x$$
$$14=2x$$
$$14\left(\tfrac{1}{2}\right)=\cancel{2}\left(\cancel{\tfrac{1}{2}}\right)x$$
$$\frac{14}{1}\frac{1}{2}=x$$
$$\frac{14}{2}=x$$
$$\boxed{7}=x$$

*18. 4t = 143 + 1

$$4t=143+1$$
$$4t=144$$
$$\cancel{4}\left(\cancel{\tfrac{1}{4}}\right)t=144\left(\tfrac{1}{4}\right)$$
$$t=\frac{144}{1}\frac{1}{4}$$
$$t=\frac{144}{4}$$
$$t=\boxed{36}$$

19. 5 = 2.5 + x

$$5=\cancel{2.5}+x$$
$$-2.5\quad \cancel{-2.5}$$
$$\boxed{2.5}=x$$

20. 0 = y + (–3.1)

$$0=y-\cancel{3.1}$$
$$3.1\quad \cancel{3.1}$$
$$\boxed{3.1}=y$$

*21. Show that h = – 6 is a solution of (–1/2)h + 4 – h = 13.

$$-\frac{1}{2}h+4-h=13$$
$$-\frac{1}{2}(-6)+4-(-6)=13$$
$$-\frac{1}{2}\,\frac{-6}{1}+4+6=13$$
$$\frac{6}{2}+4+6=13$$
$$3+4+6=13$$
$$13\overset{\checkmark}{=}13$$

Unit 2: Lesson 02 **Solving two-step linear equations**

In the process of solving some equations it is necessary to **both** add a number to both sides **and** then divide (or multiply) both sides by another number in order to "get *x* by itself."

Example 1: Solve 5x – 7 = 3

$$5x \cancel{-7} = 3$$
$$\underline{\ \cancel{7}\ } \quad \underline{\ 7\ }$$
$$5x = 10$$
$$\frac{\cancel{5}x}{\cancel{5}} = \frac{10}{5}$$
$$x = \boxed{2}$$

Example 2: Solve y/2 + 12 = 30

$$\frac{y}{2} + \cancel{12} = 30$$
$$\underline{\ \cancel{-12}\ } \quad \underline{-12}$$
$$\frac{y}{2} = 18$$
$$\frac{y}{\cancel{2}} \cdot \frac{\cancel{2}}{1} = 18 \cdot 2$$
$$y = \boxed{36}$$

Example 3: Solve 8 = –3m – 10

$$8 = -3m \cancel{-10}$$
$$\underline{10} \quad \underline{\ \cancel{10}\ }$$
$$18 = -3m$$
$$\frac{18}{1}\left(-\frac{1}{3}\right) = \cancel{-\frac{3}{1}\left(-\frac{1}{3}\right)}\, m$$
$$-\frac{18}{3} = m$$
$$\boxed{-6} = m$$

Example 4: Solve 6.4z – 13.2 = 38

$$6.4z \cancel{-13.2} = 38$$
$$\underline{\ \cancel{13.2}\ } \quad \underline{13.2}$$
$$6.4z = 51.2$$
$$\frac{\cancel{6.4}z}{\cancel{6.4}} = \frac{51.2}{6.4}$$
$$z = \boxed{8}$$

Example 5: Solve $4 = -11 + \dfrac{p}{-5}$

$$4 = \cancel{-11} + \frac{p}{-5}$$
$$\underline{11} \qquad \underline{\cancel{+11}}$$
$$15 = \frac{p}{-5}$$
$$15(-5) = \frac{p}{\cancel{-5}}\left(\frac{\cancel{-5}}{1}\right)$$
$$\boxed{-75} = p$$

Example 6: Solve 20 –(1/7)c = – 9

$$\cancel{20} - \tfrac{1}{7}c = -9$$
$$\underline{\cancel{-20}} \qquad \underline{-20}$$
$$-\tfrac{1}{7}c = -29$$
$$\cancel{-\tfrac{1}{7}}\,\cancel{\tfrac{-7}{1}}\,c = \frac{-29}{1}\cdot\frac{-7}{1}$$
$$c = \boxed{203}$$

Assignment: Solve for the indicated variable in the following problems.

1. 11x + 2 = 35

$$11x + \cancel{2} = 35$$
$$\quad \underline{-\cancel{2}} \qquad \underline{-2}$$
$$11x = 33$$
$$\frac{\cancel{11}}{1}\cdot\frac{1}{\cancel{11}}x = \frac{33}{1}\cdot\frac{1}{11}$$
$$x = \frac{33}{11}$$
$$x = \boxed{3}$$

2. 8 = 2b – 22

$$8 = 2b - \cancel{22}$$
$$\underline{22} \qquad \underline{\cancel{22}}$$
$$30 = 2b$$
$$\frac{30}{1}\cdot\frac{1}{2} = \frac{\cancel{2}}{1}\cdot\frac{1}{\cancel{2}}b$$
$$\frac{30}{2} = b$$
$$\boxed{15} = b$$

3. 100 = 5x – 35

$$100 = 5x - \cancel{35}$$
$$\underline{35} \qquad \underline{\cancel{35}}$$
$$135 = 5x$$
$$\frac{135}{1}\cdot\frac{1}{5} = \cancel{5}\left(\frac{1}{\cancel{5}}\right)x$$
$$\frac{135}{5} = x$$
$$\boxed{27} = x$$

4. 11 – 6v = – 49

$$\cancel{11} - 6v = -49$$
$$\underline{-\cancel{11}} \qquad \underline{-11}$$
$$-6v = -60$$
$$\frac{\cancel{-6}v}{\cancel{-6}} = \frac{-60}{-6}$$
$$v = \boxed{10}$$

5. 6 – 4h = –22

$$\cancel{6} - 4h = -22$$
$$\underline{-\cancel{6}} \qquad \underline{-6}$$
$$-4h = -28$$
$$\frac{\cancel{-4}h}{\cancel{-4}} = \frac{-28}{-4}$$
$$h = \boxed{7}$$

6. –32 = 4t – 16

$$-32 = 4t - \cancel{16}$$
$$\underline{16} \qquad \underline{\cancel{+16}}$$
$$-16 = 4t$$
$$\frac{-16}{4} = \frac{\cancel{4}t}{\cancel{4}}$$
$$\boxed{-4} = t$$

7. $.5x - 6 = -1$

$.5x \cancel{-6} = -1$
$\quad\ \ \underline{\cancel{6}} \quad \underline{6}$
$.5x = 5$
$\frac{\cancel{.5}x}{\cancel{.5}} = \frac{5}{.5}$
$x = \boxed{10}$

8. $2.7d + 11.6 = 19.7$

$2.7d \cancel{+11.6} = 19.7$
$\quad \underline{\cancel{-11.6}} \quad \underline{-11.6}$
$2.7d = 8.1$
$\frac{\cancel{2.7}d}{\cancel{2.7}} = \frac{8.1}{2.7}$
$d = \boxed{3}$

