

Section 6.1 – Polynomial Basics and Addition and Subtraction

This booklet belongs to: _____ **Block:** _____

- There will be a lot vocabulary necessary to accurately understand Polynomials

Term: Any variable, constant, or product of the two

Example: 3, $4x$, t , $2r^2$, xyz

Like Terms: Terms that have the **same variable(s)** to the same **exponents**

Example: x^2 and $4x^2$, $7t$ and $3t$, 4 and 9

Degree of a Term: The **exponent** on the **variable** or **sum** of exponents on **different variables** of one term

Example: $3x$ is Degree 1, $4x^2$ is Degree 2, $5xyz$ is Degree 3

Polynomial: Any term or terms **separated by addition or subtraction** where all **exponents** on the variables are **whole numbers**

Example: $5t^2 + 2t - 7$

Leading Term: The term in a Polynomial with **the highest degree**

Example: From above: $5t^2$ is the leading term, it has the highest degree

Descending Order: Writing terms from **highest to lowest** degree

Example: From Above: Is in descending order, degree goes 2, 1, 0

Polynomial Degree: The **highest degree** on a term, becomes the degree of the polynomial

Example: From Above: $5t^2$ the leading has degree 2, so the Polynomial is degree 2

Combining like Terms

- Combining like terms is doing exactly that
- When we have a long list of terms written as a Polynomial, we can combine any that are **Like Terms**: **same variables, same exponent**

Example 1: Combine the Like Term of the following equation: $3q^2 - 4 + 2q - 2q^2 + 4q - 8$

Solution 1:

Like Terms are: $3q^2$ and $-2q^2$, -4 and -8 , $2q$ and $4q$

So, $3q^2 - 2q^2 = q^2$

$$2q + 4q = 6q$$

$$-4 - 8 = -12$$

And Descending Order: $q^2 + 6q - 12$
 Degree 2 Degree 0
 Degree 1

Example 2: Combine the **Like Terms** and leave the simplified expression in **Descending Order**

$$5xy + 5x^2 + 2x - 6 - 4yx + 2x + 6 - 3x^2$$

Solution 2:

Like Terms are:

$+5x^2$ and $-3x^2$ so $5x^2 - 3x^2 = 2x^2$ Degree of 2

$5xy$ and $-4yx$ so $5xy - 4xy = xy$ Degree of 2

$+2x$ and $+2x$ so $2x + 2x = 4x$ Degree of 1

-6 and $+6$ so $-6 + 6 = 0$ Degree of 0

xy and yx are the same, in multiplication order doesn't matter, $xy = yx$

Since x^2 and xy are both degree 2, which one goes first?

We list them **ALPHABETICALLY**, $x^2 = xx$ and xx comes before xy

$$2x^2 + xy + 4x$$

Addition of Polynomials**Example 1:** Add the following polynomials: $(x^2 + 4x - 7) + (2x^2 - 3x + 4)$ **Solution 1:**We have 2 Polynomials, **shown in brackets**, and we are adding the second polynomial to the first.Step 1: In **addition**, just **drop the Brackets**, keep the **sign** on the first term of the second Polynomial, since it's positive, nothing changes

$$x^2 + 4x - 7 + 2x^2 - 3x + 4$$

Step 2: Group the Like Terms

$$x^2 + 4x - 7 + 2x^2 - 3x + 4$$

$$= 3x^2 + x - 3$$

Make sure your answer is in **DESCENDING ORDER!**

- **We can't SOLVE** for the unknown yet, this is as far as we will go in this class.
- If you make the Polynomial equal to something, then we can solve: We do this in Grade 10.

Example 2: Add the following polynomials: $(-4p^2 + 3 - 2p) + (2 - 3p^2 + 7p)$ **Solution 2:**

Rearrange the terms so like terms are together, descending order right away is a bonus

$$-4p^2 + 3 - 2p + 2 - 3p^2 + 7p$$

Drop the brackets, leave the sign on the 1st term of the second Polynomial

$$-4p^2 - 3p^2 - 2p + 7p + 3 + 2$$

$$-7p^2 + 5p + 5$$

Leave the solution in **Descending Order**

Example 3: Add the following: $(5xy + 3 - 2x) + (-3 + 2x - 5xy)$

Solution 3:

$$5xy + 3 - 2x - 3 + 2x - 5xy$$

Drop the brackets, leave the sign on the 1st term of the second Polynomial

Rearrange the terms so like terms are together, descending order right away is a bonus

$$5xy - 5xy - 2x + 2x + 3 - 3$$

0

Leave the solution in **Descending Order**, if everything **cancels out**, zero is a valid answer!

