MATH 106 WEEK 1 PACKET

IN ORDER TO BE SUCCESSFUL IN MATH 106, YOU MUST MASTER THE CONENT OF THIS PACKET AND BE ABLE TO DEMONSTRATE THAT ON THE TEST FRIDAY OF WEEK 1.

THIS PACKET CONTAINS PREREQUISITE MATERIAL FOR MATH 106

Multiplication Facts: In this course, you can only use a calculator that multiplies, divides, adds and subtracts (4 function calculator). It is recommended, that if you don't know them already, that you memorize the multiplication tables up through 12 times 12. It is very difficult to become sufficient at factoring without knowing your multiplication facts.

Here are a couple of sites where you can practice:

Picture of facts: https://www.mathsisfun.com/tables.html

Practice up through 12 by 12: https://www.ixl.com/math/grade-3/multiplication-facts-to-12

Finding the missing factors: https://www.ixl.com/math/grade-3/multiplication-facts-up-to-12-select-the-missing-factors

Integer operations: Also, it is recommended that you understand how to add and subtract signed numbers, so that you don't rely on this 4 function calculator. Also, you will have to change some of the signs in order to even use this calculator. If you need to practice this, there is plenty of practice in this packet.

Fractions and Exponents: There is not an option to do fraction computation, exponents, etc. on the calculator allowed in this course. You will need to do this by hand. This packet should help you learn how to do this, in case you have relied heavily on a scientific or graphing calculator to do this in the past.

Direct Link to help videos in this packet can be found online on the Math Department website under Course Information:
https://math.siu.edu/courses/math106-help-page-2023.php

Order of Operations

Order of Operations:

1) **P**arentheses. Do anything in parentheses, brackets, braces, square root, absolute value or any other grouping symbol first. This includes the fraction bar. Start with the innermost grouping symbol first.
2) **E**xponents.
3) **M**ultiplication/**D**ivision. In order from left to right. (Multiplication doesn't come before division).
4) **A**ddition/**S**ubtraction. In order from left to right (Addition doesn't come before subtraction).

Note: People remember PEMDAS by "Please Excuse My Dear Aunt Sally"

What do you think could be misunderstood by students who remember this pneumonic? It is a great tool, but one item must be overemphasized. What is it?

<u>We know that many of you have been doing all computation only on a scientific calculator. They are not allowed, so you will need to understand the order of operations and how to do them without a scientific calculator.</u>

Recall:

Exponents are used in mathematics as a type of short-hand to denote the product of repeated factors. That is, instead of multiplying 2 five times, we can write 2^5.

Anatomy of an exponential expression:

$$a^n = \underbrace{a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot \ldots \cdot a}_{n \text{ times}}$$

a is the **base**, n is the **exponent**, and a^n is the **exponential expression**.

These come up frequently, you should <u>memorize these:</u>

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$
$10^2 = 100$
$11^2 = 121$
$12^2 = 144$

Ex. 1 : Evaluate the exponential expressions.

1. 8^2 2. -8^2 3. $(-8)^2$

4. 5^3 5. -2^5

6. $(-1)^{11}$ 7. $(-2)^3$

8. $-(-2)^3$

These come up frequently, you should <u>memorize these</u>

Number	Cube
1	$1^3 = 1$
2	$2^3 = 8$
3	$3^3 = 27$
4	$4^3 = 64$
5	$5^3 = 125$

Ex. 2 DO ONLY ONE OPERATION PER STEP ACCORDING TO THE ORDER OF OPERATIONS:

$(9-2^2+10\times 8)\div 5$

$9+4\times(3^3-7)\div 8$

Evaluating Expressions:

Ex. 3 Evaluate each expression for a = 2, b = 4 and c = 4

1. $\sqrt{b}+c-a$
2. $\dfrac{2c+a^3}{b+6a}$
3. $4a^3+2c$

ORDER OF OPERATIONS PRACTICE- ANSWERS ON NEXT PAGE

$(4^2\times 2)\div(10-5+3)$

$(4^3\div 2+7-8)\times 3$

$(5\times 3+9)\div(4^2-10)$

$((9+3-8)\times 10)\div 2^2$

$(2\times(9-8))^2\div 4+3$

$(9+5-6)\times(4^3\div 8)$

ANSWERS TO ORDER OF OPERATIONS PRACTICE

$$(\underline{4^2} \times 2) \div (10 - 5 + 3)$$
$$= (\underline{16 \times 2}) \div (10 - 5 + 3)$$
$$= 32 \div (\underline{10 - 5} + 3)$$
$$= 32 \div (\underline{5 + 3})$$
$$= \underline{32 \div 8}$$
$$= 4$$

$$(\underline{4^3} \div 2 + 7 - 8) \times 3$$
$$= (\underline{64 \div 2} + 7 - 8) \times 3$$
$$= (\underline{32 + 7} - 8) \times 3$$
$$= (\underline{39 - 8}) \times 3$$
$$= \underline{31 \times 3}$$
$$= 93$$

$$(\underline{5 \times 3} + 9) \div (4^2 - 10)$$
$$= (\underline{15 + 9}) \div (4^2 - 10)$$
$$= 24 \div (\underline{4^2} - 10)$$
$$= 24 \div (\underline{16 - 10})$$
$$= \underline{24 \div 6}$$
$$= 4$$

$$((\underline{9 + 3} - 8) \times 10) \div 2^2$$
$$= ((\underline{12 - 8}) \times 10) \div 2^2$$
$$= (\underline{4 \times 10}) \div 2^2$$
$$= 40 \div \underline{2^2}$$
$$= \underline{40 \div 4}$$
$$= 10$$

$$(2 \times (\underline{9 - 8}))^2 \div 4 + 3$$
$$= (\underline{2 \times 1})^2 \div 4 + 3$$
$$= \underline{2^2} \div 4 + 3$$
$$= \underline{4 \div 4} + 3$$
$$= \underline{1 + 3}$$
$$= 4$$

$$(\underline{9 + 5} - 6) \times (4^3 \div 8)$$
$$= (\underline{14 - 6}) \times (4^3 \div 8)$$
$$= 8 \times (\underline{4^3} \div 8)$$
$$= 8 \times (\underline{64 \div 8})$$
$$= \underline{8 \times 8}$$
$$= 64$$

AFTER CLASS ON DAY 1, BUT BEFORE DAY 2 OF CLASS, COMPLETE THROUGH PAGE 19 OF THIS PACKET UNLESS YOU DID IT PRIOR TO CLASS STARTING - INTEGERS AND ORDER OF OPERATIONS WITH SIGNED NUMBERS, ALONG WITH POLYNOMIAL OPERATIONS. PICK AND CHOOSE WHAT YOU NEED TO PRACTICE. YOU WILL BE RESPONSIBLE FOR KNOWING THIS CONTENT FOR THE TEST ON FRIDAY WITH ONLY A CALCULATOR THAT MULTIPLIES, ADDS, SUBRACTS AND DIVIDES (SO REALLY SHOULD BE DOING IT WITHOUT A CALCULATOR) . THE INSTRUCTOR WILL ASSUME YOU KNOW THIS CONTENT FOR CLASS TOMORROW. THERE ARE VIDEOS/ONLINE PRACTICE TO HELP. CLICK PRACTICE IN THESE VIDEO LINKS TO WORK ON PROBLEMS AND GET IMMEDIATE FEEDBACK.

Direct Link to help videos found online on the Math Department website under Course Information:
https://math.siu.edu/courses/math106-help-page-2023.php

ANSWERS BELOW

Evaluating Expressions (A)

Evaluate each expression using the values given.

1. $4 \div 6 \cdot (a-1)^3$
   $(a=2)$

6. $2 \div ((8-v+a) \div 4)$
   $(a=7, v=8)$

2. $(z-1) \cdot 10 \div 10 + y$
   $(y=4, z=9)$

7. $c^4 + 10 - 3 + v$
   $(c=2, v=4)$

3. $b-(3+u)+a-a$
   $(a=5, b=7, u=4)$

8. $(8 \cdot 2 + b + 7) \div 5$
   $(b=8)$

4. $y + 8 \div 7 \cdot c \div 2$
   $(y=4, c=9)$

9. $(3^2 - a + 9) \cdot x$
   $(a=3, x=6)$

5. $a(2 \cdot 10 \div b + 10)$
   $(a=2, b=3)$

10. $9 - v + x + v^4$
    $(x=8, v=2)$

Answers:

1) 2/3 2) 12 3) 0 4) 64/7 5) 100/3 6) 8/7 7) 27 8) 31/5 9) 90 10) 31

Video 1: Adding and subtracting Integers main page: https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-negative-numbers-add-and-subtract#cc-7th-sub-neg-intro

Video 2: Adding and subtracting negative numbers video:

https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-negative-numbers-add-and-subtract/cc-7th-sub-neg-intro/v/adding-and-subtracting-negative-number-examples

INTEGERS:

Addition Rules	**Examples**
When adding two numbers with like signs, add the values and keep the common sign.	1. (+3) + (+5) = + 8 2. 4 + 6 = 10 3. (-3) + (-5) = - 8 4. - 4 + (- 6) = -10
When adding two numbers with unlike signs, subtract the values and use the sign of the larger-valued number.	1. (+3) + (-5) = -2 2. (-3) + (+5) = +2 3. 4 + (- 6) = -2 4. - 4 + 6 = 2

Subtraction Rules	**Examples**
Change the subtraction operator to addition and change the sign of the number that immediately follows. Follow the rules for addition stated above. *(i.e. Add the opposite)* (-3) - (+5) ↓ ↓ (-3) + (-5)	1. (+3) - (-5) = (+3) + (+5) = 8 2. (-3) - (+5) = (-3) + (-5) = - 8 3. 4 - (- 6) = 4 + (+ 6) = 10 4. - 4 - 6 = - 4 + (- 6) = - 10

Multiplication Rules	Examples
When multiplying two numbers with the same sign, the product is positive. (+)(+) = + (-)(-) = +	1. (+3) (+5) = +15 2. (4)(6) = 24 3. (-3) + (-5) = +15 4. - 4(- 6) = 24
When multiplying two numbers with unlike signs, the product is negative. (+)(-) = - (-)(+) = -	1. (+3) (-5) = -15 2. 4 (-6) = 24 3. (-3) (+5) = -15 4. - 4 (6) = -24