9. $(4/5)n - 7 = -4$

$\frac{4}{5}n \cancel{-7} = -4$
$\quad \underline{\cancel{7}} \quad \underline{7}$
$\frac{4}{5}n = 3$
$\frac{\cancel{4}}{\cancel{5}}\frac{\cancel{5}}{\cancel{4}}n = \frac{3}{1}\frac{5}{4}$
$n = \boxed{\frac{15}{4}}$

10. $\frac{x}{-6} + 4 = 12$

$\frac{x}{-6} \cancel{+4} = 12$
$\quad \underline{\cancel{-4}} \quad \underline{-4}$
$\frac{x}{-6} = 8$
$\frac{x}{\cancel{-6}}\frac{\cancel{-6}}{1} = \frac{8}{1}\frac{-6}{1}$
$x = \boxed{-48}$

11. $10 = \frac{v}{-2} - 4$

$10 = \frac{v}{-2} \cancel{-4}$
$\underline{4} \quad\quad \underline{\cancel{4}}$
$14 = \frac{v}{-2}$
$14(-2) = \frac{v}{\cancel{-2}}\left(\frac{\cancel{-2}}{1}\right)$
$\boxed{-28} = v$

12. $2/3 = (-1/6)g - 1/3$

$\frac{2}{3} = -\frac{1}{6}g \cancel{-\frac{1}{3}}$
$\underline{\frac{1}{3}} \quad\quad \underline{\cancel{\frac{1}{3}}}$
$1 = -\frac{1}{6}g$
$1\cdot(-6) = \cancel{-\frac{1}{6}}(\cancel{-6})g$
$\boxed{-6} = g$

13. (4/5)x – 9 = 8

$$\frac{4}{5}x - 9 = 8$$
$$+9 \quad +9$$
$$\frac{4}{5}x = 17$$
$$\frac{4}{5}\left(\frac{5}{4}\right)x = \frac{17}{1}\cdot\frac{5}{4}$$
$$x = \boxed{\frac{85}{4}}$$

14. –20 = 10 + (2/3)h

$$-20 = 10 + \frac{2}{3}h$$
$$-10 \quad -10$$
$$-30 = \frac{2}{3}h$$
$$-\frac{30}{1}\cdot\frac{3}{2} = \frac{2}{3}\cdot\frac{3}{2}h$$
$$-\frac{90}{2} = h$$
$$\boxed{-45} = h$$

15. $-19 = 11 - \frac{1}{6}x$

$$-19 = 11 - \frac{1}{6}x$$
$$-11 \quad -11$$
$$-30 = -\frac{1}{6}x$$
$$-30(-6) = -\frac{1}{6}(-6)x$$
$$\boxed{180} = x$$

16. 7 – (3/8)x = – 1

$$7 - \frac{3}{8}x = -1$$
$$-7 \quad -7$$
$$-\frac{3}{8}x = -8$$
$$-\frac{3}{8}\left(-\frac{8}{3}\right)x = \frac{-8}{1}\left(-\frac{8}{3}\right)$$
$$x = \boxed{\frac{64}{3}}$$

17. 8p – 11 = 5

$$8p - 11 + 11 = 5 + 11$$
$$8p = 16$$
$$\frac{8p}{8} = \frac{16}{8}$$
$$p = \boxed{2}$$

18. 4/5 = 9 – (1/2)x

$$\frac{4}{5} - 9 = 9 - \frac{1}{2}x - 9$$
$$\frac{4}{5} - \frac{9}{1}\cdot\frac{5}{5} = -\frac{1}{2}x$$
$$-\frac{41}{5} = -\frac{1}{2}x$$
$$-\frac{41}{5}\left(-\frac{2}{1}\right) = -\frac{1}{2}x\left(-\frac{2}{1}\right)$$
$$\boxed{\frac{82}{5}} = x$$

Unit 2: Lesson 03 — Solving linear equations by combining like terms
Solving multi-step linear equations

If an equation has several terms of the same type, **combine** those terms before proceeding to solve the equation.

Example 1: Solve x – 5 + 4x = 10

$$x - 5 + 4x = 10$$
$$5x \cancel{-5} = 10$$
$$\cancel{+5} \quad +5$$
$$5x = 15$$
$$\frac{\cancel{5}x}{\cancel{5}} = \frac{15}{5}$$
$$x = \boxed{3}$$

Example 2: Solve –x + 8 – 9x = 11

$$-x + 8 - 9x = 11$$
$$-10x \cancel{+8} = 11$$
$$\cancel{-8} \quad -8$$
$$-10x = 3$$
$$\frac{\cancel{-10}x}{\cancel{-10}} = \frac{3}{-10}$$
$$x = \boxed{-\frac{3}{10}}$$

Example 3: Find the solution to this equation: 14p – 9 + 6p + 1 = 32

$$14p - 9 + 6p + 1 = 32$$
$$20p \cancel{-8} = 32$$
$$\cancel{+8} \quad +8$$
$$20p = 40$$
$$\frac{\cancel{20}p}{\cancel{20}} = \frac{40}{20}$$
$$p = \boxed{2}$$

The solution of some equations requires multiple steps.

If an equation has a multiplier in front of a parentheses (or any other similar group), distribute the multiplier.

Example 4: Solve 3(y – 4) + 12 = – 6

$$3(y-4)+12=-6$$
$$3y\cancel{-12}\cancel{+12}=-6$$
$$3y=-6$$
$$\frac{\cancel{3}y}{\cancel{3}}=\frac{-6}{3}\qquad y=\boxed{-2}$$

Example 5: Solve –9 –3(4t –1) = 30

$$-9-3(4t-1)=30$$
$$-9-12t+3=30$$
$$\cancel{-6}-12t=30$$
$$\underline{\cancel{6}}\qquad\qquad\underline{6}$$
$$-12t=36$$
$$\frac{\cancel{-12}t}{\cancel{-12}}=\frac{36}{-12}$$
$$t=\boxed{-3}$$

***Example 6:** Find the solution to this equation: 5(k – 2) + 2[k – 3(k + 2)] = 0

$$5(k-2)+2[k-3(k+2)]=0$$
$$5k-10+2[k-3k-6]=0$$
$$5k-10+2[-2k-6]=0$$
$$5k-10-4k-12=0$$
$$k\cancel{-22}=0$$
$$\underline{\cancel{22}}\qquad\underline{22}$$
$$\longrightarrow k=\boxed{22}$$

Assignment: Solve the following equations.

