MAT 011 - Review Practice B Name ________________________

Text Sections 1.4 & 1.8

Read through the following information to review the order of mathematical operations, variable expressions and the properties of real numbers used to simplify algebraic expressions and equations. Fill in the missing values in the blanks provided for the ***You Try It Problems***.

Order of Operations: A common technique for remembering the order of mathematical operations is the abbreviation **PEMDAS** (***P****lease* ***E****xcuse* ***M****y* ***D****ear* ***A****unt* ***S****ally).*
The abbreviation stands for the following:

P First, simplify expressions inside **Parentheses** (Grouping Symbols).

- Grouping symbols can include Parentheses ( ), Brackets [ ] or { }, and Absolute Value Bars | |.
- If multiple grouping symbols are included, then start with the innermost set.
- The order of operations also applies while simplifying inside the grouping symbols.
- A fraction bar implies grouping, so simplify the numerator and the denominator separately.

E Next, simplify any **Exponents**.

- Exponents can include Powers 7^2, and Radicals $\sqrt{4}$.
- In the expression 2^3, 2 is the base and 3 is the exponent so $2^3 = 2 \cdot 2 \cdot 2 = 8$.
- Be careful when evaluating an exponential expression with a negative base. For example:

$(-3)^4 = (-3)(-3)(-3)(-3) = 81$ — Since the negative sign is inside the parentheses the entire base (– 3) is multiplied by itself 4 times.

$-3^4 = -(3)^4 = -(3)(3)(3)(3) = -81$ — Since the negative sign is NOT inside the parentheses it means the base 3 is multiplied by itself 4 times and the sign of the entire expression becomes negative.

MD Perform all **Multiplications** and **Divisions**, working in order from left to right.

AS Perform all **Additions** and **Subtractions**, working in order from left to right.

Simplify the Following Example Problems:	You Try It Problems: Simplify
1. $50 + 3 \cdot 7 = 50 + 21 = 71$ *Since there are no parentheses or exponents, first multiply and then add the remaining values.*	a. $5 \cdot 8 - 32 + 3$ = ________
2. $-7 + (5 - 2) + 4^2 = -7 + 3 + 4^2 = -7 + 3 + 16 = 12$ *First simplify the parentheses and then the exponent. Now add or subtract the remaining values.*	b. $3^3 - (-2 + 9) + 11$ = ________
3. $2[5 + 2(8 - 3)] = 2[5 + 2(5)] = 2[5 + 10] = 2[15] = 30$ *Start with the innermost set of parentheses and then simplify inside the brackets by performing the multiplication and then addition. Finally multiply the remaining values.*	c. $3[20 - 5(9 + 3)]$ = ________

Check your answers at the bottom of pg. 4.

Order of Operations, Continued:

Simplify the Following Example Problems:	**You Try It Problems: Simplify**
4. $-3^2 + (-4)^2$ $= -9 + 16$ $= 7$ *First simplify the exponent inside parentheses and then the exponent without parentheses. Remember to be careful because of the negative base. Add the remaining values.*	d. $-2^3 + (-7)^2 \quad = \_\_\_\_\_\_\_\_\_\_$
5. $\dfrac{\lvert 2-6 \rvert + 8}{5 \cdot 2 - 4} = \dfrac{12}{6} = 2$ *Since there is a fraction bar, simplify the numerator and denominator separately (see below). Reduce the final fraction.* Numerator: $\lvert 2-6 \rvert + 8 = \lvert -4 \rvert + 8 = 4 + 8 = 12$ *Simplify the expression inside the absolute value bars. Find the absolute value and add the remaining numbers.* Denominator: $5 \cdot 2 - 4 = 10 - 4 = 6$ *Multiply and then subtract the remaining values.*	e. $\dfrac{7^2 + \lvert 13 - 20 \rvert}{-14 \div 7 + 6} = \_\_\_\_\_\_\_\_\_\_$
6. $\dfrac{6 \div 2 + 3\,(8-5)}{-4^2 + 2} = \dfrac{12}{-14} = \dfrac{-6}{7}$ *Since there is a fraction bar, simplify the numerator and denominator separately (see below). Reduce the final fraction.* Numerator: $6 \div 2 + 3(8-5) = 6 \div 2 + 3(3) = 3 + 9 = 12$ *Simplify the expression inside the parentheses. Working from left to right perform the division and then the multiplication. Add the remaining values.* Denominator: $-4^2 + 2 = -16 + 2 = -14$ *Simplify the exponent (notice that the negative sign is NOT inside parentheses). Then add the remaining values.*	f. $\dfrac{-8\,(5+1) \div 12}{8 + (-4)^2} = \_\_\_\_\_\_\_\_\_\_$

Evaluating Algebraic Expressions: A symbol that is used to represent a number is called a **variable**. An **algebraic expression** is a collection of numbers, variables, operations and grouping symbols. The following are examples of algebraic expressions:

$$5x, \qquad 2y + 7, \qquad x^2 - 3x + 6 \qquad \text{and} \qquad \frac{x}{y} - (x + 4).$$

If a specific value is given to a variable, then the algebraic expression can be evaluated by substituting the given value into the variable and simplifying. Algebraic expressions are often used in problem solving and you will frequently encounter them in MAT 011.