Division Rules	Examples
When dividing two numbers with the same sign, the quotient is positive. (+)/(+) = + (-)/(-) = +	1. (+3) (+5) = +15 2. (4)(6) = 24 3. (-3) + (-5) = +15 4. - 4(- 6) = 24
When dividing two numbers with unlike signs, the quotient is negative. (+)/(-) = - (-)/(+) = -	1. (+15) / (-5) = -3 2. 24 /(-6) = 4 3. (-15) /(+3) = -5 4. - 24 /(6) = -4
Note: ***The division rules are the same as the multiplication rules.***	

***Please note: $\frac{0}{a} = 0 \quad but \quad \frac{a}{0}$ is undefined, where $a \neq 0$. *You CANNOT Divide by 0.*

INTEGER PRACTICE (Answers on next page)

$7 - (-4) =$	$6 \times (-3) =$	$(-8) \times 9 =$
$5 + (-8) =$	$(-13) - 2 =$	$(-13) + (-5) =$
$(-15) - 1 =$	$(-11) - 12 =$	$(-9) \times 3 =$
$14 + 8 =$	$60 \div (-4) =$	$(-4) + (-14) =$
$20 \div 5 =$	$(-12) + 8 =$	$6 + 11 =$
$(-14) \times 7 =$	$(-12) - 15 =$	$12 \times 13 =$
$3 \times (-4) =$	$(-2) - 1 =$	$(-11) + (-7) =$
$(-4) - (-15) =$	$(-3) \times (-6) =$	$143 \div (-13) =$
$(-7) \times 10 =$	$(-8) + (-5) =$	$(-10) + 4 =$
$0 \div -4 =$	$6 \div 0 =$	

INTEGER PRACTICE ANSWERS

$7 - 3 = 4$	$1 - (-12) = 13$	$9 + 11 = 20$
$7 - (-4) = 11$	$6 \times (-3) = (-18)$	$(-8) \times 9 = (-72)$
$5 + (-8) = (-3)$	$(-13) - 2 = (-15)$	$(-13) + (-5) = (-18)$
$(-15) - 1 = (-16)$	$(-11) - 12 = (-23)$	$(-9) \times 3 = (-27)$
$14 + 8 = 22$	$60 \div (-4) = (-15)$	$(-4) + (-14) = (-18)$
$20 \div 5 = 4$	$(-12) + 8 = (-4)$	$6 + 11 = 17$
$(-14) \times 7 = (-98)$	$(-12) - 15 = (-27)$	$12 \times 13 = 156$
$3 \times (-4) = (-12)$	$(-2) - 1 = (-3)$	$(-11) + (-7) = (-18)$
$(-4) - (-15) = 11$	$(-3) \times (-6) = 18$	$143 \div (-13) = (-11)$
$(-7) \times 10 = (-70)$	$(-8) + (-5) = (-13)$	$(-10) + 4 = (-6)$
$0 \div -4 = 0$	$6 \div 0 = \ undefined$	

ORDER OF OPERATIONS PRACTICE WITH SIGNED NUMBERS (INTEGERS) – ANSWERS ON NEXT PAGE

$(-5)^2 - 2 \times (-9) + 6$

$3 \times 10 + 8 - 4^2$

$(-9) - (-8) + 2 \times 4^2$

$(-3)^3 - 2 + 8 \div (-8)$

$8 \div (-4) \times (-6)^2 + 7$

$4 \times (-8) + 6 - (-2)^3$

$10 \times 5 - (-6)^2 + (-8)$

$(-5)^2 \times 3 \div 5 + 9$

$(10 \div (-5) - (-2)) \times (-3)^3$

$4 \times (-6) \div 8 + 3^3$

ANSWERS TO ORDER OF OPERATIONS PRACTICE

$$\underline{(-5)^2} - 2\times(-9)+6$$
$$= 25 - \underline{2\times(-9)} + 6$$
$$= \underline{25-(-18)} + 6$$
$$= \underline{43+6}$$
$$= 49$$

$$(-9)-(-8)+2\times \underline{4^2}$$
$$= (-9)-(-8)+\underline{2\times 16}$$
$$= \underline{(-9)-(-8)}+32$$
$$= \underline{(-1)+32}$$
$$= 31$$

$$8\div(-4)\times\underline{(-6)^2}+7$$
$$= \underline{8\div(-4)}\times 36+7$$
$$= \underline{(-2)\times 36}+7$$
$$= \underline{(-72)+7}$$
$$= -65$$

$$10\times 5-\underline{(-6)^2}+(-8)$$
$$= \underline{10\times 5}-36+(-8)$$
$$= \underline{50-36}+(-8)$$
$$= \underline{14+(-8)}$$
$$= 6$$

$$\left(\underline{10\div(-5)}-(-2)\right)\times(-3)^3$$
$$= \left(\underline{(-2)-(-2)}\right)\times(-3)^3$$
$$= 0\times\underline{(-3)^3}$$
$$= \underline{0\times(-27)}$$
$$= 0$$

$$3\times 10+8-\underline{4^2}$$
$$= \underline{3\times 10}+8-16$$
$$= \underline{30+8}-16$$
$$= \underline{38-16}$$
$$= 22$$

$$\underline{(-3)^3}-2+8\div(-8)$$
$$= (-27)-2+\underline{8\div(-8)}$$
$$= \underline{(-27)-2}+(-1)$$
$$= \underline{(-29)+(-1)}$$
$$= -30$$

$$4\times(-8)+6-\underline{(-2)^3}$$
$$= \underline{4\times(-8)}+6-(-8)$$
$$= \underline{(-32)+6}-(-8)$$
$$= \underline{(-26)-(-8)}$$
$$= -18$$

$$\underline{(-5)^2}\times 3\div 5+9$$
$$= \underline{25\times 3}\div 5+9$$
$$= \underline{75\div 5}+9$$
$$= \underline{15+9}$$
$$= 24$$

$$4\times(-6)\div 8+\underline{3^3}$$
$$= \underline{4\times(-6)}\div 8+27$$
$$= \underline{(-24)\div 8}+27$$
$$= \underline{(-3)+27}$$
$$= 24$$

Operations with Polynomials:

Direct Link to help videos found online on the Math Department website under Course Information:
https://math.siu.edu/courses/math106-help-page-2023.php

Video 3 Operations with Polynomials main page : https://www.khanacademy.org/test-prep/sat/x0a8c2e5f:untitled-652/x0a8c2e5f:passport-to-advanced-math-lessons-by-skill/a/gtp--sat-math--article--operations-with-polynomials--lesson

POLYNOMIALS

polynomial—A monomial, or two or more monomials combined by addition or subtraction, is a polynomial.

- **monomial**—A polynomial with exactly one term is called a monomial.
- **binomial**—A polynomial with exactly two terms is called a binomial.
- **trinomial**—A polynomial with exactly three terms is called a trinomial.

Here are some examples of polynomials.

Polynomial	$b+1$	$4y^2-7y+2$	$4x^4+x^3+8x^2-9x+1$
Monomial	14	$8y^2$	$-9x^3y^5$
Binomial	$a+7$	$4b-5$	y^2-16
Trinomial	$x^2-7x+12$	$9y^2+2y-8$	$6m^4-m^3+8m$

Recall Polynomial Vocabulary:

The *degree* of a polynomial is the highest exponent on a variable.

The *leading coefficient* is the coefficient (number in front of) the highest power term.

The *constant* term is the term with no variable (letter)

Ex. Consider: $2x^2-4x^5+8x-3$

a) What is the degree of the polynomial?
5 (the highest exponent)

b) What is the leading coefficient?
-4 (the number in front of the highest power term)

c) What is the leading term?

$\boldsymbol{-4x^5}$

d) How many terms does this polynomial have?

4 terms are separated by addition or subtraction)

e) What is the constant term?
-3 (the term with no variables - "letters")

f) What is the degree of the constant term?
zero

a) <u>Simplifying Polynomials – combine like terms</u>

Example:

$$\mathbf{4x^2 + 2x^2 + 7 - 6x + 9}$$

$4x^2 + 2x^2 - 6x + 7 + 9$	*Arrange in descending order.*
$4x^2 + 2x^2 - 6x + \boxed{7} + \boxed{9}$	*Identify like terms.*
$6x^2 - 6x + 16$	*Combine coefficients: $4 + 2 = 6$ and $7 + 9 = 16$*

Combining Like Terms Practice (ANSWERS ON NEXT PAGE)

1. $6b^2 - 1 - c - 1$
2. $1 - bx - 1 - bx$
3. $u - 2bu + 1 + bu$
4. $2 + 1 + x - 1$
5. $1 + av + 3 - 3a$
6. $1 + uy - 1 + 1$
7. $3c - cz + 1 + 1$
8. $x^2 + x + 1 - 6$
9. $1 - 6x + 5 + 1$
10. $v^2 + 1 - v^2 - 6v$

COMBINING LIKE TERMS ANSWERS

1. $6b^2 - 1 - c - 1$
$= 6b^2 - c - 2$

2. $1 - bx - 1 - bx$
$= -2bx$

3. $u - 2bu + 1 + bu$
$= -bu + u + 1$

4. $2 + 1 + x - 1$
$= x + 2$

5. $1 + av + 3 - 3a$
$= av - 3a + 4$

6. $1 + uy - 1 + 1$
$= uy + 1$

7. $3c - cz + 1 + 1$
$= -cz + 3c + 2$

8. $x^2 + x + 1 - 6$
$= x^2 + x - 5$

9. $1 - 6x + 5 + 1$
$= -6x + 7$

10. $v^2 + 1 - v^2 - 6v$
$= -6v + 1$

b) Addition and Subtraction – you can only add/subtract like terms

Video 4- adding and subtracting polynomials (again, website to find direct links can be found on page 1 of this packet)
https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-arithmetic/x2ec2f6f830c9fb89:poly-add-sub/v/adding-and-subtracting-polynomials-1

Add Polynomials	Subtract Polynomials
Combine like terms	Rewrite the subtraction as addition. Combine like terms.
Example:	*Example:*
$(x^2 - x + 5) + (6x^2 + 2x - 10)$	$(3x^2 - 8x + 7) - (2x^2 - 6x + 12)$ $= (3x^2 - 8x + 7) + (-2x^2 + 6x - 12)$
$\begin{array}{r} x^2 - x + 5 \\ + \; 6x^2 + 2x - 10 \\ \hline 7x^2 + x - 5 \end{array}$	$\begin{array}{r} 3x^2 - 8x + 7 \\ + \; -2x^2 + 6x - 12 \\ \hline x^2 - 2x - 5 \end{array}$

