ADDING AND SUBTRACTING MONOMIALS (COLLECTING LIKE TERMS)

BIG IDEAS:

- Numbers, variables, and products of numbers and variables are called **monomials**
- **Like terms** contain the same variables with the same exponents
- Only **like terms** can be combined through **addition** or **subtraction**

LEARNING GOALS AND SKILL DEVELOPMENT:
You know you have met the goals for this lesson when you can:

EMERGING

LEARNING GOALS	ANCHOR QUESTIONS
Identify and state like terms	3
Identify and state the coefficient of a monomial	4
Simplify expressions by adding and subtracting (collecting) like terms	5, 6

SKILL BUILDING QUESTIONS			
1	2	3	4
5	6	10	14

EVOLVING

LEARNING GOALS	ANCHOR QUESTIONS
Simplify expressions by adding and subtracting (collecting) like terms with double negatives or a positive and negative together	9
Simplify an expression and then evaluate the simplified expression for a given value	12
Simplify expressions by collecting like terms, including terms in which the exponent on the variable is greater than 1	15
Solve real-world problems that require writing an expression including two terms	19ab

SKILL BUILDING QUESTIONS			
7	8	9	11
12	13	15	17
19ab			

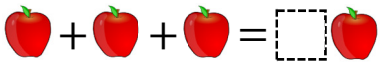
EXTENDING

LEARNING GOALS	ANCHOR QUESTIONS
Simplify an expression with terms in which the variable on the exponent is not 1 and evaluate the simplified expression for a given value	16
Simplify expressions including terms that have fractions as coefficients	20
Solve real-world problems that require writing expressions, including connections to other curriculum topics	19c, 28

SKILL BUILDING QUESTIONS			
16	18	19c	20
21	22	23	24
25	26	27	28

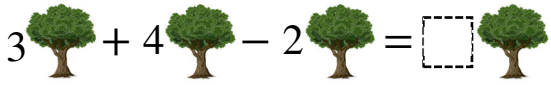
BUILD YOUR SKILLS

1. State the value that should be placed in each box.

a) 

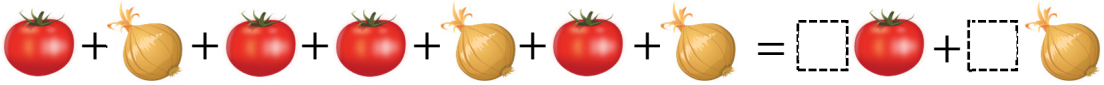
b)

c)

d) 

2. State the value that should be placed in each box.

a)

b) 

c)

3. Identify each of the following pairs as like terms or unlike terms.

a) $6x$ and $14x$ b) $10x$ and $10y$ c) $-5a$ and $10a$ d) $-9x$ and 5

4. State the coefficient for each of the following terms.

a) $8x$ b) $15y$ c) $-4x$ d) x e) $-y$

5. Simplify each of the following expressions by collecting like terms.

a) $x+x+x+x$ b) $2y+5y$ c) $3x+4x+x$ d) $9a-5a+4a$

e) $2x+6x-8x$ f) $3k-7k$ g) $w+5w-9w$ h) $2z-10z+7z$

6. Simplify each of the following expressions by collecting like terms.

a) $x+x+y+y+y$ b) $2a+5a+6b+10b$ c) $3g+10h+4g+3h$

d) $10c+8d-4c-3d$ e) $5x+2y-8x-y$ f) $6m-4m+6n-3m-2n$

7. Shagun stated that $5x+2$ is equal to $7x$. Is Shagun's claim correct? Explain.

8. Kalani and Marc were asked to simplify the expression $9x+3-4x-10$ by collecting like terms. Kalani's answer was $5x+(-7)$ and Marc's answer was $5x-7$. Was Kalani correct? Was Marc correct? Explain.

9. Express each of the following without using brackets.

a) $8x+(-3)$ b) $-4x-(-6)$ c) $8x+(-4y)$ d) $-9a-(-4b)$

10. Simplify each of the following expressions by collecting like terms.

a) $2x+5x+6+8$ b) $7x+3+4x+2$ c) $8p-10p+4+12$

d) $5y-8y+6-10$ e) $6t+5-t-9$ f) $3x+4-x+7-6x$

11. Simplify each of the following expressions by collecting like terms.

a) $-5x+6x+(-3x)$ b) $-8x-(-2x)$ c) $16x-4y+x+12y$

d) $-a+4a-9+15$ e) $4x-3-9x+6$ f) $2-4m+9+(-11m)$

12. Simplify each of the following expressions by collecting like terms and the evaluate for $x=3$ and $y=-4$.

a) $9x+8y-4x+5y$ b) $-7x-(-4x)-8+15$ c) $-9-4y+7-y$

13. To check if the expressions $11x-5x+13-6$ and $-4x-12+9x+22$ are equivalent, Nikola substituted 3 for x in each expression and evaluated. Since both expressions worked out to the same value of 25, he concluded that the expressions are equivalent. Is Nikola's conclusion correct? Explain.