1. $6x + 2x = -48$

$$\underbrace{6x+2x}=-48$$
$$8x=-48$$
$$\frac{\cancel{8}x}{\cancel{8}}=\frac{-48}{8}$$
$$x=\boxed{-6}$$

2. $-11z + 9 - 4z = 2$

$$\underbrace{-11z+9-4z}=2$$
$$-15z+\cancel{9}=2$$
$$\quad\;\cancel{-9}\quad -9$$
$$-15z=-7$$
$$\frac{\cancel{-15}z}{\cancel{-15}}=\frac{-7}{-15}$$
$$z=\boxed{\frac{7}{15}}$$

3. $3(x - 5) = 30$

$$3(x-5)=30$$
$$3x-\cancel{15}=30$$
$$\quad\;\cancel{+15}\quad 15$$
$$3x=45$$
$$\frac{\cancel{3}x}{\cancel{3}}=\frac{45}{3}$$
$$x=\boxed{15}$$

4. $14 = 7r - 4 + 2r$

$$14=7r-4+2r$$
$$14=9r-\cancel{4}$$
$$4\qquad\;\cancel{4}$$
$$18=9r$$
$$\frac{18}{9}=\frac{\cancel{9}r}{\cancel{9}}$$
$$\boxed{2}=r$$

5. $2(v + 10) - 6 = 2$

$$2(v+10)-6=2$$
$$2v+\underbrace{20-6}=2$$
$$2v+\cancel{14}=2$$
$$\quad\;\cancel{-14}\quad -14$$
$$2v=-12$$
$$\frac{\cancel{2}v}{\cancel{2}}=\frac{-12}{2}$$
$$v=\boxed{-6}$$

6. $11 = 7(f - 3) + 21$

$$11=7(f-3)+21$$
$$11=7f\cancel{-21}\cancel{+21}$$
$$\frac{11}{7}=\frac{\cancel{7}f}{\cancel{7}}$$
$$\boxed{\frac{11}{7}}=f$$

7. b + 9(b + 4) = –3

$$b + 9(b+4) = -3$$
$$b + 9b + 36 = -3$$
$$10b + \cancel{36} = -3$$
$$\underline{-\cancel{36}} \quad \underline{-36}$$
$$10b = -39$$
$$\frac{\cancel{10}b}{\cancel{10}} = \frac{-39}{10}$$
$$b = \boxed{\frac{-39}{10}}$$

8. – 22 + 2(4n + 10) = 10

$$-22 + 2(4n + 10) = 10$$
$$-22 + 8n + 20 = 10$$
$$-\cancel{2} + 8n = 10$$
$$\underline{\cancel{2}} \quad \underline{2}$$
$$8n = 12$$
$$\frac{8n}{8} = \frac{12}{8}$$
$$n = \boxed{\frac{3}{2}}$$

9. – 8 = 7[w – (–1)]

$$-8 = 7[w + 1]$$
$$-8 = 7w + \cancel{7}$$
$$\underline{-7} \quad \underline{-\cancel{7}}$$
$$-15 = 7w$$
$$\frac{-15}{7} = \frac{\cancel{7}w}{\cancel{7}}$$
$$\boxed{-\frac{15}{7}} = w$$

10. (6 – t) + (7 – t) – (4 – t) = 0

$$6 - t + 7 - t - 1(4 - t) = 0$$
$$13 - 2t - 4 + t = 0$$
$$\cancel{9} - t = 0$$
$$\underline{-\cancel{9}} \quad \underline{-9}$$
$$-t = -9$$
$$-1(-1)t = -9(-1)$$
$$t = \boxed{9}$$

*11. 2a + 3[4(2 – a) – 6(1 + a)] = 5

$$2a + 3[4(2 - a) - 6(1 + a)] = 5$$

$$2a + 3[8 - 4a - 6 - 6a] = 5$$

$$2a + 3[2 - 10a] = 5$$

$$2a + 6 - 30a = 5$$

$$-28a + 6 = 5$$

$$ -6 \quad -6$$

$$-28a = -1$$

$$\frac{-28a}{-28} = \frac{-1}{-28}$$

$$a = \boxed{1/28}$$

---

*12. (x + 4) – x – (5 – 6x) = 1

$$\cancel{x} + 4 - \cancel{x} - 1(5 - 6x) = 1$$

$$4 - 5 + 6x = 1$$

$$-1 + 6x = 1$$

$$+1 \qquad\quad +1$$

$$6x = 2$$

$$\frac{6x}{6} = \frac{2}{6}$$

$$x = \boxed{\frac{1}{3}}$$

Unit 2: Lesson 04 — Solving linear equations with variables on both sides

To solve an equation with **variables on both sides**, **eliminate** the variable on one side, thus collecting all of the variables on the other side.

It is not a requirement, but is suggested that variables be collected on the **left side** of the equation.

Example 1: Solve 4x – 6 = 7x

$$4x - 6 = \cancel{7x}$$
$$-7x \qquad \cancel{-7x}$$
$$-3x \cancel{-6} = 0$$
$$\cancel{6} \qquad 6$$
$$-3x = 6$$

$$\frac{\cancel{-3}x}{\cancel{-3}} = \frac{6}{-3}$$
$$x = \boxed{-2}$$

At this point we want to increase our level of sophistication in how to add (or subtract) numbers or terms from each side of an equation.

In the following example (which is the same problem in Example 1), notice how we still add –7x and +6 to both side, but in a new way.

Example 2: Solve 4x – 6 = 7x

$$4x - 6 = 7x$$
$$4x - 6 - 7x = \cancel{7x - 7x}$$
$$-3x - 6 = 0$$
$$-3x \cancel{-6 + 6} = +6$$
$$-3x = 6$$

$$\frac{\cancel{-3}x}{-3} = \frac{6}{-3}$$
$$x = \boxed{-2}$$

Example 3: Solve 4(2 + x) – 5x = x + 12

$$4(2+x) - 5x = x + 12$$
$$8 + \underbrace{4x - 5x}_{} = x + 12$$
$$8 - x = x + 12$$
$$8 \underbrace{- x - x}_{} = \underbrace{\cancel{x} + 12 \cancel{- x}}_{}$$
$$8 - 2x = 12$$
$$\underbrace{\cancel{8} - 2x \cancel{- 8}}_{} = 12 - 8$$
$$-2x = 4$$
$$\frac{\cancel{-2}x}{\cancel{-2}} = \frac{4}{-2}$$
$$x = \boxed{-2}$$

Example 4: Solve 2(y – 3) + 4 = 6(7 – y)

$$2(y-3) + 4 = 6(7-y)$$
$$2y \underbrace{- 6 + 4}_{} = 42 - 6y$$
$$\underbrace{2y - 2 + 6y}_{} = 42 \cancel{- 6y} \cancel{+ 6y}$$
$$8y - 2 = 42$$
$$8y \cancel{- 2} \cancel{+ 2} = 42 + 2$$
$$8y = 44$$
$$\frac{\cancel{8}y}{\cancel{8}} = \frac{44}{8}$$
$$y = \frac{44}{8} = \boxed{\frac{11}{2}}$$

Example 5: Solve 2(f –3) = 2(f – 2) – 5

$$2(f-3) = 2(f-2) - 5$$

$$2f - 6 = 2f \underbrace{- 4 - 5}$$

$$\underbrace{\cancel{2f} - 6 - \cancel{2f}} = \underbrace{\cancel{2f} - 9 - \cancel{2f}}$$

$$-6 \neq -9 \quad \text{No solution}$$

Sometimes (as in the example above) a statement is produced that is not true. This means there is **no solution** to the equation.