Adding and Subtracting Polynomial Practice (answers on next page)

1. $(-7g^2 + 6g - 8) - (5g^2 - 2g + 4)$

2. $(7b^2 + 3b + 7) + (3b^2 - 6b - 8)$

3. $(6k^2 - 3k + 8) - (-k^2 - 2k - 9)$

4. $(6v^2 - v - 1) + (-4v^2 - 9v + 9)$

5. $(4p^2 + 2p + 9) + (-5p^2 - 5p - 2)$

6. $(-9f^2 - f - 7) + (6f^2 + f - 5)$

7. $(8q^2 - 7q - 1) + (-6q^2 + 8q + 7)$

8. $(-8c^2 - 9c + 9) + (-5c^2 - 8c - 6)$

9. $(9r^2 - 5r - 7) + (8r^2 + 8r + 6)$

10. $(4k^2 - 9k - 8) + (-3k^2 + 8k + 2)$

Answers to adding and subtracting polynomial practice

1. $(-7g^2 + 6g - 8) - (5g^2 - 2g + 4)$
   $-12g^2 + 8g - 12$

2. $(7b^2 + 3b + 7) + (3b^2 - 6b - 8)$
   $10b^2 - 3b - 1$

3. $(6k^2 - 3k + 8) - (-k^2 - 2k - 9)$
   $7k^2 - k + 17$

4. $(6v^2 - v - 1) + (-4v^2 - 9v + 9)$
   $2v^2 - 10v + 8$

5. $(4p^2 + 2p + 9) + (-5p^2 - 5p - 2)$
   $-p^2 - 3p + 7$

6. $(-9f^2 - f - 7) + (6f^2 + f - 5)$
   $-3f^2 - 12$

7. $(8q^2 - 7q - 1) + (-6q^2 + 8q + 7)$
   $2q^2 + q + 6$

8. $(-8c^2 - 9c + 9) + (-5c^2 - 8c - 6)$
   $-13c^2 - 17c + 3$

9. $(9r^2 - 5r - 7) + (8r^2 + 8r + 6)$
   $17r^2 + 3r - 1$

10. $(4k^2 - 9k - 8) + (-3k^2 + 8k + 2)$
    $k^2 - k - 6$

c) **Multiplication – Distributive Property**

Video 5: Distribute property - https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-arithmetic/x2ec2f6f830c9fb89:mono-by-poly/v/multiplying-monomials-by-polynomials

Distributive Property ***Watch for sign changes when"$\boldsymbol{a}$" is negative, both signs change.**

$\boldsymbol{a}(b+c) = \boldsymbol{a}b + \boldsymbol{a}c$

$\boldsymbol{a}(b-c) = \boldsymbol{a}b - \boldsymbol{a}c$ ***Basic exponent property:** $a^m \cdot a^n = a^{m+n}$

MULTIPLYING POLYNOMIALS:

Use the distributive property and exponent rules:

$-2x^2(7x^3+5x^2-12)$

$(-2)(7)x^3x^2+(-2)(5)x^2x^2-(-2)(12)\,x^2$

$\boxed{-14x^5 - 10x^4 + 24x^2}$

Distributive Property Practice (Answers on next page)

1. $6s^5(-3s^4-2s^3+s^2)$

2. $5b^3(4b^5-8b^4+9b^3)$

3. $s^4(-s^4+9s^3+2s^2)$

4. $-5z^4(-z^3+3z^2+5z)$

5. $-8s^3(2s^3+4s^2-2s)$

6. $a^5(-9a^4-9a^3+4a^2)$

7. $3f^5(-3f^2-2f+1)$

8. $8p^4(-9p^3-7p^2+3p)$

9. $-6r^3(7r^3-5r^2+4r)$

10. $-2n^3(5n^2+7n-6)$

ANSWERS TO DISTRIBUTIVE PROPERY PRACTICE

1. $6s^5(-3s^4 - 2s^3 + s^2)$
   $= -18s^9 - 12s^8 + 6s^7$

2. $5b^3(4b^5 - 8b^4 + 9b^3)$
   $= 20b^8 - 40b^7 + 45b^6$

3. $s^4(-s^4 + 9s^3 + 2s^2)$
   $= -s^8 + 9s^7 + 2s^6$

4. $-5z^4(-z^3 + 3z^2 + 5z)$
   $= 5z^7 - 15z^6 - 25z^5$

5. $-8s^3(2s^3 + 4s^2 - 2s)$
   $= -16s^6 - 32s^5 + 16s^4$

6. $a^5(-9a^4 - 9a^3 + 4a^2)$
   $= -9a^9 - 9a^8 + 4a^7$

7. $3f^5(-3f^2 - 2f + 1)$
   $= -9f^7 - 6f^6 + 3f^5$

8. $8p^4(-9p^3 - 7p^2 + 3p)$
   $= -72p^7 - 56p^6 + 24p^5$

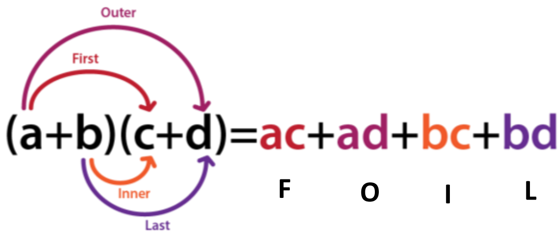
9. $-6r^3(7r^3 - 5r^2 + 4r)$
   $= -42r^6 + 30r^5 - 24r^4$

10. $-2n^3(5n^2 + 7n - 6)$
    $= -10n^5 - 14n^4 + 12n^3$

d) <u>Multiplication – binomials</u>

Video 6: Multiplying Binomials https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:multiply-binomial/v/multiplying-binomials

FOIL (First, Outer, Inner, Last) is used to multiply two binomials. Combine like terms if possible after you multiply.



$$(2x+3)\underbrace{(x-5)}_{\text{Last}} = \underset{F}{2x^2} - \underset{O}{10x} + \underset{I}{3x} - \underset{L}{15}$$

$$= 2x^2 - 7x - 15$$

<u>FOIL practice: (Answers on next page)</u>

1.	$(-x - 4)(x + 4)$	11.	$(-4x - 6)(-x - 1)$
2.	$(-4x + 3)(-7x + 3)$	12.	$(-8x + 2)(-7x - 6)$
3.	$(7x + 8)(2x - 1)$	13.	$(-3x + 2)(-8x - 7)$
4.	$(-4x - 9)(-4x - 3)$	14.	$(-2x + 9)(-4x + 8)$
5.	$(-6x + 9)(-4x - 2)$	15.	$(-3x - 8)(6x + 8)$
6.	$(-5x - 2)(-2x + 7)$	16.	$(4x - 1)(3x + 4)$
7.	$(2x - 1)(-2x + 5)$	17.	$(x + 2)(-8x + 5)$
8.	$(-9x - 8)(x - 8)$	18.	$(8x + 8)(-3x - 9)$
9.	$(-3x + 9)(-4x + 2)$	19.	$(5x - 2)(-8x - 1)$
10.	$(4x + 3)(5x - 6)$	20.	$(-2x - 4)(-8x + 4)$

ANSWERS TO FOIL PRACTICE

1. $(-x - 4)(x + 4)$
   $-x^2 - 8x - 16$

2. $(-4x + 3)(-7x + 3)$
   $28x^2 - 33x + 9$

3. $(7x + 8)(2x - 1)$
   $14x^2 + 9x - 8$

4. $(-4x - 9)(-4x - 3)$
   $16x^2 + 48x + 27$

5. $(-6x + 9)(-4x - 2)$
   $24x^2 - 24x - 18$

6. $(-5x - 2)(-2x + 7)$
   $10x^2 - 31x - 14$

7. $(2x - 1)(-2x + 5)$
   $-4x^2 + 12x - 5$

8. $(-9x - 8)(x - 8)$
   $-9x^2 + 64x + 64$

9. $(-3x + 9)(-4x + 2)$
   $12x^2 - 42x + 18$

10. $(4x + 3)(5x - 6)$
    $20x^2 - 9x - 18$

11. $(-4x - 6)(-x - 1)$
    $4x^2 + 10x + 6$

12. $(-8x + 2)(-7x - 6)$
    $56x^2 + 34x - 12$

13. $(-3x + 2)(-8x - 7)$
    $24x^2 + 5x - 14$

14. $(-2x + 9)(-4x + 8)$
    $8x^2 - 52x + 72$

15. $(-3x - 8)(6x + 8)$
    $-18x^2 - 72x - 64$

16. $(4x - 1)(3x + 4)$
    $12x^2 + 13x - 4$

17. $(x + 2)(-8x + 5)$
    $-8x^2 - 11x + 10$

18. $(8x + 8)(-3x - 9)$
    $-24x^2 - 96x - 72$

19. $(5x - 2)(-8x - 1)$
    $-40x^2 + 11x + 2$

20. $(-2x - 4)(-8x + 4)$
    $16x^2 + 24x - 16$

FACTORING

Factoring implies polynomials are multiplied together. So, a polynomial is factored if it is written as a product.

	In Factored Form	Not in Factored Form
Example 1	$2x(x+y)$	$2x+3y+z$
Example 2	$(x+y)(3x-2y)$	$2(x+y)+z$
Example 3	$(x+4)(x^2+3x-1)$	$(x+y)(2x-y)+5$

Steps to factor:

1) Remove the greatest common factor, GCF, (if it has one other than 1).

2) Remaining steps depend on the number of terms.

- Two terms (binomial),
  try using the difference of two squares: $a^2-b^2=(a+b)(a-b)$

  Note: the sum of two squares does NOT factor.
- Three terms (trinomial), use trial and error or the "ac method."
- Four terms, try factoring by grouping – group the terms in pairs then pull out the greatest common factor from each. Now remove the common factor quantity.

3) To check, multiply the factors together. The result should be the original expression.