Example Problems: Evaluate Algebraic Expressions for the Given Replacement Values	**You Try It Problems: Evaluate**
1. $5x - 12$ *if* $x = 4$ $= 5(4) - 12$ $= 20 - 12 = 8$ *In the expression, substitute 4 in place of x. Simplify using the order of operations.*	g. $3x + 7$ *if* $x = -5$ __________
	h. $\lvert -6w \rvert$ *if* $w = 11$ __________
2. $\frac{x}{y} + 2z$ *if* $x = -10$, $y = 2$ *and* $z = 7$ $= \frac{-10}{2} + 2(7)$ $= -5 + 14 = 9$ *In the expression, substitute –10 in place of x, 2 for y and 7 for z. Simplify using the order of operations.*	i. $\frac{y}{2z}$ *if* $y = 3$ *and* $z = 5$ __________
3. $2x^2 + 3y$ *if* $x = -5$ *and* $y = -8$ $= 2(-5)^2 + 3(-8)$ $= 2(25) - 24$ $= 50 - 24 = 26$	j. $y^2 - 3y + 8$ *if* $y = -7$ __________

Combining Like Terms: Terms with the same variables raised to exactly the same exponent are called **like terms**. Consider the following examples:

- $2x$, $-5x$ and $17x$ — These are **like** terms with the same variable x.
- $5x$ and $5x^2$ — These are **unlike** terms because of the different exponents.
- $3a$, $8b$ and $-9c$ — These are **unlike** terms because of the different variables.
- -7, 0, 4 and ½ — These are **like** terms since they are all constant values.

Like terms can be grouped together by combining the **coefficients** of the common variable factors (the coefficient is the numerical value in front of the variable). Combining like terms is necessary for simplifying an algebraic expression or equation.

Simplify the Following Example Problems:	**You Try It Problems: Simplify**
1. $3x + 10 - 7x$ $= (3x - 7x) + 10 = -4x + 10$ *Group and combine the like x terms.*	k. $-12a + 13 + 6a$ = __________
2. $11 - 2y + 6 + 4y$ $= (-2y + 4y) + (11 + 6) = 2y + 17$ *Combine the like y terms and the constants.*	l. $9x - 7 + 6 + x$ = __________
3. $5x^2 + 4 - 4x^2 + x$ $= (5x^2 - 4x^2) + x + 4 = x^2 + x + 4$ *Combine the like* x^2 *terms.*	m. $y^2 + 2 - 7y + 3y^2$ = __________

The Properties of Real Numbers

- **Commutative Property:** Changing the order in which numbers are added or multiplied does not change their sum or product.

  $a + b = b + a$ $\quad 4 + 5 = 5 + 4$

  $a \cdot b = b \cdot a$ $\quad 2 \cdot 7 = 7 \cdot 2$

  NOTE: The commutative property does not apply to subtraction and division.

- **Associative Property:** Changing the grouping of numbers that are added or multiplied does not change their sum or product.

  $(a + b) + c = a + (b + c)$ $\quad (3+7)+9 = 3+(7+9)$

  $(a \cdot b) \cdot c = a \cdot (b \cdot c)$ $\quad (8 \cdot 2) \cdot 5 = 8 \cdot (2 \cdot 5)$

  NOTE: The associative property does not apply to subtraction and division.

- **Distributive Property:** This property removes parentheses by distributing (or multiplying) a single product to every term inside the parentheses.

  $a(b + c) = ab + ac$ OR $a(b - c) = ab - ac$

  $12(x - 5)$ Distribute the 12 to each term inside the parentheses.

  $= 12(x) - 12(5)$ Multiply and combine like terms if possible.

  $= 12x - 60$ The expression can now be written without parentheses.

Use the Distributive Property to Simplify the Following Example Problems:	**You Try It Problems: Simplify**
1. $5(2y + 6) - 15$ $= 5(2y) + 5(6) - 15$ $= 10y + 30 - 15 = 10y + 15$ *Only distribute the 5 to the terms inside the parentheses. Combine like terms to simplify.*	n. $2(x - 6)$ = ______________ o. $-8(2a + 3) + 7$ = ______________
2. $-(4x + 3y - 7)$ $= -(4x) + -(3y) + -(-7)$ $= -4x - 3y + 7$ *Distribute the negative sign to every term inside the parentheses. This will change the sign of each term. Pay careful attention to the signs when simplifying.*	p. $5x - (3x - 6)$ = ______________
3. $\frac{1}{2}(8x - 6) - (7x + 1)$ $= \frac{1}{2}(8x) + \frac{1}{2}(-6) + -(7x) + -(1)$ $= 4x - 3 - 7x - 1 = -3x - 4$ *Distribute the fraction to every term in the first set of parentheses. Then distribute the negative sign to every term in the second set of parentheses. Be careful with the signs when combining like terms and simplifying.*	q. $-(7x - y + 9) - 5$ = ______________

Key for You Try It Problems pgs. 1-4.

a. 11 **b.** 31 **c.** – 120 **d.** 41 **e.** 14 **f.** – 1/6 **g.** – 8 **h.** 66 **i.** 3/10 **j.** 78

k. $-6a + 13$ **l.** $10x - 1$ **m.** $4y^2 - 7y + 2$ **n.** $2x - 12$ **o.** $-16a - 17$ **p.** $2x + 6$ **q.** $-7x + y - 14$