Example 6: Solve 4(z + 5) – 8 = 4(z + 3)

$$4(z+5) - 8 = 4(z+3)$$

$$4z + \underbrace{20 - 8} = 4z + 12$$

$$\underbrace{\cancel{4z} + 12 - \cancel{4z}} = \underbrace{\cancel{4z} + 12 - \cancel{4z}}$$

$$12 = 12 \quad \text{All real } x$$

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Sometimes (as in the example above) a statement is produced that is true; however, the variables are no longer present (they all canceled out). This means there are an **infinite number of solutions** (all real numbers).

Assignment: Solve the following equations.

1. 3(x + 6) = 5(x + 2)

$$3(x+6)=5(x+2)$$
$$3x+18=5x+10$$
$$3x+18-5x=\cancel{5x}+10-\cancel{5x}$$
$$-2x+18=10$$
$$-2x+\cancel{18}-\cancel{18}=10-18$$
$$-2x=-8$$
$$\frac{\cancel{-2}x}{\cancel{-2}}=\frac{-8}{-2}\rightarrow x=\boxed{4}$$

2. v + 8 = 5v + 5(1 – v)

$$v+8=5v+5(1-v)$$
$$v+8=\cancel{5v}+5-\cancel{5v}$$
$$v+\cancel{8}-\cancel{8}=5-8$$
$$v=\boxed{-3}$$

3. 6x – 2 + x = 7x – 13

$$6x-2+x=7x-13$$
$$7x-2=7x-13$$
$$\cancel{7x}-2-\cancel{7x}=\cancel{7x}-13-\cancel{7x}$$
$$-2\neq-13$$

No solution

4. –11d – 2d – 1 = 27 + d

$$-11d-2d-1=27+d$$
$$-13d-1=27+d$$
$$-13d-1-d=27\cancel{+d}\cancel{-d}$$
$$-14d-1=27$$
$$-14d\cancel{-1}\cancel{+1}=27+1$$
$$-14d=28$$
$$\frac{\cancel{-14}d}{\cancel{-14}}=\frac{28}{-14}\rightarrow d=\boxed{-2}$$

5. –3(p + 5) + 6 = 3(– p – 3)

$$-3(p+5)+6=3(-p-3)$$
$$-3p-15+6=-3p-9$$
$$-3p-9=-3p-9$$
$$\cancel{-3p}-9\cancel{+3p}=\cancel{-3p}-9\cancel{+3p}$$
$$-9=-9$$

~~No solution~~

ARX

6. – 4m – 9 + 5m = 51 – 5m

$$-4\underbrace{m-9+5m}=51-5m$$
$$m-9=51-5m$$
$$\underbrace{m-9+5m}=51-\cancel{5m}+\cancel{5m}$$
$$6m-9=51$$
$$6m\cancel{-9}\cancel{+9}=51+9$$
$$6m=60$$
$$\frac{\cancel{6}m}{\cancel{6}}=\frac{60}{6}\longrightarrow m=\boxed{10}$$

---

7. w – 4(w + 2) = 7 – 2w

$$w-4(w+2)=7-2w$$
$$\underbrace{w-4w}-8=7-2w$$
$$-3\underbrace{w-8+2w}=7-\cancel{2w}\cancel{+2w}$$
$$-w-8=7$$
$$-w\cancel{-8}\cancel{+8}=7+8$$
$$-w=15$$
$$\frac{-w}{-1}=\frac{15}{-1}\longrightarrow w=\boxed{-15}$$

---

*8. (3/2)x + 1/2 = (7/3)x + 4

$$\frac{3}{2}x+\frac{1}{2}=\frac{7}{3}x+4$$
$$\frac{3}{2}x+\frac{1}{2}-\frac{7}{3}x=\cancel{\frac{7}{3}x}+4\cancel{-\frac{7}{3}x}$$
$$\frac{3}{3}\frac{3}{2}x+\frac{1}{2}-\frac{2}{2}\frac{7}{3}x=4$$
$$\frac{9-14}{6}x+\frac{1}{2}=4$$
$$-\frac{5}{6}x\cancel{+\frac{1}{2}}\cancel{-\frac{1}{2}}=4-\frac{1}{2}$$
$$-\frac{5}{6}x=\frac{4}{1}\frac{2}{2}-\frac{1}{2}$$
$$-\frac{5}{6}x=\frac{7}{2}$$
$$\cancel{-\frac{5}{6}}\cancel{\left(-\frac{6}{5}\right)}x=\frac{7}{2}\left(-\frac{6}{5}\right)$$
$$x=-\frac{42}{10}=\boxed{-\frac{21}{5}}$$

9. 3q –(2 – q) = 2(2q – 1)

$3q - 1(2 - q) = 2(2q - 1)$

$\underbrace{3q - 2 + q} = 4q - 2$

$4q - 2 = 4q - 2$

$\cancel{4q} - 2 - \cancel{4q} = \cancel{4q} - 2 - \cancel{4q}$

$-2 = -2$

ARX

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10. 5r + 22r – 7 = 2 – r

$\underbrace{5r + 22r} - 7 = 2 - r$

$27r - 7 = 2 - r$

$\underbrace{27r - 7 + r} = 2 - \cancel{r} + \cancel{r}$

$28r - 7 = 2$

$28r - \cancel{7} + \cancel{7} = 2 + 7$

$28r = 9$

$\frac{\cancel{28}r}{\cancel{28}} = \frac{9}{28} \rightarrow r = \boxed{\frac{9}{28}}$

---

11. 8(j + 2) + 9(–j – 1) = – j + 2

$8(j + 2) + 9(-j - 1) = -j + 2$

$8j + 16 - 9j - 9 = -j + 2$

$-1j + 7 = -j + 2$

$\cancel{-j} + 7 \cancel{+j} = \cancel{-j} + 2 \cancel{+j}$

$7 \neq 2$ No solution

*12. 2[x – 3(–x – 5) + 1] = 2(x + 11) – (–4 + x)

$$2[x - 3(-x - 5) + 1] = 2(x + 11) - 1(-4 + x)$$

$$2[x + 3x + 15 + 1] = 2x + 22 + 4 - x$$

$$2[4x + 16] = x + 26$$

$$8x + 32 = x + 26$$

$$8x + 32 - x = \cancel{x} + 26 \cancel{- x}$$

$$7x + 32 = 26$$

$$7x \cancel{+32} \cancel{-32} = 26 - 32$$

$$7x = -6$$

$$\frac{\cancel{7}x}{\cancel{7}} = \frac{-6}{7}$$

$$x = \boxed{-\frac{6}{7}}$$

Unit 2: Review Solve the following equations for the indicated variables.