Ex. Factor completely:

a) $9x^{10}-18x^8$

b) $x^3+3x^2-4x-12$

c) x^2-x-12

d) $-x^2+5x+6$

e) $2x^2 + 8x + 6$

f) $2x^2 - 7x + 3$

g) $y^4 - y^2 - 12$

AFTER CLASS ON DAY 2, BUT BEFORE DAY 3 OF CLASS COMPLETE THROUGH PAGE 46 (FACTORING, FRACTIONS, SOLVING LINEAR EQUATIONS). YOU WILL BE RESPONSIBLE FOR KNOWING THIS CONTENT FOR THE TEST ON FRIDAY WITH ONLY A CALCULATOR THAT MULTIPLIES, ADDS, SUBRACTS AND DIVIDES (SO REALLY SHOULD BE DOING IT WITHOUT A CALCULATOR) . THE INSTRUCTOR WILL ASSUME YOU KNOW THIS CONTENT FOR CLASS TOMORROW.

a) GCF FACTORING (Greatest Common Factor)

Video 7: GCF Factoring https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-factor/x2ec2f6f830c9fb89:common-factor/v/factoring-and-the-distributive-property-3

Factor Out the GCF

The first step to factoring is to factor out the greatest common factor (GCF) from each term.

Example:

$$12y^3 - 15y^2 + 6y$$

$$2 \times 2 \times \boxed{3 \times y} \times y \times y \qquad 5 \times \boxed{3 \times y} \times y \qquad 2 \times \boxed{3 \times y}$$

$$\boxed{3y}(4y^2 - 5y + 2)$$

GCF Factoring Practice (Answers on next page)

1. $35c^2 - 5c$
2. $54b^2 - 36b$
3. $-48a - 24$
4. $-21a + 27$
5. $-36a - 54$
6. $-54b - 27$
7. $8z - 32$
8. $9b + 9$
9. $-12a^2 + 4a$
10. $-16c + 32$
11. $-14a^2 + 28a$
12. $56a^2 + 40a$
13. $-7c + 35$
14. $12x^2 + 6x$
15. $5b^2 - 20b$
16. $3y^2 - 12y$
17. $16b^2 + 64b$
18. $-12c^2 + 6c$
19. $-24z^2 - 6z$
20. $-6x^2 + 4x$
21. $24c + 48$
22. $40x^2 - 20x$
23. $24c - 48$
24. $-56y - 42$
25. $48x^2 - 24x$
26. $-32a - 32$
27. $5x^2 + 9x$
28. $-28c + 20$
29. $63c + 56$
30. $10x - 5$

GCF Factoring Answers:

1. $35c^2 - 5c$
   $5c(7c - 1)$

2. $54b^2 - 36b$
   $18b(3b - 2)$

3. $-48a - 24$
   $-24(2a + 1)$

4. $-21a + 27$
   $-3(7a - 9)$

5. $-36a - 54$
   $-18(2a + 3)$

6. $-54b - 27$
   $-27(2b + 1)$

7. $8z - 32$
   $8(z - 4)$

8. $9b + 9$
   $9(b + 1)$

9. $-12a^2 + 4a$
   $-4a(3a - 1)$

10. $-16c + 32$
    $-16(c - 2)$

11. $-14a^2 + 28a$
    $-14a(a - 2)$

12. $56a^2 + 40a$
    $8a(7a + 5)$

13. $-7c + 35$
    $-7(c - 5)$

14. $12x^2 + 6x$
    $6x(2x + 1)$

15. $5b^2 - 20b$
    $5b(b - 4)$

16. $3y^2 - 12y$
    $3y(y - 4)$

17. $16b^2 + 64b$
    $16b(b + 4)$

18. $-12c^2 + 6c$
    $-6c(2c - 1)$

19. $-24z^2 - 6z$
    $-6z(4z + 1)$

20. $-6x^2 + 4x$
    $-2x(3x - 2)$

21. $24c + 48$
    $24(c + 2)$

22. $40x^2 - 20x$
    $20x(2x - 1)$

23. $24c - 48$
    $24(c - 2)$

24. $-56y - 42$
    $-14(4y + 3)$

25. $48x^2 - 24x$
    $24x(2x - 1)$

26. $-32a - 32$
    $-32(a + 1)$

27. $5x^2 + 9x$
    $x(5x + 9)$

28. $-28c + 20$
    $-4(7c - 5)$

29. $63c + 56$
    $7(9c + 8)$

30. $10x - 5$
    $5(2x - 1)$

b) Video 8- factoring a binomial as the difference of two squares:
https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-difference-squares/v/difference-of-squares-intro

Difference of Squares

$$a^2 - b^2 = (a+b)(a-b)$$

Examples:

$9x^2 - 16$
$= (3x)^2 - 4^2$
$= (3x+4)(3x-4)$

$4x^2 - 81y^2$
$= (2x)^2 - (9y)^2$
$= (2x+9y)(2x-9y)$

Factoring binomials practice (remember to factor out the GCF first if it is something larger than 1– always! – Answers below.

1) $9x^2 - 1$

2) $4n^2 - 49$

3) $36k^2 - 1$

4) $p^2 - 36$

5) $2x^2 - 18$

6) $196n^2 - 144$

7) $180m^2 - 5$

8) $294r^2 - 150$

9) $150k^2 - 216$

10) $20a^2 - 45$

ANSWERS to factoring binomials

1) $(3x+1)(3x-1)$
2) $(2n+7)(2n-7)$
3) $(6k+1)(6k-1)$
4) $(p+6)(p-6)$
5) $2(x+3)(x-3)$
6) $4(7n+6)(7n-6)$
7) $5(6m+1)(6m-1)$
8) $6(7r+5)(7r-5)$
9) $6(5k+6)(5k-6)$
10) $5(2a+3)(2a-3)$

c) Trial and Error or AC FACTORING METHOD

Video 9 Factoring Trinomials by Trial and Error Method
https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-quadratics-intro/v/factoring-quadratic-expressions

If you are not successful at Trial and Error – here is a video to help you with the AC Grouping Method

Video 10 Factoring Trinomials by Grouping or "AC method" - see d) factoring by grouping

https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-quadratics-grouping/v/factoring-trinomials-by-grouping-4

Factoring Trinomial Practice (answers on next page)

1. $3x^2 + 5x - 2$
2. $4x^2 + 9x - 9$
3. $4x^2 + 15x - 54$
4. $2x^2 + 3x - 14$
5. $4x^2 - 81$
6. $3x^2 - 25x + 8$
7. $2x^2 + 21x + 49$
8. $3x^2 - 19x + 20$
9. $4x^2 - 4x - 63$
10. $3x^2 + 19x + 6$
11. $3x^2 - 20x - 32$
12. $3x^2 - 11x - 4$
13. $2x^2 + 23x + 63$
14. $3x^2 - 20x - 7$
15. $2x^2 + 21x + 27$
16. $4x^2 - 25x + 25$
17. $4x^2 - 5x - 6$
18. $4x^2 - 16x - 9$
19. $4x^2 + 20x + 9$
20. $2x^2 + 21x + 40$

Factoring Trinomial Answers:

1. $3x^2 + 5x - 2$

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

2. $4x^2 + 9x - 9$

   $(x + 3)(4x - 3)$

3. $4x^2 + 15x - 54$

   $(4x - 9)(x + 6)$

4. $2x^2 + 3x - 14$

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

5. $4x^2 - 81$

   $(2x + 9)(2x - 9)$

6. $3x^2 - 25x + 8$

   $(3x - 1)(x - 8)$

7. $2x^2 + 21x + 49$

   $(2x + 7)(x + 7)$

8. $3x^2 - 19x + 20$

   $(3x - 4)(x - 5)$

9. $4x^2 - 4x - 63$

   $(2x - 9)(2x + 7)$

10. $3x^2 + 19x + 6$

    $(x + 6)(3x + 1)$

11. $3x^2 - 20x - 32$

    $(3x + 4)(x - 8)$

12. $3x^2 - 11x - 4$

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

13. $2x^2 + 23x + 63$

    $(x + 7)(2x + 9)$

14. $3x^2 - 20x - 7$

    $(3x + 1)(x - 7)$

15. $2x^2 + 21x + 27$

    $(x + 9)(2x + 3)$

16. $4x^2 - 25x + 25$

    $(x - 5)(4x - 5)$

17. $4x^2 - 5x - 6$

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

18. $4x^2 - 16x - 9$

    $(2x - 9)(2x + 1)$

19. $4x^2 + 20x + 9$

    $(2x + 9)(2x + 1)$

20. $2x^2 + 21x + 40$

    $(2x + 5)(x + 8)$

d) **Factoring by grouping**
https://youtu.be/HXIj16mjfgk

Factor by Grouping Steps

1. Given problem $ab + ac + db + dc$
2. Split into two groups $(ab + ac) \quad + \quad (db + dc)$
3. Factor common term from each group $a(b + c) \quad + \quad d(b + c)$
4. Factor out the common term again $(a + d)(b + c)$

FACTOR BY GROUPING PRACTICE (ANSWERS BELOW)

a. $8x^3 + 2x^2 + 12x + 3$

b. $4x^3 - 6x^2 - 6x + 9$

c. $x^3 + x^2 - x - 1$

d. $3a - 6b + 5a^2 - 10ab$

ANSWERS TO FACTOR BY GROUPING PRACTICE:

a) $(4x+1)(2x^2+3)$ b) $(2x^2 -3)(2x-3)$ c) $(x+1)(x-1)(x+1)$ d) $(3+5a)(a-2b)$

FRACTIONS - You should know these terms

You will need to do fraction computation on the early warning test (for a grade) without a scientific calculator. It is best that you learn your multiplication tables if you don't know them.

But, if you need to, until you learn them, you can use a calculator that only multiples, divides, adds and subtracts. If you do any fractions on a different calculator, then you will not know it for the test!!!

Denominator: Bottom number of a fraction indicating how many parts make a whole.

Difference: The result when two numbers are subtracted.

Divisor: The number after the division sign in a division problem, (i.e. 12÷**7**); or the bottom number of a fraction, (i.e. $\frac{12}{7}$); the number "outside" the division house (i.e. $\mathbf{7}\overline{)12}$).

Equivalent Fraction: Fractions that are found by multiplying the numerators and denominators by the same number.

Factor: Numbers equal to or less than a given number that divides the number evenly. For example, the factors of 12 are 1, 2, 3, 4, 6, 12.

Fraction: Any number written in the form of one whole number over another, $\left(\frac{3}{5}\right)$, indicating number of parts being considered over the number of parts that make one whole.

Fraction Bar: The line separating the numerator and denominator in a fraction, and it indicates division.

Greatest Common Factor (GCF): The largest matching factor of two or more given numbers. It is used to reduce fractions.

Improper Fraction: Any fraction with the numerator larger than the denominator.

Least Common Denominator (LCD): The smallest matching multiple of two or more given numbers. It is used to "boost" fractions. (Also called Least Common Multiple, LCM)

Mixed Number: A whole number and a fraction. (It implies addition of wholes and parts; that is, $3\frac{5}{7}$ is read "three and five sevenths".)

