Section 6.2 – Multiplication, Division, and Combined Operations

This booklet belongs to:_____Block: _____

Multiplication of Polynomials

- **Multiplication** is awesome, all we do is **WATERBOMB (DISTRIBUTIVITY)** and use our **Exponent Laws** for the **Variables**

- Remember: When we **multiply** a **COMMON BASE,** we **ADD** the **exponents**!
  - ✓ Also, the **Order of Multiplication** does not matter!

$$2 \cdot 3 \textit{ is the same as } 3 \cdot 2$$

$$xyz \textit{ is the same as } yxz, zyx, \textit{or } zxy$$

  - ✓ It makes no difference, keep this in mind

Example 1: $3(x+4)$

Solution 1:

$3(x+4)$ Waterbomb in the 3

3 times x is 3
3 times 4 is 12

So,

$$\mathbf{3(x+4) = 3x + 12}$$

Example 2:

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

$$-4x \cdot x + -4x \cdot 6$$

$$\mathbf{-4x^2 - 24x}$$

Example 3:

$$x(x+y)$$

$$x \cdot x + x \cdot y$$

$$\mathbf{x^2 + xy}$$

Example 4:

$$4k(3km - 2m)$$

$$4k \cdot 3km + 4k \cdot -2m$$

$$\mathbf{12k^2m - 8km}$$

Example 5:

$$t^2(6p - 4t)$$

$$t^2 \cdot 6p + t^2 \cdot -4t$$

$$6t^2p - 4t^3$$

$$\mathbf{-4t^3 + 6t^2p}$$

Example 6:

$$14q(2q^2 - 4q)$$

$$14q \cdot 2q^2 + 14q \cdot -4q$$

$$\boldsymbol{28q^3 - 56q^2}$$

Division of Polynomials

- **Division of Polynomials** is just working with **fractions** and **exponent laws**

Consider this:

$$\frac{2+3}{7} = \frac{2}{7} + \frac{3}{7}$$

Remember this?

We can break Polynomials down the same way.

Using that logic,

$$\frac{4r+2}{2} = \frac{4r}{2} + \frac{2}{2} \rightarrow 2r + 1$$

- You **MUST BE ABLE** to **divide each term** by the **denominator** in order to do the division, otherwise you cannot do the operation
- This is a regular error that gets made, so DO NOT fall into that trap

Example 7:

$$\frac{t^2 + 7t}{t} = \frac{t^2}{t} + \frac{7t}{t} \rightarrow \boldsymbol{t + 7}$$

$$\frac{t^2}{t} = t$$

$$\frac{7t}{t} = 7$$

- Exponent Laws
- Anything divided by itself is 1

Example 8:

$$\frac{4z^3 - 2z^2 + 12z}{2z}$$

$$\frac{4z^3}{2z} + \frac{-2z^2}{2z} + \frac{12z}{2z}$$

$$\boldsymbol{2z^2 - z + 6}$$

Example 9:

$$\frac{8xyz + 4yz + 2z}{2z}$$

$$\frac{8xyz}{2z} + \frac{4yz}{2z} + \frac{2z}{2z}$$

$$\boldsymbol{4xy + 2y + 1}$$

Combined Operations

- It is very rare that you only have to add, subtract, multiply, or divide only.
- More often than not it involves a combination of steps

Example 10:

$$3r(r + 4) - 2r(4r + 6)$$

Waterbomb to remove the **BRACKETS**

$$3r^2 + 12r - 8r^2 - 12r$$

Don't forget, your Waterbombing in $\boldsymbol{-2r}$ **not just** $\boldsymbol{2r}$

Combine **LIKE TERMS** and **SIMPLIFY**

$$-5r^2$$

- So, it'll take a **few steps**, multiply first, add/subtract, then combine the terms and leave your answer in Descending Order