1. m + 11 = – 4

$m + 11 = -4$

$m + \cancel{11} - \cancel{11} = -4 - 11$

$m = \boxed{-15}$

2. –24 = –18 + p

$-24 = -18 + p$

$-24 + 18 = \cancel{-18} + p \cancel{+18}$

$\boxed{-6} = p$

3. 5x – 8 = 2

$5x - 8 = 2$

$5x \cancel{-8} \cancel{+8} = \underbrace{2 + 8}$

$5x = 10$

$\frac{\cancel{5}x}{\cancel{5}} = \frac{10}{5}$

$x = \boxed{2}$

4. 10 = –3m – 14

$10 = -3m - 14$

$10 + 14 = -3m \cancel{-14} \cancel{+14}$

$24 = -3m$

$\frac{24}{-3} = \frac{\cancel{-3}m}{\cancel{-3}}$

$\boxed{-8} = m$

5. 2x – 5 + 4x = 31

$\underbrace{2x - 5 + 4x} = 31$

$6x \cancel{-5} \cancel{+5} = \underbrace{31 + 5}$

$6x = 36$

$\frac{\cancel{6}x}{\cancel{6}} = \frac{36}{6}$

$x = \boxed{6}$

6. 3(y – 2) + 12 = – 6

$3(y - 2) + 12 = -6$

$3y \underbrace{- 6 + 12} = -6$

$3y + 6 = -6$

$3y \cancel{+6} \cancel{-6} = \underbrace{-6 - 6}$

$3y = -12$

$\frac{\cancel{3}y}{\cancel{3}} = \frac{-12}{3}$; $y = \boxed{-4}$

7. 11(k – 2) + 2[k – 3(k + 1)] = 0

$$11(k-2)+2[k-3(k+1)]=0$$
$$11k-22+2[k-3k-3]=0$$
$$11k-22+2[-2k-3]=0$$
$$11k-22-4k-6=0$$
$$7k-\cancel{28}+\cancel{28}=28$$
$$7k=28$$
$$\frac{\cancel{7}k}{\cancel{7}}=\frac{28}{7}$$
$$k=\boxed{4}$$

---

8. (x + 8) – x – (5 – 6x) = 15

$$\cancel{x}+8-\cancel{x}-1(5-6x)=15$$
$$8-5+6x=15$$
$$3+6x=15$$
$$\cancel{3}+6x-\cancel{3}=15-3$$
$$6x=12$$
$$\frac{\cancel{6}x}{\cancel{6}}=\frac{12}{6}\;;\;x=\boxed{2}$$

---

9. –3(p + 1) + 2 = 3(– p – 3)

$$-3(p+1)+2=3(-p-3)$$
$$-3p-3+2=-3p-9$$
$$-3p-1=-3p-9$$
$$-\cancel{3p}-1+\cancel{3p}=-\cancel{3p}-9+\cancel{3p}$$
$$-1\neq-9\quad\text{No Solution}$$

10. 10(f – 3) = 2(f – 20) – 50

$$10(f-3) = 2(f-20)-50$$
$$10f-30 = 2f-\underbrace{40-50}$$
$$10f-30 = 2f-90$$
$$10f\cancel{-30}\cancel{+30} = 2f-\underbrace{90+30}$$
$$10f = 2f-60$$
$$\underbrace{10f-2f} = \cancel{2f}-60\cancel{-2f}$$
$$8f = -60 \;;\; \frac{\cancel{8}f}{\cancel{8}} = \frac{-60}{8} \;;\; f = \boxed{-\frac{15}{2}}$$

11. 5(x + 6) = 5(x + 2)

$$5(x+6) = 5(x+2)$$
$$5x+30 = 5x+10$$
$$5x+\cancel{30}\cancel{-30} = 5x+\underbrace{10-30}$$
$$5x = 5x-20$$
$$\cancel{5x}-5x = \cancel{5x}-20-\cancel{5x}$$
$$0 \neq -20 \quad \text{No solution}$$

12. – 4m + 10 + 5m = 14 – 4m

$$\underbrace{-4m+10+5m} = 14-4m$$
$$m+10 = 14-4m$$
$$m\cancel{+10}\cancel{-10} = \underbrace{14-4m-10}$$
$$m = 4-4m$$
$$\underbrace{m+4m} = 4-\cancel{4m}+\cancel{4m}$$
$$5m = 4$$
$$\frac{\cancel{5}m}{\cancel{5}} = \frac{4}{5} \;;\; m = \boxed{\frac{4}{5}}$$

13. 3(– x – 3) = –3(x + 5) + 6

$$3(-x-3) = -3(x+5)+6$$
$$-3x-9 = -3x-\underbrace{15+6}$$
$$-3x-\cancel{9}+\cancel{9} = -3x-\cancel{9}+\cancel{9}$$
$$-3x = -3x$$
$$-\cancel{3x}+\cancel{3x} = -\cancel{3x}+\cancel{3x}$$
$$0=0$$

ARX

---

*14. (1/2)x + 1 – x = (3/5)(x –7/2) – 1

$$\frac{1}{2}x+1-x = \frac{3}{5}\left(x-\frac{7}{2}\right)-1$$
$$\overbrace{\frac{1}{2}x+1-\frac{x}{1}}\cdot\frac{2}{2} = \frac{3}{5}x-\overbrace{\frac{21}{10}-1\cdot\frac{10}{10}}$$
$$-\frac{1}{2}x+1 = \frac{3}{5}x-\frac{31}{10}$$
$$-\frac{1}{2}x+\cancel{1}-\cancel{1} = \frac{3}{5}x-\underbrace{\frac{31}{10}-1\cdot\frac{10}{10}}$$
$$-\frac{1}{2}x = \frac{3}{5}x-\frac{41}{10}$$
$$-\frac{1}{2}x-\frac{3}{5}x = \cancel{\frac{3}{5}x}-\frac{41}{10}-\cancel{\frac{3}{5}x}$$
$$\underbrace{-\frac{1}{2}\cdot\frac{5}{5}x-\frac{3}{5}\cdot\frac{2}{2}x} = -\frac{41}{10}$$
$$-\frac{11}{10}x = -\frac{41}{10}$$
$$\cancel{-\frac{11}{10}\left(-\frac{10}{11}\right)}x = -\frac{41}{\cancel{10}}\cdot-\frac{\cancel{10}}{11}$$
$$x = \boxed{\frac{41}{11}}$$

Alg 1, Unit 3

Inequality basics

Solving linear, single-variable inequalities

Unit 3: Lesson 01 Inequality statements

Read the symbol, > , "greater than."

Read the symbol, < , "less than."

If *a* lies to the left of *b* on a number line, then we can make the statement, **a < b.** (Read this, "***a* is less than *b***.")

If *x* lies to the right of *y* on a number line, then we can make the statement, **x > y.** (Read this, "*x* is **greater than** *y*.")

Just remember, "The alligator eats the big one."

Example 1: Express "x + 3 is greater than 2y" in symbols.

$x + 3 > 2y$

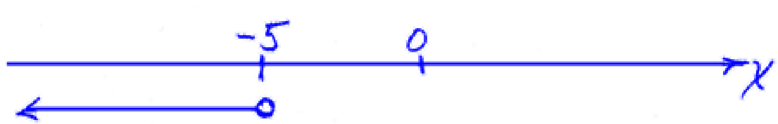
Example 2: The number represented by *m* lies to the right of the number represented by *n* on a number line. Express the inequality relationship between *m* and *n* using "<".