Numerator: The top number of a fraction. It indicates how many parts of a certain size are represented.

Prime Factor: Factors of a number that are only divisible by 1 and the given number. For example, prime factors of 12 are 1 x 2 x 2 x 3. Some frequently used Prime Numbers are 2, 3, 5, 7, 11, 13.

Product: The result when two numbers are multiplied.

Proper Fraction: Any fraction when the numerator is less than the denominator.

Quotient: The solution to a division problem.

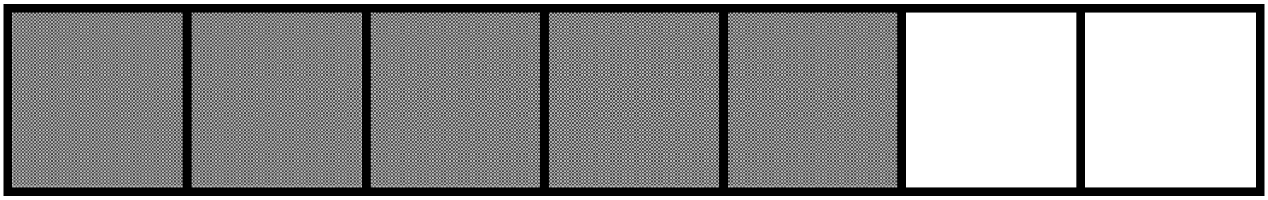
Reducing: Dividing the numerator and the denominator by the same number to get an equivalent fraction. Final answers of most fraction problems should be expressed reduced to "simplest terms"; in other words, the numerator and denominator have no more common factors.

Remainder: The number left after a whole number division problem is complete. When converting an improper fraction to a mixed number, the remainder is the numerator of the fraction.

Sum: the result when two numbers are added.

Whole Number: The Numbers system including 0, 1, 2, 3,….

General Fraction Information



- The fraction that represents the above picture is $\frac{5}{7}$ and is read "five sevenths". That means that five of the parts are shaded, and it would take seven parts of that size to make a whole.

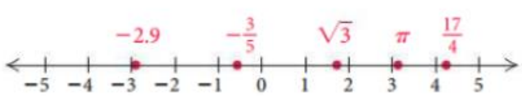
- One whole can be "cut up" into equal size parts; therefore, $1 = \frac{13}{13} = \frac{9}{9} = \frac{123}{123}$, etc.

- A whole number can be written as a fraction with a denominator of 1; for example, $2 = \frac{2}{1}$. Zero can be written as a fraction using zero as the numerator and any whole number as the denominator, for example, $\frac{0}{23}$.

Video 11: ORDERING RATIONAL NUMBERS:

https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-negative-number-topic/x0267d782:ordering-rational-numbers/v/ordering-rational-numbers

The real numbers are modeled using a **number line,** as shown below. Each point on the line represents a real number, and every real number is represented by a point on the line.



The order of the real numbers can be determined from the number line. If a number a is to the left of a number b, then a **is less than** b $(a < b)$. Similarly, a **is greater than** b $(a > b)$ if a is to the right of b on the number line. For example, we see from the number line above that $-2.9 < -\frac{3}{5}$, because -2.9 is to the left of $-\frac{3}{5}$. Also, $\frac{17}{4} > \sqrt{3}$, because $\frac{17}{4}$ is to the right of $\sqrt{3}$.

The statement $a \le b$, read "a is less than or equal to b," is true if either $a < b$ is true or $a = b$ is true. A similar statement holds for $a \ge b$.

Classify the inequality as true or false.

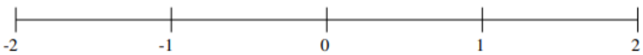
1. $9 < -9$
2. $-10 \le -1$
3. $-\sqrt{26} < -5$
4. $\sqrt{6} \ge \sqrt{6}$
5. $-30 > -25$
6. $-\frac{4}{5} > -\frac{5}{4}$

Answers:

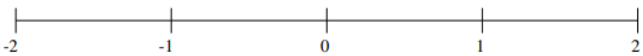
1)F 2) T 3) T 4) T 5) F 6) T

Order and place on number line:

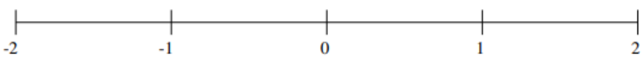
$1\frac{3}{5},\ -1\frac{1}{13},\ -\frac{1}{2},\ -1\frac{13}{23},\ -1\frac{22}{23},\ -\frac{1}{5},\ -\frac{5}{6},\ \frac{3}{19}$



$\frac{11}{12},\ \frac{10}{23},\ -\frac{1}{16},\ -\frac{7}{8},\ -1\frac{1}{2},\ -1\frac{1}{6},\ 1\frac{1}{4},\ 1\frac{6}{7}$



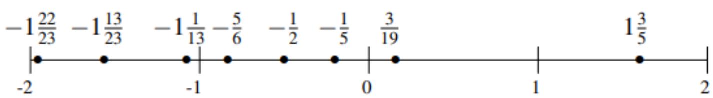
$-\frac{1}{3},\ -\frac{7}{12},\ -1\frac{1}{2},\ 1\frac{3}{4},\ \frac{17}{20},\ -1\frac{1}{8},\ -\frac{4}{5},\ \frac{7}{22}$



ANSWERS:

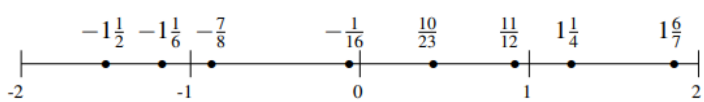
$1\frac{3}{5},\ -1\frac{1}{13},\ -\frac{1}{2},\ -1\frac{13}{23},\ -1\frac{22}{23},\ -\frac{1}{5},\ -\frac{5}{6},\ \frac{3}{19}$

$-1\frac{22}{23},\ -1\frac{13}{23},\ -1\frac{1}{13},\ -\frac{5}{6},\ -\frac{1}{2},\ -\frac{1}{5},\ \frac{3}{19},\ 1\frac{3}{5}$



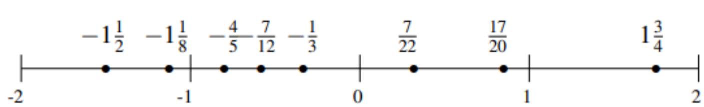
$\frac{11}{12},\ \frac{10}{23},\ -\frac{1}{16},\ -\frac{7}{8},\ -1\frac{1}{2},\ -1\frac{1}{6},\ 1\frac{1}{4},\ 1\frac{6}{7}$

$-1\frac{1}{2},\ -1\frac{1}{6},\ -\frac{7}{8},\ -\frac{1}{16},\ \frac{10}{23},\ \frac{11}{12},\ 1\frac{1}{4},\ 1\frac{6}{7}$



$-\frac{1}{3},\ -\frac{7}{12},\ -1\frac{1}{2},\ 1\frac{3}{4},\ \frac{17}{20},\ -1\frac{1}{8},\ -\frac{4}{5},\ \frac{7}{22}$

$-1\frac{1}{2},\ -1\frac{1}{8},\ -\frac{4}{5},\ -\frac{7}{12},\ -\frac{1}{3},\ \frac{7}{22},\ \frac{17}{20},\ 1\frac{3}{4}$



Mixed Numbers

To convert a mixed number, $5\frac{2}{7}$, to an improper fraction, $\frac{37}{7}$:

Numerator

Whole Number $\longrightarrow$ $5\frac{2}{7} = \frac{37}{7}$

Denominator

$5\frac{2}{7}$	Work in a clockwise direction, beginning with the denominator, (7).
$5 \times 7 = 35$	Multiply the denominator (7) by the whole number, (5)
$35 + 2 = 37$	Add that product, (35), to the numerator (2) of the fraction.
$\frac{(5\times7)+2}{7} = \frac{37}{7}$	The denominator remains the same for the mixed number and the improper fraction.

VIDEO 12: Converting between mixed numbers and improper fractions:

https://www.khanacademy.org/math/cc-fourth-grade-math/imp-fractions-2/imp-mixed-numbers/v/changing-a-mixed-number-to-an-improper-fraction

Convert to Improper Fractions:

1) $4\frac{2}{5} =$

2) $5\frac{3}{8} =$

3) $2\frac{4}{9} =$

4) $5\frac{6}{7} =$

5) $8\frac{1}{8} =$

6) $14\frac{3}{4} =$

7) $6\frac{3}{5} =$

8) $9\frac{1}{10} =$

9) $16\frac{1}{2} =$

10) $8\frac{0}{1} =$

11) $9 =$
Hint: See #10

12) $7\frac{3}{4} =$

13) $12\frac{5}{9} =$

14) $10\frac{3}{8} =$

15) $28\frac{2}{3} =$

Try all of these and check your answers on page 43 of this packet

Finding Equivalent Fractions with Larger Denominators

This process is sometimes called "**Boosting**"

$$Example: \frac{5}{8} = \frac{?}{56}$$

$56 \div 8 = 7$	Divide the larger denominator by the smaller to find the factor used to multiply the denominator. (Note: The product of the smaller denominator and the factor is the larger denominator)
$\frac{5}{8} \times \frac{7}{7} = \frac{5 \times 7}{8 \times 7}$	Use this factor to multiply the numerator.
$\frac{5}{8} = \frac{35}{56}$	The result is two equivalent fractions.

Note: Equal denominators are required for addition and subtraction of fractions.

Video 13: Finding Equivalent Fractions

https://www.khanacademy.org/math/cc-fourth-grade-math/comparing-fractions-and-equivalent-fractions

Find the equivalent fractions as indicated:

1) $\frac{2}{5} = \frac{\quad}{15}$

2) $\frac{3}{8} = \frac{\quad}{32}$

3) $\frac{4}{9} = \frac{\quad}{54}$

4) $\frac{6}{7} = \frac{\quad}{49}$

5) $\frac{1}{8} = \frac{\quad}{48}$

6) $\frac{3}{4} = \frac{\quad}{44}$

7) $\frac{3}{5} = \frac{\quad}{45}$

8) $\frac{1}{10} = \frac{\quad}{60}$

9) $\frac{1}{2} = \frac{\quad}{28}$

10) $\frac{10}{100} = \frac{\quad}{700}$

11) $\frac{8}{9} = \frac{\quad}{81}$

12) $\frac{3}{4} = \frac{\quad}{68}$

13) $\frac{5}{9} = \frac{\quad}{108}$

14) $\frac{3}{8} = \frac{\quad}{112}$

15) $\frac{2}{3} = \frac{\quad}{462}$

Try all of these and check your answers on page 43 of this packet

Equivalent Fractions with Smaller Denominators

Reducing Fractions

Example: Reduce the following fraction to lowest terms

$$\frac{90}{105}$$

There are **three** common **methods,** DO NOT mix steps of the methods!