Example 4: Add the following polynomials: $(4 + 3t^2 - 7x) + (6x - 2t^2 - 12)$

Solution 4:

$$4 + 3t^2 - 7x + 6x - 2t^2 - 12$$

$$3t^2 - 2t^2 - 7x + 6x + 4 - 12$$

$$t^2 - x - 8$$

Subtraction of Polynomials

- There is 1 very important concept to understand with subtraction

Consider this:

$$(x^2 + 5x - 4) - (2x^2 - 5x - 4)$$

- We are subtracting this from the 1st one. The subtraction symbol **MUST** affect each term.
- Think about **WATERBOMBING** in the **negative symbol**
- The **signs change**

$$(x^2 + 5x - 4) - (2x^2 - 5x - 4)$$

- After you **WATERBOMB** in the negative you can **change the signs** and **DROP the BRACKETS**

- Remember:
 - negative · negative=positive
 - negative · positive=negative
- This is where mistakes happen the most, **be careful with brackets and negative!!!!**

$$x^2 + 5x - 4 - 2x^2 + 5x + 4$$

- Now we **GROUP** the **LIKE TERMS** and we're done

$$x^2 - 2x^2 = -x^2$$

$$5x + 5x = 10x$$

$$-4 + 4 = 0$$

So, in **Descending Order**,

$$-x^2 + 10x$$

Example 5: Subtract the following polynomials: $(3x^2 - 4x + 2) - (6x^2 + 5x - 12)$

Solution 5: Be very careful with the brackets, you are subtracting the entire polynomial, each term

Step 1: **Drop the Brackets** $3x^2 - 4x + 2 - (6x^2 + 5x - 12)$
of 1st Polynomial

Step 2: **Waterbomb** in the $3x^2 - 4x + 2 - 6x^2 - 5x + 12$
(-) to the second one
and **Drop the Brackets**

Step 3: Group the **LIKE TERMS** $-3x^2 - 9x + 14$
and put the result in
DESCENDING ORDER

Example 6: Subtract: $(9r^2 + 4r + 5) - (-3r^2 - 4r + 5)$

Solution 6:

$$9r^2 + 4r + 5 + 3r^2 + 4r - 5$$

Waterbomb in the negative sign

$$9r^2 + 3r^2 + 4r + 4r + 5 - 5$$

Group the **LIKE TERMS**

$$12r^2 + 8r$$

Example 7: Subtract: $-(2t^2 + 4t - 6) - (8t^2 - 5t + 2)$

Solution 7: If there is a negative out front of the first polynomial, do not forget to waterbomb it in too

Waterbomb in the 1st negative

$$-2t^2 - 4t + 6 - (8t^2 - 5t + 2)$$

$$-2t^2 - 4t + 6 - 8t^2 + 5t - 2$$

Waterbomb in the 2nd negative sign

$$-10t^2 + t + 4$$

Group the **LIKE TERMS and simplify**

There is nothing to say you cannot add and subtract multiple polynomials, just follow the logic above

Example 8: Perform the operations: $(3r^2 + 6 - 7r) - (5 - 4r + r^2) + (-5 + 8r^2 + 5r)$

Solution 8:

$$(3r^2 + 6 - 7r) - (5 - 4r + r^2) + (-5 + 8r^2 + 5r)$$

$$3r^2 + 6 - 7r - 5 + 4r - r^2 + (-5 + 8r^2 + 5r)$$

Since we are **adding** the **last polynomial**, just **drop the brackets** and **keep the signs** that the numbers had

Drop the brackets from the **1st polynomial** and **waterbomb** in the **negative** to the **2nd polynomial**

$$3r^2 + 6 - 7r - 5 + 4r - r^2 - 5 + 8r^2 + 5r$$

$$10r^2 - 4 + 2r$$

Group the Like Terms

$$10r^2 + 2r - 4$$

Answer in Descending Order

Polynomials in this grade are not a huge jump, they involve waterbombing (distributive method), grouping like terms, and sometimes exponent laws.

They are, however, a recurring topic that we will cover in increasing detail in the years to come!

Section 6.1 – Practice Questions

EMERGING LEVEL QUESTIONS

Identify the **number of terms**, what are they, and their **degrees**?

1. $3x - 4x^2 - 5$	2. $4xyz$	3. $-2xyz - 5xy + 4$
4. $5x^3y + 4xy^3 - 6xyz$	5. 5	6. $3x + 4y + 5z - x^2$

Put the following Polynomials in **DESCENDING ORDER**

7. $3 + 4x^2 - 5x$	8. $-2t + 4t^3 - 2t - 3t^2$	9. $2 - x + 5x^2$
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10. $z^2 - 4z + 5$

11. $x + xy + xz - y$

12. $-5xy - y + 2x + x^2$

Simplify the following, put your answer in **DESCENDING ORDER**

13. $3t + 4 - 6t + 2t^2 + 4 - 3t^2$

14. $7z^3 + 2z - 4z^2 + 1 - 4z^2 - 5 + 3z^2 + 3z$

15. $5xy + 3 - 5yx + 2$

16. $-4q + 5q^2 - 7 - 5q^2 + 4q + 7$

PROFICIENT LEVEL QUESTIONS

17. $\frac{1}{3}i^2 + 2i - \frac{1}{6}i^2 + 4 - 9$

18. $-4.9x - 3.2y - 1.3x + 4.2y + 1$

19. $\frac{11}{5}x + \frac{2}{3}y - \frac{3}{5}x - \frac{1}{3}y + 10$

$$20. \frac{1}{4}j^2 - j - \frac{1}{2}j + \frac{3}{8}j^2 + \frac{5}{16}j^2$$

EMERGING LEVEL QUESTIONS

Add the following Polynomials, leave answer in **DESCENDING** order.