Example 11:

$$\frac{4t(t^2 + 5)}{t}$$

$$\frac{4t^3 + 20t}{t}$$

$$\frac{4t^3}{t} + \frac{20t}{t} \quad = \quad \boldsymbol{4t^2 + 20}$$

Example 12:

$$\frac{3x(x+4)}{x}+\frac{5x(3x-12)}{3x}$$

$$\frac{3x^2+12x}{x}+\frac{15x^2-60x}{3x}$$

Waterbomb to **remove brackets**

$$\frac{3x^2}{x}+\frac{12x}{x}+\frac{15x^2}{3x}+\frac{-60x}{3x}$$

Divide each term by the **denominator**

$$3x+12+5x-20$$

Group **LIKE TERMS** and **SIMPLIFY**

$$\boldsymbol{8x-8}$$

Example 13:

$$\frac{2r^2(r-4)}{r}-\frac{6(r^2+2r)}{2}$$

Waterbomb to **remove brackets**

$$\frac{2r^3-8r^2}{r}-\left(\frac{6r^2+12r}{2}\right)$$

Since you're **subtracting**, put **brackets** around the **second Polynomial** so you don't forget to **subtract each term**

$$\frac{2r^3}{r}-\frac{8r^2}{r}-\left(\frac{6r^2}{2}+\frac{12r}{2}\right)$$

Divide each term by its denominator

$$2r^2-8r-(3r^2+6r)$$

Waterbomb in the **NEGATIVE** symbol

$$2r^2-8r-3r^2-6r$$

Group **LIKE TERMS**

$$2r^2-3r^2-8r-6r$$

Simplify the final solution

$$\boldsymbol{-r^2-14r}$$

Section 6.2 – Practice Questions

EMERGING LEVEL QUESTIONS

Multiply the following. Leave answer in **DESCENDING** order.

1. $-3(x-7)$	2. $-(t^2-7t+4)$	3. $4tp(-2t^2+3p)$
4. $4k^2(k^2+7k-2)$	5. $-z(z+4)$	6. $2x(2y+x-3z)$
7. $xy(xyz+z-xy)$	8. $2st(-3s+4t-st)$	9. $-2x^2(3x^2-2y^2+4z^2)$

Divide the following. Leave answer in **DESCENDING** order.

10. $\frac{3x+12}{3}$	11. $\frac{t^2+4t}{t}$	12. $\frac{3x^2-9x+6}{3}$

PROFICIENT LEVEL QUESTIONS

13. $\frac{5q^3 + 10q^2 - 5q}{5q}$

14. $\frac{-4t^2 + 2t}{2t}$

15. $\frac{-a^2bc - ab^2c + abc^2}{-abc}$

16. $\frac{18z^4 - 6z^3 + 3z^2}{-3z^2}$

17. $\frac{4r^{12} + 6r^3 - 8r^2}{-2r^{-2}}$

18. $\frac{-a^2b^2c + ab^2c^2 - a^2b^2c^2}{ab^2c}$

Perform the Combined Operations. Answer in **DESCENDING** order.

19. $-3(x^2 + 4x) + 5x(x - 6)$

20. $$\frac{2t(t^2 - 4t)}{t} - 3t(4t - 5)$$

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21. $$\frac{7q(3q^2+4q)}{7} + \frac{9q(6q^2-3q)}{3}$$

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22. $$\frac{-3z^3(z-3)}{3} - \frac{4z^2(3z+6z^2)}{3}$$

Answer Key – Section 6.2

1. $-3x + 21$	2. $-t^2 + 7t - 4$	3. $-8t^3p + 12tp^2$	4. $4k^4 + 28k^3 - 8k^2$
5. $-z^2 - 4z$	6. $2x^2 + 4xy - 6xz$	7. $x^2y^2z - x^2y^2 + xyz$	8. $-2s^2t^2 - 6s^2t + 8st^2$
9. $-6x^4 + 4x^2y^2 - 8x^2z^2$	10. $x + 4$	11. $t + 4$	12. $x^2 - 3x + 2$
13. $q^2 + 2q - 1$	14. $-2t + 1$	15. $a + b - c$	16. $-6z^2 + 2z - 1$
17. $-2r^{14} - 3r^5 + 4r^4$	18. $-ac - a + c$	19. $2x^2 - 42x$	20. $-10t^2 + 7t$
21. $21q^3 - 5q^2$	22. $-9z^4 - z^3$		

Extra Work Space