Method 1:

$$\frac{90 \div 15}{105 \div 15} = \frac{6}{7}$$

The Greatest Common Factor for 90 and 105 is 15. Divide the numerator and the denominator by the GCF, 15.

Method 2:

$$\frac{90 \div 5}{105 \div 5} = \frac{18}{21}$$

Examine the numerator and denominator for any common factors, divide both numerator and denominator by that common factor. Repeat as needed.

- Both 90 and 105 are divisible by 5.

$$\frac{18 \div 3}{21 \div 3} = \frac{6}{7}$$

- Both 18 and 21 are divisible by 3.

Method 3:

$$\frac{90}{105} = \frac{2 \times 3 \times 3 \times 5}{7 \times 3 \times 5}$$

Express the numerator and denominator as a product of prime factors.

$$\frac{90}{105} = \frac{2 \times 3 \times (3 \times 5)}{7 \times (3 \times 5)}$$

Divide numerator and denominator by common factors, (3x5)

$$= \frac{2 \times 3}{7} = \frac{6}{7}$$

Multiply remaining factors.

Video 14: Simplifying Fractions: https://www.youtube.com/watch?v=WPimvspl0_c

Reduce these fractions.

1) $\frac{28}{50} =$

5) $\frac{32}{48} =$

9) $\frac{36}{216} =$

2) $\frac{8}{24} =$

6) $\frac{36}{54} =$

10) $\frac{35}{42} =$

3) $\frac{30}{54} =$

7) $\frac{14}{56} =$

11) $12\frac{54}{99} =$

4) $\frac{18}{42} =$

8) $\frac{18}{28} =$

12) $15\frac{280}{320} =$

Try all of these and check your answers on page 43 of this packet

Improper Fractions

Example: Convert $\frac{14}{3}$ to a mixed number

$14 \div 3 = 4$
Remainder 2

Remember: Dividend $\div$ Divisor = Quotient
Divide the numerator (14) by the denominator (3).

$\frac{14}{3} = 4\frac{2}{3}$

Write the mixed number in the form: $Quotient\frac{remainder}{divisor}$

Note: Check you answer to see if you can reduce the fraction.

Video 15: Converting to mixed numbers: https://www.khanacademy.org/math/cc-fourth-grade-math/imp-fractions-2/imp-mixed-numbers/v/changing-an-improper-fraction-to-a-mixed-number

Convert these improper fractions to mixed numbers. ***Be sure to reduce when it's possible.***

#11, 12 Hint: how many wholes will there be?

1) $\frac{8}{5} =$

6) $\frac{114}{5} =$

11) $15\frac{280}{6} =$

2) $\frac{18}{7} =$

7) $\frac{128}{3} =$

12) $8\frac{315}{3} =$

3) $\frac{37}{9} =$

8) $\frac{401}{3} =$

13) $\frac{54}{8} =$

4) $\frac{127}{5} =$

9) $\frac{36}{6} =$

14) $\frac{26}{8} =$

5) $\frac{32}{9} =$

10) $\frac{235}{2} =$

15) $\frac{258}{9} =$

Try all of these and check your answers on page 43 of this packet

Least Common Multiple (LCM)

Used to find the Least Common Denominator (LCD)

Example: Find the LCM of 30 and 45

Note: There are **four** common **methods**; DO NOT mix the steps of the methods!

Method 1

30, 60, **90**, 120, … 45, **90**, 135, …	*Remember that multiples are equal to or larger than the given number.* List the multiples of each of the given numbers, in ascending order.
LCM = 90	The LCM is the first multiple common to both lists.

Method 2

45, 90, 135, …	List the multiples of the larger number.
$45 \div 30$ remainder	Divide each in turn by the smaller.
$90 \div 30$ no remainder LCM = 90	The LCM is the multiple that the smaller number divides without leaving a remainder.

Method 3

$30 \div 5 = 6$; $45 \div 5 = 9$ $6 \div 3 = 2$; $9 \div 3 = 3$	Divide both numbers by any common factor, (5 then 3). Continue until there are no more common factors. *Note: 2 and 3, the results of the last division have no common factors.*
LCM = $5 \times 3 \times 2 \times 3$ = 90	The LCM equals the product of the factors, (5 and 3) and the remaining quotients, (2 and 3).

Method 4

30 45 5 x 6 5 x 9 5 x 2 x 3 5 x 3 x 3	Find the prime factors of each the given numbers.
$30 = 5 \times 2 \times 3$ $45 = 5 \times 3 \times 3$ **Or** $45 = 5 \times 3^2$	Write each number as a product of primes using exponents, if required.
LCM = $2 \times 3^2 \times 5$ = 90	LCM equals the product of all the factors to the highest power.

Video 16: Finding the LCM https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-expressions-and-variables/cc-6th-lcm/v/least-common-multiple-exercise

In each exercise, find the LCM of the given numbers.

1) 4 and 18

7) 50 and 75

2) 16 and 40

8) 24 and 30

3) 20 and 28

9) 36 and 45

4) 5 and 8

10) 8 and 20

5) 12 and 18

11) 16 and 20

6) 12 and 16

12) 28, 35, and 21

Try all of these and check your answers on page 43 of this packet

Addition and Subtraction of Fractions with the Same Denominator

To add or subtract fractions, the denominators MUST be the same.

Example 1:

$$\frac{3}{5}-\frac{1}{5}=?$$

$$\frac{3}{5}-\frac{1}{5}=\frac{3-1}{5}$$

$$=\frac{2}{5}$$

Because both fractions have the same denominator, you may subtract the numerators and keep the denominator.

*****All final answers which are fractions should be reduced (not have a common factor in the numerator and denominator*******

Add or Subtract as indicated.

1. $\frac{4}{8}+\frac{3}{8}$
2. $\frac{7}{10}-\frac{1}{10}$
3. $\frac{7}{48}+\frac{9}{48}+\frac{4}{48}$
4. $\frac{40}{37}-\frac{3}{37}$
5. $\frac{10}{13}+\frac{4}{13}$
6. $\frac{9}{17}+\frac{11}{17}+\frac{17}{17}$
7. $\frac{2}{3}+\frac{4}{3}-\frac{6}{3}$
8. $\frac{7}{6}-\frac{5}{6}+\frac{1}{6}$
9. $\frac{7}{13}+\frac{9}{13}$

Try all of these and check your answers on page 44 of this packet

Addition and Subtraction of Fractions with Different Denominators

Remember: In order to add or subtract fractions, the denominators MUST be the same.

Example:

$$\frac{2}{3}+\frac{3}{8}=?$$

LCM = 24	Find the LCM
$\frac{2}{3}\times\frac{8}{8}=\frac{16}{24}$	Write the problem vertically.
$+\ \frac{3}{8}\times\frac{3}{3}=\frac{9}{24}$	Find the equivalent fractions with the LCM as a denominator.
$\frac{25}{24}$	Add the fractions with the same denominator.

*****All final answers which are fractions should be reduced (not have a common factor in the numerator and denominator*******

Video 17: Adding and Subtracting Fractions with Different Denominators:

https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-negative-numbers-add-and-subtract#cc-7th-add-sub-neg-fractions

Add or Subtract:

1) $\frac{7}{8}+\frac{3}{4}$

5) $\frac{15}{24}-\frac{10}{27}$

9) $\frac{11}{4}+\frac{23}{18}$

2) $\frac{7}{8}-\frac{3}{4}$

6) $\frac{7}{12}+\frac{5}{16}$

10) $\frac{29}{8}+\frac{9}{7}$

3) $\frac{11}{12}+\frac{17}{18}$

7) $\frac{16}{27}-\frac{5}{24}$

11) $2\frac{13}{35}-1\frac{5}{14}$

4) $\frac{3}{7}+\frac{2}{5}$

8) $1\frac{1}{4}+\frac{3}{8}$

12) $\frac{2}{3}+\frac{1}{21}-\frac{2}{7}$

Try all of these and check your answers on page 44 of this packet

Multiplication of Fractions

Example:

$$\frac{3}{10} \times 3\frac{5}{6}$$

Note: LCD is not needed to multiply fractions.

$3\frac{5}{6} = \frac{(6 \times 3) + 5}{6}$ Change mixed numbers to improper fractions

$\frac{3}{10} \times \frac{23}{6} = \frac{1 \times 23}{10 \times 2}$ Before multiplying, reduce by dividing any numerator with any denominator with a common factor. (3 and 6 have a common factor of 3)

$\frac{1 \times 23}{10 \times 2} = \frac{23}{20}$ Multiply numerators and denominators

Video 18: Multiplying Fractions https://www.khanacademy.org/math/cc-fifth-grade-math/5th-multiply-fractions/imp-multiplying-fractions/v/multiplying-fractions

---

Multiply:

1) $4\frac{1}{2} \times \frac{2}{3}$

2) $3\frac{1}{5} \times 1\frac{1}{4}$

3) $6 \times 1\frac{1}{9}$

4) $2\frac{1}{6} \times 1\frac{1}{2}$

5) $\frac{10}{11} \times 1\frac{7}{15}$

6) $4\frac{3}{5} \times 15$

7) $3\frac{3}{8} \times 2\frac{2}{9}$

8) $34 \times 2\frac{3}{17}$

9) $9\frac{7}{8} \times \frac{4}{5}$

10) $7\frac{9}{10} \times 1\frac{1}{4}$

11) $18 \times 1\frac{3}{7} \times \frac{4}{15}$

12) $3\frac{1}{5} \times 1\frac{5}{6} \times \frac{3}{8}$

Try all of these and check your answers on page 44 of this packet

Division of Fractions

Example:

$$2\frac{3}{4} \div 2\frac{3}{8} \qquad \textbf{OR} \qquad \frac{2\frac{3}{4}}{2\frac{3}{8}}$$

Note: One fraction divided by another may be expressed in either way shown above. Also, LCD is not needed to divide fractions.