$$21. (x + 4) + (x - 7)$$

$$22. (2x^2 - 4x - 7) + (3x^2 - 7 + 4x)$$

$$23. (3xy + 4x^3 + 4) + (2xy - 4x^3 - 4)$$

$$24. (10 + 4t^2 + 4t) + (2t - 7t^2 - 8)$$

$$25. (j^3 + 2j^2 + j + 4) + (3j^3 - 2j^2 - 7j + 15)$$

26. $(4 + 6x - 2x^2) + (-x^2 - 2x)$

27. $(t^2 + 4) + (-t^2 - 4)$

PROFICIENT LEVEL QUESTIONS

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

29. $(-2x + x^2 - 2y^2) + (-y^2 - x + 2x^2)$

30. $(4x - 2x^2) + (-5 + x^2)$

31. $(-3 + 4x^2 + 4x) + (5x - 2x^2 + 4)$

32. $(3x - 2xy + 2y) + (xy - 3y) + (-3y - x)$

33. $(-2y + 3x + xy) + (2xy - x - y) + (-x - 4xy)$

Subtract the Polynomials, leave answer in **DESCENDING** order.

34. $(3x^2 + 4x - 7) - (-2x^2 + 4x + 9)$

35. $(t^3 - 5t + 4t^2) - (t^2 - 7t - 2t^2)$

36. $(z - 4) - (3z - 7)$

37. $(w - 7) - (2w + 4)$

38. $(r + 6) - (-2r - 2)$

39. $(j + 14) - (-5j + 7)$

40. $(2k^2 + k - 7k) - (3k^2 - k - 4k) - (6k^2 - 8k + 7k)$

41. $(5 - t) - (-7 + t) - (12 + t^2)$

42. $(-2x - 3y) - (4x + 2y) - (x - 3y)$

43. $(-5x - 2y + 3z) - (-2x + 9y) - (-x + y - 2z)$

EXTENDING LEVEL QUESTIONS

Perform the Combined Operations

44. $(2st - s - t) - (-3st + t) + (-s + 2t)$

45. $(-3x + 4y) + (6x - 5y) - (2x + 11y - 5z)$

46. $(-2xy + 9z) + (4x^2 - 11z) - (6x^2 + 8xy - 11z)$

Answer Key – Section 6.1

1. <i>Terms: 3</i> $3x, -4x^2, -5$ <i>Degree: 1, 2, 0</i>	2. <i>Terms: 1</i> $4xyz$ <i>Degree: 3</i>	3. <i>Terms: 3</i> $-2xyz, -5xy, 4$ <i>Degree: 3, 2, 0</i>	4. <i>Terms: 3</i> $5x^3y, 4xy^3, -6xyz$ <i>Degree: 4, 4, 3</i>
5. <i>Terms: 1</i> 5 <i>Degree: 0</i>	6. <i>Terms: 4</i> $3x, 4y, 5z, -x^2$ <i>Degree: 1, 1, 1, 2</i>	7. $4x^2 - 5x + 3$	8. $4t^3 - 3t^2 - 4t$
9. $5x^2 - x + 2$	10. $z^2 - 4z + 5$	11. $xy + xz + x - y$	12. $x^2 - 5xy + 2x - y$
13. $-t^2 - 3t + 8$	14. $7z^3 - 5z^2 + 5z - 4$	15. 5	16. 0
17. $\frac{1}{6}i^2 + 2i - 5$	18. $-6.2x + y + 1$	19. $\frac{8}{5}x + \frac{1}{3}y + 10$	20. $\frac{15}{16}j^2 - \frac{3}{2}j$
21. $2x - 3$	22. $5x^2 - 14$	23. $5xy$	24. $-3t^2 + 6t + 2$
25. $4j^3 - 6j + 19$	26. $-3x^2 + 4x + 4$	27. 0	28. $-5x^2 - 2x - 3$
29. $3x^2 - 3y^2 - 3x$	30. $-x^2 + 4x - 5$	31. $2x^2 + 9x + 1$	32. $-xy + 2x - 4y$
33. $-xy + x - 3y$	34. $5x^2 - 16$	35. $t^3 + 5t^2 + 2t$	36. $-2z + 3$
37. $-w - 11$	38. $3r + 8$	39. $6j + 7$	40. $-7k^2$
41. $-t^2 - 2t$	42. $-7x - 2y$	43. $-2x - 12y + 5z$	44. $-2s + 5st$
45. $x - 12y + 5z$	46. $-2x^2 - 10xy + 9z$		

Extra Work Space