$n < m$

When graphing x > a or x < a on a number line just remember that the "inequality arrow" is in the same direction as the "graph arrow" (only true when the **variable is on the left side)**.

Graph with an **open circle** as illustrated in the example below.

Example 3: Sketch the graph of x < –5 on a number line.

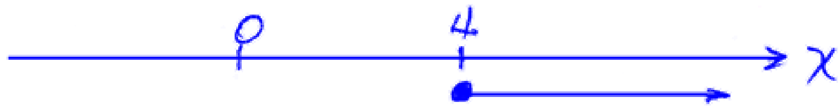


Read the symbol, ≥ , "greater than or equal to."

Read the symbol, ≤ , "less than or equal to."

Graph with a **solid circle** as illustrated in the example below.

Example 4: Sketch the graph of $x \geq 4$ on a number line.



Adding (or subtracting) a number to both sides of an inequality:

Suppose *a* and *b* are related by the inequality, then

$a > b$

When the quantity *c* is added to both sides, the result is

$a + c > b + c$

Multiplying (or dividing) a number times both sides of an inequality:

Suppose *a* and *b* are related by the inequality, then

$a > b$

When the quantity *c* is multiplied by both sides, the result is

$a(c) > b(c)$ if *c* is a **positive** number.

$a(c) < b(c)$ if *c* is a **negative** number (Note the **reversal** of the inequality symbol.)

Example 5: Rewrite the inequality f < g after subtracting 3 from both sides.

$f - 3 < g - 3$

Example 5: Rewrite the inequality m ≥ n after multiplying 4 times both sides.

$4m \geq 4n$

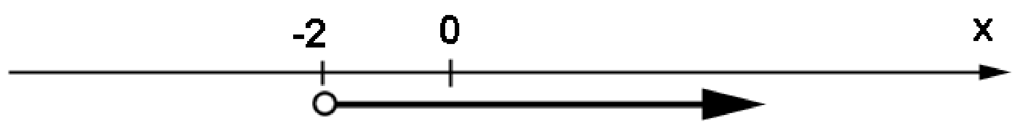
Example 7: Rewrite the inequality x ≥ y after dividing both sides by – 6.

$x/(-6) \leq y/(-6)$

Example 8: Rewrite the inequality p ≤ q after adding 2 to both sides.

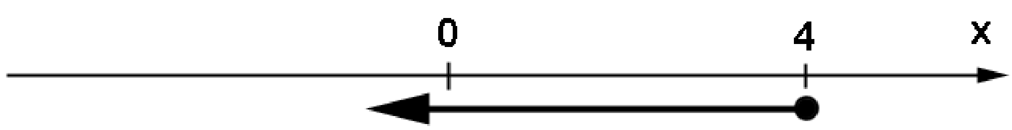
$p + 2 \leq q + 2$

Example 9: Write the inequality that describes this graph.



$x > -2$

Example 10. Write the inequality that describes this graph.



$x \leq 4$

Example 11: Which of the following set of *x* values is a solution to the inequality of Example 10? {–6, – 5, –4, –3, –2, –1, 0, 1, 2, 3, 4, 5, 6}

{–6, – 5, –4, –3, –2, –1, 0, 1, 2, 3, 4}

Assignment:

1. Express "*f* is less than or equal to *m*" in mathematical symbols.

$f \le m$

2. Express "*z* is greater than *v*" in mathematical symbols.

$z > v$

3. Express x ≤ k in words.

x is less than or equal to k

4. Express w > z in words.

w is greater than z

5. Rewrite the inequality f < g after subtracting 3 from both sides.

$f - 3 < g - 3$

6. Rewrite the inequality x ≥ y after dividing both sides by – 6.

$x/(-6) \le y/(-6)$

7. Rewrite the inequality m ≥ n after multiplying 4 times both sides.

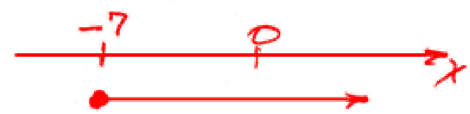
$4m \ge 4n$

8. Rewrite the inequality p ≤ q after adding 2 to both sides.

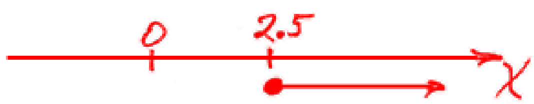
$p + 2 \le q + 2$

9. Sketch the graph of x < 6 on a number line.

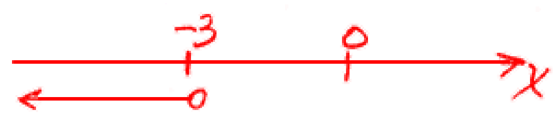
10. Sketch the graph of x ≥ –7 on a number line.



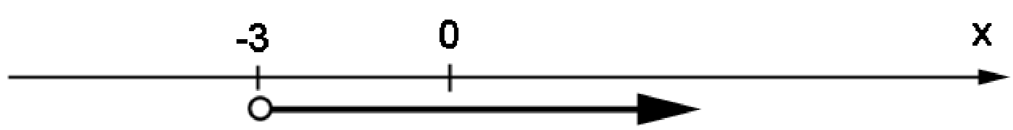
11. Sketch the graph of x ≥ 2.5 on a number line.



12. Sketch the graph of x < –3 on a number line.

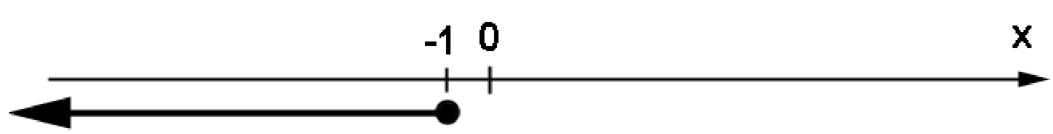


13. Write the inequality that describes this graph.



$x > -3$

14. Write the inequality that describes this graph.



$x \leq -1$

15. Which of the following set of *x* values is a solution to the inequality of problem 13?

{– 5, –4, –3, –2, –1, 0, 1, 2, 3, 4, 5}

{-2, -1, 0, 1, 2, 3, 4, 5}

16. Which of the following set of *x* values is a solution to the inequality of problem 14?

{– 5, –4, –3, –2, –1, 0, 1, 2, 3, 4, 5}

{- 5, -4, -3, -2, -1}

17. Express “p could be equal to 5; however, it could also be less than 5” in mathematical symbols.

$p \leq 5$

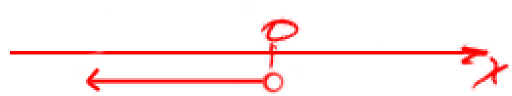
18. Rewrite $2g \geq 11f$ after dividing both sides by -13.

$2g/(-13) \leq 11f/(-13)$

19. Express $m \leq n$ in words.

m is less than or equal to n.

20. Sketch the graph of $x < 0$ on a number line.



Unit 3:
Lesson 02

Inequality phrases
Solving linear inequalities

The phrases

"at least",
"no more than",
"don't exceed",
"in excess of",
or their equivalents

in a statement all lead to **inequality** statements.