$2\frac{3}{4} = \frac{11}{4}$ and $2\frac{3}{8} = \frac{19}{8}$ — Convert mixed numbers to improper fractions

$\frac{11}{4} \div \frac{19}{8} = \frac{11}{4} \times \frac{8}{19}$ — Invert the divisor $\left(\frac{19}{8}\right)$. (Turn the fraction after the division sign upside down)

$\frac{11 \times 8}{4 \times 19} = \frac{11 \times 2}{1 \times 19}$ — Reduce if possible. (4 and 8 have a common factor)

$\frac{11 \times 2}{1 \times 19} = \frac{22}{19}$ — Multiply numerators and denominators

Video 19: https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-arithmetic-operations/cc-6th-dividing-fractions/v/dividing-fractions-example

Divide these fractions. Reduce to lowest terms!

1) $\frac{5}{6} \div \frac{1}{2}$

2) $\frac{3}{4} \div \frac{3}{7} =$

3) $3 \div 1\frac{2}{5} =$

4) $\frac{\frac{1}{2}}{\frac{1}{3}} =$

5) $\frac{1}{2} \div 6 =$

6) $2\frac{1}{4} \div 3 =$

7) $3\frac{1}{7} \div 2\frac{5}{14} =$

8) $\frac{2\frac{5}{8}}{1\frac{7}{8}}$

9) $4\frac{1}{2} \div 1\frac{3}{4} =$

Try all of these and check your answers on page 44 of this packet

Now, try some mixed problems, which will now include some negative fractions (Answers on next page)

Calculate the answer to each question.

1. $\frac{48}{19} - \left(-\frac{31}{11}\right)$

2. $\frac{1}{2} - \left(-\frac{15}{8}\right)$

3. $\frac{11}{10} \div \frac{1}{2}$

4. $\frac{16}{15} \times \frac{18}{11}$

5. $\frac{13}{11} - \left(-\frac{1}{7}\right)$

6. $\left(-\frac{3}{7}\right) \div \left(-\frac{14}{11}\right)$

7. $\left(-\frac{1}{2}\right) \times \frac{20}{7}$

8. $\frac{11}{5} + \frac{1}{11}$

9. $\left(-\frac{5}{9}\right) + \frac{5}{6}$

10. $\left(-\frac{36}{19}\right) + \left(-\frac{45}{19}\right)$

ANSWERS TO FRACTION OPERATIONS WITH SIGNED RATIONAL NUMBERS

1. $\frac{48}{19} - \left(-\frac{31}{11}\right)$

$\frac{1117}{209}$

2. $\frac{1}{2} - \left(-\frac{15}{8}\right)$

$\frac{19}{8}$

3. $\frac{11}{10} \div \frac{1}{2}$

$\frac{11}{5}$

4. $\frac{16}{15} \times \frac{18}{11}$

$\frac{96}{55}$

5. $\frac{13}{11} - \left(-\frac{1}{7}\right)$

$\frac{102}{77}$

6. $\left(-\frac{3}{7}\right) \div \left(-\frac{14}{11}\right)$

$\frac{33}{98}$

7. $\left(-\frac{1}{2}\right) \times \frac{20}{7}$

$-\frac{10}{7}$

8. $\frac{11}{5} + \frac{1}{11}$

$\frac{126}{55}$

9. $\left(-\frac{5}{9}\right) + \frac{5}{6}$

$\frac{5}{18}$

10. $\left(-\frac{36}{19}\right) + \left(-\frac{45}{19}\right)$

$-\frac{81}{19}$

Answers to Fractions Competency Packet

p. 31		p. 32		p. 33		p. 34		p. 36	
1)	$\frac{22}{5}$	1)	6	1)	$\frac{14}{25}$	1)	$1\frac{3}{5}$	1)	36
2)	$\frac{43}{8}$	2)	12	2)	$\frac{1}{3}$	2)	$2\frac{4}{7}$	2)	80
3)	$\frac{22}{9}$	3)	24	3)	$\frac{5}{9}$	3)	$4\frac{1}{9}$	3)	140
4)	$\frac{41}{7}$	4)	42	4)	$\frac{3}{7}$	4)	$25\frac{2}{5}$	4)	40
5)	$\frac{65}{8}$	5)	6	5)	$\frac{2}{3}$	5)	$3\frac{5}{9}$	5)	36
6)	$\frac{59}{4}$	6)	33	6)	$\frac{2}{3}$	6)	$22\frac{4}{5}$	6)	48
7)	$\frac{33}{5}$	7)	27	7)	$\frac{1}{4}$	7)	$42\frac{2}{3}$	7)	150
8)	$\frac{91}{10}$	8)	6	8)	$\frac{9}{14}$	8)	$133\frac{2}{3}$	8)	120
9)	$\frac{33}{2}$	9)	14	9)	$\frac{1}{6}$	9)	6	9)	180
10)	$\frac{8}{1}$	10)	70	10)	$\frac{5}{6}$	10)	$117\frac{1}{2}$	10)	40
11)	$\frac{9}{1}$	11)	72	11)	$12\frac{6}{11}$	11)	$61\frac{2}{3}$	11)	80
12)	$\frac{31}{4}$	12)	51	12)	$15\frac{7}{8}$	12)	113	12)	420
13)	$\frac{113}{9}$	13)	60			13)	$6\frac{3}{4}$		
14)	$\frac{83}{8}$	14)	42			14)	$3\frac{1}{4}$		
15)	$\frac{86}{3}$	15)	308			15)	$28\frac{2}{3}$		

p. 37		p. 38	
1)	$\frac{7}{8}$	1)	$1\frac{5}{8}$
2)	$\frac{3}{5}$	2)	$\frac{1}{8}$
3)	$\frac{5}{12}$	3)	$1\frac{31}{36}$
4)	1	4)	$\frac{29}{35}$
5)	$1\frac{1}{13}$	5)	$\frac{55}{216}$
6)	$2\frac{3}{17}$	6)	$\frac{43}{48}$
7)	$\frac{0}{3}$	7)	$\frac{83}{216}$
8)	$\frac{1}{2}$	8)	$1\frac{5}{8}$
9)	$1\frac{3}{13}$	9)	$4\frac{1}{36}$
		10)	$4\frac{51}{56}$
		11)	$1\frac{1}{70}$
		12)	$\frac{3}{7}$

p. 39		p. 40	
1)	3	1)	$1\frac{2}{3}$
2)	4	2)	$1\frac{3}{4}$
3)	$6\frac{2}{3}$	3)	$2\frac{1}{7}$
4)	$3\frac{1}{4}$	4)	$1\frac{1}{2}$
5)	$1\frac{1}{3}$	5)	$\frac{1}{12}$
6)	69	6)	$\frac{3}{4}$
7)	$7\frac{1}{2}$	7)	$1\frac{1}{3}$
8)	74	8)	$1\frac{2}{5}$
9)	$7\frac{9}{10}$	9)	$2\frac{4}{7}$
10)	$9\frac{7}{8}$		
11)	$6\frac{6}{7}$		
12)	$2\frac{1}{5}$		

SOLVING LINEAR EQUATIONS (no fractions):

1) Clear any parentheses using the distributive property
2) Collect like terms on the left side and then on the right side
3) Using addition and subtraction, get all variable (letter) terms on one side and all constants (numbers only) on the other.
4) Divide each side by the coefficient of the variable.

Video 20 Solving Linear Equations: https://www.khanacademy.org/math/algebra-home/alg-basic-eq-ineq/alg-old-school-equations/v/algebra-linear-equations-1
(this video starts you out with level one equations, click through linear-equations-2 through 4 to advance through multistep linear equations).

Example:	Example:
3(x + 1) = 5 + x	2(x + 2) – 5 = 3(x + 1)
3x + 3 = 5 + x	2x – 1 = 3x + 3
2x + 3 = 5	-x – 1 = 3
2x = 2	-x = 4
x = 1	x = -4

Practice solving multi-step linear equations (Answers on next page)

1. $2(3-h)-6=-5h$	11. $2(3x-2)+9=-5x$
2. $7+9d=7d+3$	12. $3(1+p)=-5(p+1)$
3. $-2(4+3y)=-2(4+y)$	13. $3(1-3g)=-7+g$
4. $-7+4c=7c+6$	14. $1+2b=4b+9$
5. $5(1+s)=-9s+6$	15. $2z+6=3z+1$
6. $3+v=2(2v-1)$	16. $5a-2=-9a+8$
7. $-2-4w=7w-8$	17. $6t-5=-9t-9$
8. $-6(1-m)=9-2m$	18. $-1+3f=-7-6f$
9. $-2q-3=-2(2q+1)$	19. $2+r=7+6r$
10. $6n+7=2n+5$	20. $-6k+1=-2+7k$

SOLVING LINEAR EQUATION ANSWERS:

1. $2(3-h)-6=-5h$
   $h=0$
2. $7+9d=7d+3$
   $d=-2$
3. $-2(4+3y)=-2(4+y)$
   $y=0$
4. $-7+4c=7c+6$
   $c=-4\frac{1}{3}$
5. $5(1+s)=-9s+6$
   $s=\frac{1}{14}$
6. $3+v=2(2v-1)$
   $v=1\frac{2}{3}$
7. $-2-4w=7w-8$
   $w=\frac{6}{11}$
8. $-6(1-m)=9-2m$
   $m=1\frac{7}{8}$
9. $-2q-3=-2(2q+1)$
   $q=\frac{1}{2}$
10. $6n+7=2n+5$
    $n=-\frac{1}{2}$
11. $2(3x-2)+9=-5x$
    $x=-\frac{5}{11}$
12. $3(1+p)=-5(p+1)$
    $p=-1$
13. $3(1-3g)=-7+g$
    $g=1$
14. $1+2b=4b+9$
    $b=-4$
15. $2z+6=3z+1$
    $z=5$
16. $5a-2=-9a+8$
    $a=\frac{5}{7}$
17. $6t-5=-9t-9$
    $t=-\frac{4}{15}$
18. $-1+3f=-7-6f$
    $f=-\frac{2}{3}$
19. $2+r=7+6r$
    $r=-1$
20. $-6k+1=-2+7k$
    $k=\frac{3}{13}$

EXPONENTS:

Definitions and Rules for Exponents

1) Product Rule: $a^m \cdot a^n = a^{m+n}$

2) Quotient Rule: $\frac{a^m}{a^n} = a^{m-n}$ for $a \neq 0$.

3) Zero Exponent: $a^0 = 1$ for $a \neq 0$.