Example 1: Write the inequality expressed by the statement, "This year's profit is **at least** last year's profit."

$typ \geq lyp$

Example 2: Write the inequality expressed by the statement, "Make sure the expenses are **no more than** \$100."

$e \leq 100$

Example 3: Write the inequality expressed by the statement, "My speed did not exceed 70 mph."

$s \leq 70$

Example 4: Write the inequality expressed by the statement, "My speed was in excess of 50 mph."

$s > 50$

Solving an inequality involves exactly the same steps as when solving an equation with the following **exception**:

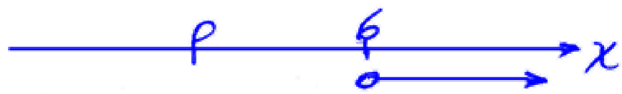
If both sides of the inequality are multiplied (or divided) by a **negative** number, the **inequality symbol must be reversed.**

Example 5: Determine the inequality solution to x – 4 > 2. Express the answer both symbolically and as a graph on a number line.

$$x - 4 > 2$$

$$x - \cancel{4} + \cancel{4} > 2 + 4$$

$$\boxed{x > 6}$$



Example 6: Determine the inequality solution to –3x + 2 ≤ – 7. Express the answer both symbolically and as a graph on a number line.

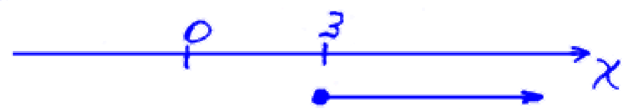
$$-3x + 2 \le -7$$

$$-3x + \cancel{2} - \cancel{2} \le -7 - 2$$

$$-3x \le -9$$

$$\frac{\cancel{-3}x}{\cancel{-3}} \ge \frac{-9}{-3}$$ reversed

$$\boxed{x \ge 3}$$



Example 7: Determine the inequality solution to 3x – 5 > x + 6. Express the answer both symbolically and as a graph on a number line.

$$3x - 5 > x + 6$$

$$3x - \cancel{5} + \cancel{5} > x + 6 + 5$$

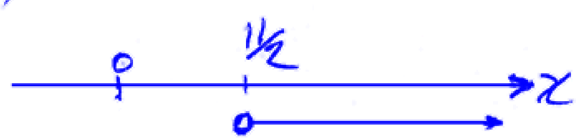
$$3x > x + 11$$

$$3x - x > \cancel{x} + 11 - \cancel{x}$$

$$2x > 11$$

$$\frac{\cancel{2}x}{\cancel{2}} > \frac{11}{2}$$

$$\boxed{x > \frac{11}{2}}$$



Example 8: Determine the inequality solution to 3(x + 2) > 7x – 10. Express the answer both symbolically and as a graph on a number line.

$$3(x+2) > 7x - 10$$

$$3x + 6 > 7x - 10$$

$$3x + \cancel{6} \cancel{-6} > 7x - 10 - 6$$

$$3x > 7x - 16$$

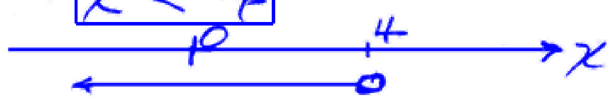
$$3x - 7x > \cancel{7x} - 16 \cancel{-7x}$$

$$-4x > -16$$

reversed

$$\frac{\cancel{-4}x}{\cancel{-4}} < \frac{-16}{-4}$$

$$\boxed{x < 4}$$



Assignment:

1. Write the inequality expressed by the statement, "Unfortunately, Richard's grade **did not exceed** 70."

$g \leq 70$

2. Write the inequality expressed by the statement, "The government says the work-day should be **no more than** 8 hours."

$wd \leq 8$

3. Write the inequality expressed by the statement, "When I graduate, I want to make **at least** $50,000 per year."

$salary \geq 50{,}000$

4. Write the inequality expressed by the statement, "The number of calories in that meal was definitely **in excess of** 2000."

$c > 2000$

5. Write the inequality expressed by the statement, "The probability of me passing Algebra is **not less than** 80%."

$p \geq .80$

6. Write the inequality expressed by the statement, "The score made by the Eagles will likely **not exceed** 10 more than the Bobcat's score."

$e \leq b + 10$

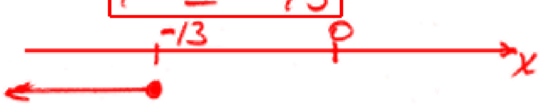
Determine the inequality solution to the following problems. Express the answer both symbolically and as a graph on a number line.

7. x + 17 ≤ 4

$x + 17 \leq 4$

$x + \cancel{17} - \cancel{17} \leq 4 - 17$

$\boxed{x \leq -13}$



8. 4 – x < 11

$4 - x < 11$

$\cancel{4} - x - \cancel{4} < 11 - 4$

$-x < 7$ reversed

$(-1)(-x) > 7(-1)$

$\boxed{x > -7}$

9. 7x + 2 > x – 9

$$7x + 2 > x - 9$$
$$7x + \cancel{2} - \cancel{2} > x - \underbrace{9 - 2}$$
$$7x > x - 11$$
$$7x - x > \cancel{x} - 11 - \cancel{x}$$
$$6x > -11$$
$$\frac{\cancel{6}x}{\cancel{6}} > \frac{-11}{6}$$
$$\boxed{x > \frac{-11}{6}}$$

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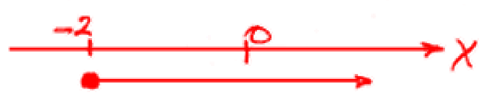
10. –3 ≤ x + 7 + 4x

$$-3 \le \underbrace{x + 7 + 4x}$$
$$-3 \le 5x + 7$$
$$-3 - 5x \le \cancel{5x} + 7 - \cancel{5x}$$
$$-3 - 5x \le 7$$
$$\cancel{-3} - 5x + \cancel{3} \le 7 + 3$$
$$-5x \le 10$$

reversed

$$\frac{\cancel{-5}x}{\cancel{-5}} \ge \frac{10}{-5}$$
$$\boxed{x \ge -2}$$



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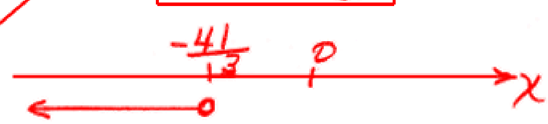
11. 4(x + 12) + 1 < x + 8

$$4(x + 12) + 1 < x + 8$$
$$4x + \underbrace{48 + 1} < x + 8$$
$$4x + 49 < x + 8$$
$$4x + \cancel{49} - \cancel{49} < x + \underbrace{8 - 49}$$
$$4x < x - 41$$
$$\underbrace{4x - \cancel{x}} < \cancel{x} - 41 - \cancel{x}$$
$$3x < -41$$
$$\frac{\cancel{3}x}{\cancel{3}} < \frac{-41}{3}$$
$$\boxed{x < \frac{-41}{3}}$$



12. 4x – 6 > 7x

$$4x - 6 > 7x$$

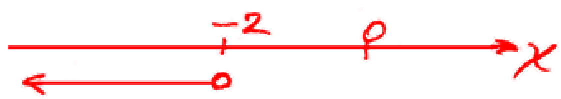
$$4x \cancel{-6} \cancel{+6} > 7x + 6$$

$$4x > 7x + 6$$

$$\underbrace{4x - 7x} > \cancel{7x} + 6 \cancel{-7x}$$

$-3x > 6$ reversed

$$\frac{\cancel{-3}x}{\cancel{-3}} < \frac{6}{-3}; \quad \boxed{x < -2}$$



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13. 4(2 + x) – 5x < x + 12

$$4(2 + x) - 5x < x + 12$$

$$8 + \underbrace{4x - 5x} < x + 12$$

$$8 - x < x + 12$$

$$\cancel{8} - x \cancel{-8} < x + \underbrace{12 - 8}$$

$$-x < x + 4$$

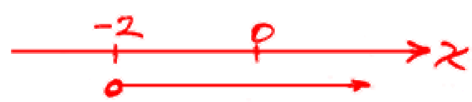
$$\underbrace{-x - x} < \cancel{x} + 4 \cancel{-x}$$

$$-2x < 4$$

reversed

$$\frac{\cancel{-2}x}{\cancel{-2}} > \frac{4}{-2}$$

$$\boxed{x > -2}$$



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*14. 6x – 2 + x ≥ 7x – 13

$$\underbrace{6x - 2 + x} \geq 7x - 13$$

$$7x - 2 \geq 7x - 13$$

$$\cancel{7x} - 2 \cancel{-7x} \geq \cancel{7x} - 13 \cancel{-7x}$$

$$-2 \geq -13 \quad \boxed{A\ R\ x}$$

Unit 3: Cumulative Review

1. Use three successive unit multipliers to convert from 156,000 centimeters to miles. First convert from centimeters to inches, then from inches to feet, and finally from feet to miles. (1 in = 2.54 cm, 12 in = 1 ft, 5280 ft = 1 mi)

$$\frac{156{,}000\ \cancel{cm}}{1}\cdot\frac{1\ in}{2.54\ \cancel{cm}}$$

$$=\frac{156{,}000}{2.54}\ \cancel{in}\cdot\frac{1\ ft}{12\ \cancel{in}}$$

$$=\frac{156{,}000}{2.54\cdot 12}\ \cancel{ft}\cdot\frac{1\ mi}{5280\ \cancel{ft}}=\frac{156{,}000}{2.54\cdot 12\cdot 5{,}280}\ mi=\boxed{.969339\ mi}$$

2. Simplify this expression: $1 + 8\cdot 6 \div 2 - 10$

$1+8\cdot 6/2-10$

$=1+48/2-10$

$=1+24-10$

$=25-10=\boxed{15}$

3. Simplify $\dfrac{10\cdot 2 + 1\cdot 12}{1 + 2\cdot 3 - 3}$

$\dfrac{10\cdot 2+1\cdot 12}{1+2\cdot 3-3}$

$=\dfrac{20+1\cdot 12}{1+6-3}$

$=\dfrac{20+12}{7-3}$

$=\dfrac{32}{4}=\boxed{8}$

4. Simplify | 8 – 6 – 5|

$|8-6-5|$

$=|2-5|=|-3|$

$=\boxed{3}$

5. What is the opposite of 10? What is the absolute value of the opposite of 10?

$\boxed{-10}$

$|-10|=\boxed{10}$

6. Simplify –3(–4)(–2) + 1

$-3(-4)(-2)+1$

$=12(-2)+1$

$=-24+1=\boxed{-23}$

7. Simplify –200/(–4)/(–25)

$-200/(-4)/(-25)$

$=50/(-25)$

$=\boxed{-2}$

8. Evaluate |3x – 2y + 1| if x = 2 and y = – 6.

$$|3x-2y+1|$$
$$=|3\cdot 2-2(-6)+1|$$
$$=|6-2(-6)+1|$$
$$=|6+12+1|$$
$$=|18+1|=|19|$$
$$=\boxed{19}$$

9. Simplify 3x + 2 – 11x + 9 and then evaluate when x = –1.

$$3x+2-11x+9$$
$$=-8x+11$$
$$=-8(-1)+11$$
$$=8+11=\boxed{19}$$

10. Simplify (1/2)x – (1/5) x + (2/7)y – (3/8)y

$$\frac{1}{2}x-\frac{1}{5}x+\frac{2}{7}y-\frac{3}{8}y$$
$$=\frac{5}{5}\cdot\frac{1}{2}x-\frac{2}{2}\cdot\frac{1}{5}x+\frac{8}{8}\cdot\frac{2}{7}y-\frac{7}{7}\cdot\frac{3}{8}y$$
$$=\frac{5}{10}x-\frac{2}{10}x+\frac{16}{56}y-\frac{21}{56}y$$
$$=\boxed{\frac{3}{10}x-\frac{5}{56}y}$$

11. Solve 8 = – 6k – 4 + 2k

$$8=-6k-4+2k$$
$$8=-4k-4$$
$$8+4=-4k\cancel{-4}\cancel{+4}$$
$$12=-4k$$
$$\frac{12}{-4}=\frac{\cancel{-4}k}{\cancel{-4}}$$
$$\boxed{-3}=k$$

12. Solve –9 + 6x + 1 + 14x = 32

$$-9+6x+1+14x=32$$
$$-8+20x=32$$
$$\cancel{-8}+20x\cancel{+8}=32+8$$
$$20x=40$$
$$\frac{\cancel{20}x}{\cancel{20}}=\frac{40}{20}$$
$$x=\boxed{2}$$

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13. Solve 6(y + 4) – 4 = y – 9(3y + 2)

$$6(y+4)-4=y-9(3y+2)$$
$$6y+24-4=y-27y-18$$
$$6y+20=-26y-18$$
$$6y\cancel{+20}\cancel{-20}=-26y-18-20$$
$$6y=-26y-38$$
$$6y+26y=\cancel{-26y}-38\cancel{+26y}$$
$$32y=-38$$
$$\frac{\cancel{32}y}{\cancel{32}}=\frac{-38}{32}$$
$$y=\boxed{-\frac{19}{16}}$$

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14. Simplify 1/2 + 1/3 – 1/4 + 2

$$\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\frac{2}{1}\ ;\ LCD=12$$
$$=\frac{1}{2}\,\frac{6}{6}+\frac{1}{3}\,\frac{4}{4}-\frac{1}{4}\,\frac{3}{3}+\frac{2}{1}\,\frac{12}{12}$$
$$=\frac{6}{12}+\frac{4}{12}-\frac{3}{12}+\frac{24}{12}=\frac{6+4-3+24}{12}$$
$$=\frac{10-3+24}{12}=\frac{7+24}{12}=\boxed{\frac{31}{12}}$$