4) Negative Exponent: $a^{-n} = \frac{1}{a^n}$ for $a \neq 0$.

5) Power Rules:

a) $(a^m)^n = a^{mn}$

b) $(ab)^m = a^m b^m$

C) $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$ for $b \neq 0$.

6)Special Rules

a. $\frac{1}{a^{-n}} = a^n$ for $a \neq 0$.

b. $\frac{a^{-n}}{b^{-m}} = \frac{b^m}{a^n}$ for $a, b \neq 0$.

c. $\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$ for $a, b \neq 0$.

Ex. Some students have trouble deciding when to multiply exponents and when to add exponents.

Show why $x^4 * x^3 = x^7$ and why $(x^4)^3 = x^{12}$

Video 21 Negative exponents: https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-pos-neg-exponents/v/negative-exponents#:~:text=A%20positive%20exponent%20tells%20us,2%E2%81%B4)%20%3D%201%2F16.

Video 22 Product and Power Rules: https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-exponent-properties/v/exponent-properties-involving-products

Video 23 Quotient Rule: https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-exponent-properties/v/exponent-properties-involving-quotients

Video 24: Exponent Properties with parentheses https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-exponent-properties/v/products-and-exponents-raised-to-an-exponent-properties

Ex. Simplify. Write each expression with only positive exponents. Simplify.

1. 7^{-2}

3. $2^{-1}+8^{-1}$

2. $(5t)^{-3}$

4. $5t^{-3}$

5. $\dfrac{1}{3^{-3}}$

7. $\left(\dfrac{3}{2}\right)^{-3}$

6. $\dfrac{3^{-3}}{2^{-2}}$

Write each result with only positive exponents.

8. $\dfrac{5^9}{5^7}$

9. $\dfrac{s^{-4}}{s^{-8}}$

Ex. Simplify. Write answers with positive exponents.

1) -2^2+3^{-1}

2) $3a^2(-5a^{-6})(2a)^0$

3) $(8s^4t)(3s^3t^5)$

4) $\dfrac{12k^{-2}(k^{-3})^{-4}}{6k^5}$

5) $\dfrac{(-2x^5)^2 y^{-3} z}{x^{-7} y^{-2} z^5}$

6) $(2x)^{-3}(5x^{-2})^{-4}$

AFTER CLASS, BUT BEFORE THE TEST, WORK THROUGH THE REST OF THIS PACKET. BE PREPARED!

Exponent Practice (Answers on next page)

Simplify. Your answer should contain only positive exponents.

1) $4a^2b^0 \cdot 4ab^2$

2) $2y \cdot 3x^{-1}y^4$

3) $\left(4m^{-1}n^2\right)^3$

4) $\left(3m^3n^{-4}\right)^{-1}$

5) $\dfrac{4x^4y^{-4}}{2x^3y^2}$

6) $\dfrac{4x^0y^{-2}}{4xy^{-4}}$

7) $2yx^{-1} \cdot \left(x^2\right)^3$

8) $\left(u^3\right)^3 \cdot 2v^4$

9) $\dfrac{3u^4v^2 \cdot 3u^3v^4}{u^4v^2}$

10) $\dfrac{3x^{-3}y^2 \cdot x^{-4}y^{-4}}{3xy^2 \cdot 3yx^{-1}}$

11) $\dfrac{\left(y^{-2}\right)^3}{2x^{-4}}$

12) $\left(\dfrac{2a^3b^{-2}}{b^3}\right)^2$

13) $\dfrac{m^4n^{-3} \cdot mn}{\left(n^2\right)^{-1}}$

14) $\dfrac{\left(yx^{-3}\right)^0}{y^4 \cdot 2y^3}$

Properties of Exponents

Simplify. Your answer should contain only positive exponents.

1) $4a^2b^0 \cdot 4ab^2$

$16a^3b^2$

2) $2y \cdot 3x^{-1}y^4$

$\frac{6y^5}{x}$

3) $(4m^{-1}n^2)^3$

$\frac{64n^6}{m^3}$

4) $(3m^3n^{-4})^{-1}$

$\frac{n^4}{3m^3}$

5) $\frac{4x^4y^{-4}}{2x^3y^2}$

$\frac{2x}{y^6}$

6) $\frac{4x^0y^{-2}}{4xy^{-4}}$

$\frac{y^2}{x}$

7) $2yx^{-1} \cdot (x^2)^3$

$2yx^5$

8) $(u^3)^3 \cdot 2v^4$

$2u^9v^4$

9) $\frac{3u^4v^2 \cdot 3u^3v^4}{u^4v^2}$

$9u^3v^4$

10) $\frac{3x^{-3}y^2 \cdot x^{-4}y^{-4}}{3xy^2 \cdot 3yx^{-1}}$

$\frac{1}{3x^7y^5}$

11) $\frac{(y^{-2})^3}{2x^{-4}}$

$\frac{x^4}{2y^6}$

12) $\left(\frac{2a^3b^{-2}}{b^3}\right)^2$

$\frac{4a^6}{b^{10}}$

13) $\frac{m^4n^{-3} \cdot mn}{(n^2)^{-1}}$

m^5

14) $\frac{(yx^{-3})^0}{y^4 \cdot 2y^3}$

$\frac{1}{2y^7}$

Simplifying Radicals

Radical	Name	Simplified Form
$\sqrt{36}$	"Square root of thirty-six" "Radical thirty-six"	$\sqrt{36} = \sqrt{6 \cdot 6} = 6$
$\sqrt{100}$	"Square root of one hundred" "Radical one hundred"	$\sqrt{100} = \sqrt{10 \cdot 10} = 10$

Radical	Principal Root	Opposite Radical	Opposite Root
$\sqrt{36}$	$\sqrt{6 \cdot 6} = 6$	$-\sqrt{36}$	$-\sqrt{6 \cdot 6} = -6$
$\sqrt{100}$	$\sqrt{10 \cdot 10} = 10$	$-\sqrt{100}$	$-\sqrt{10 \cdot 10} = -10$
$\sqrt{225}$	$\sqrt{15 \cdot 15} = 15$	$-\sqrt{225}$	$-\sqrt{15 \cdot 15} = -15$

Video 25 cube roots https://www.khanacademy.org/math/class-8-math-assamese/x6508f27e90d41441:cubes-and-cube-roots/x6508f27e90d41441:cube-roots-using-factorisation/v/introduction-to-cube-roots

Square root, cube root, and higher root practice – Again, only use the 4 function calculator. But, it is best not to need a calculator for the following. Remember, there is no cube root button on your 4 function calculator!

1 a. $\sqrt{49} \times \sqrt{49}$	**1 b.** $(\sqrt{16})^2$
2 a. $\sqrt{2 \times 8}$	**2 b.** $\sqrt{36} - \sqrt{81}$
3 a. $\sqrt{91 - 27}$	**3 b.** $\sqrt{\frac{490}{10}}$
4 a. $\sqrt{24^2}$	**4 b.** $\sqrt{49} + \sqrt{100}$

5 a. $\sqrt{49+0}$	**5 b.** $\sqrt{9} \times \sqrt{49}$
6 a. $\dfrac{\sqrt{100}}{\sqrt{4}}$	**6 b.** $(\sqrt{100})^2$

7a. $\sqrt[3]{64}$	7b. $\sqrt[3]{-64}$
8a. $-\sqrt[3]{8}$	8b. $\sqrt[4]{81}$
9a. $\sqrt[4]{-81}$	9b. $\sqrt[3]{125}-\sqrt[4]{16}$
10a. $\frac{\sqrt[5]{32}}{4}$	10b. $\sqrt[3]{\frac{27}{8}}$

Answer Key

1 a. 49	**1 b.** 16
2 a. 4	**2 b.** -3
3 a. 8	**3 b.** 7
4 a. 24	**4 b.** 17
5 a. 7	**5 b.** 21
6 a. 5	**6 b.** 100

7a. 4	7b. -4
8a. -2	8b. 3
9a. Not a real number	9b. 3
10a. 1/2	10b. 3/2

A Product Raised to a Power Rule
or sometimes called
The Square Root of a Product Rule

For any numbers *a* and *b*, $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$.

For example: $\sqrt{100} = \sqrt{10} \cdot \sqrt{10}$, and $\sqrt{75} = \sqrt{25} \cdot \sqrt{3}$

Simplify Square Roots

Two Different Methods to find the square root of 48

Find Perfect Square	Find Prime Factors
$\sqrt{48} = \sqrt{16} \times \sqrt{3}$	$\sqrt{48} = \sqrt{2 \times 2 \times 2 \times 2 \times 3}$
$= 4 \times \sqrt{3}$	$= \sqrt{2 \times 2} \times \sqrt{2 \times 2} \times \sqrt{3}$
$= 4\sqrt{3}$	$= 2 \times 2 \times \sqrt{3}$
	$= 4 \times \sqrt{3}$
	$= 4\sqrt{3}$

Video 26 Simplifying Square Roots: https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:rational-exponents-radicals/x2f8bb11595b61c86:simplifying-square-roots/v/simplifying-square-roots-1

Simplify if possible. Give in EXACT form (no decimals) Answers on next page

1 a. $\sqrt{98}$ **1 b.** $\sqrt{142}$

2 a. $\sqrt{54}$ **2 b.** $\sqrt{90}$

3 a. $\sqrt{181}$ **3 b.** $\sqrt{112}$

4 a. $\sqrt{48}$ **4 b.** $\sqrt{80}$

5 a. $\sqrt{132}$ **5 b.** $\sqrt{138}$

6a. $\sqrt{3} \cdot \sqrt{3}$ **6b.** $\sqrt{10} \cdot \sqrt{20}$

7a. $2\sqrt{3} * \sqrt{15}$ **7b.** $-5\sqrt{4} \cdot 2\sqrt{12}$

Simplifying Radical Answers

1 a.	$7\sqrt{2}$	**1 b.**	$\sqrt{142}$
2 a.	$3\sqrt{6}$	**2 b.**	$3\sqrt{10}$
3 a.	$\sqrt{181}$	**3 b.**	$4\sqrt{7}$
4 a.	$4\sqrt{3}$	**4 b.**	$4\sqrt{5}$
5 a.	$2\sqrt{33}$	**5 b.**	$\sqrt{138}$
6a.	**3**	**6b.**	$\mathbf{10\sqrt{2}}$
7a.	$\mathbf{6\sqrt{5}}$	**7b.**	$\mathbf{-40\sqrt{3}}$