14. Identify each of the following pairs as like terms or unlike terms.

a) $5x$ and $3x^2$ b) $-8x$ and $\frac{2}{3}x$ c) $-\frac{1}{2}t^2$ and $\frac{1}{3}t^2$ d) $3y^2$ and $2y^3$

15. Simplify each of the following expressions by collecting like terms.

a) $4x^2+2x^2+3x+15x$ b) $14x^2+5x+3x^2-2x$ c) $-3y+4y^2+8y-7y^2$

d) $-20x^2+4x+\left(-4x^2\right)-5x$ e) $-a^2-3a-(-5a)+10a^2$ f) $x^2-4x+x^2+(-3x)$

16. Simplify each of the following expressions by collecting like terms and the evaluate for $x=-2$ and $y=3$.

a) $-2x^2+4x+6x^2-7x$ b) $3x^2+8x-7+5x^2-9x-2$ c) $3x^2+2y^2-2x^2+4y^2$

d) $4y-y^2+9y-8-5y^2$ e) $8+y-3y^2+12-7y^2$ f) $3x^2-4y+7x-8y^2+6y-7x$

17. State whether the two expressions are equivalent or not equivalent.

a) $5x+3x$ and $8x$ b) $6x+4x$ and $2x+8x$ c) $5y-3y$ and $3y-5y$

d) $-5m+3m$ and $3m-5m$ e) $6t^2+t$ and $6t+t^2$ f) $10c-c^2$ and $4c^2+3c-5c^2+7c$

18. Nina is confused about the meaning of the expressions $2x$ and x^2.

a) Explain the meaning of each of these expressions.

b) Are there any values of x for which these two expressions are equal? Explain.

19. Xianna earns \$17 per hour at her summer job. At the end of each month, she also receives a \$100 bonus. Her friend, Marcel, earns \$15 per hour with a \$200 monthly bonus.

a) Write an expression to represent the total amount that Xianna earns for a month in which she works t hours.

b) Write an expression to represent the total amount that Marcel earns for a month in which he works t hours.

c) Write a simplified expression to represent the combined earnings for Xianna and Marcel for a month in which they both worked t hours.

20. Simplify each of the following expressions by collecting like terms.

a) $\frac{1}{2}x^2+\frac{5}{6}x^2-\frac{2}{3}x^2$ b) $\frac{3}{5}a+\frac{1}{3}b+\frac{2}{3}a-\frac{1}{5}b$ c) $\frac{2}{3}x+5-\frac{5}{6}x+\frac{4}{3}$

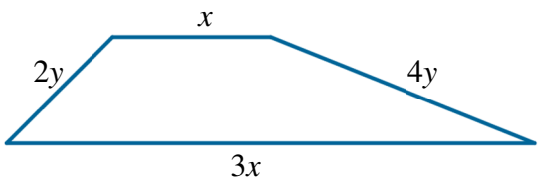
21. Explain why $\frac{1}{2}x$ and $\frac{x}{2}$ are equal and then simplify the expression $\frac{x}{2}+\frac{5}{4}x$.

22. Explain why $\frac{2}{3}x$ and $\frac{2x}{3}$ are equal and then simplify the expression $\frac{2x}{3}-\frac{4x}{9}$.

23. Simplify each of the following expressions by collecting like terms.

a) $\frac{x}{4}+\frac{2y}{3}-\frac{5y}{6}+\frac{4x}{3}$ b) $v-\frac{v}{3}+2-\frac{3}{4}$ c) $\frac{2m}{7}+\frac{3n}{8}-\frac{3m}{2}+2n$

24. Determine a simplified expression for the perimeter of the trapezoid shown on the right.



25. Simplify each of the following expressions by collecting like terms.

a) $7x-4y+8z-x+9y-10z$ b) $6x-8xy-4x+3xy$ c) $5a-4abc+5ab-3abc+6ab$

26. Simplify each of the following expressions by collecting like terms.

a) $2x^2y+3xy-7xy+3x^2y$ b) $6xy^2+4x^2y-2xy^2-3x^2y$

c) $-7a^2b-4a^2b^2+8ab^2+3a^2b^2-2a^2b$ d) $6xy+6x^2+10yx+2y^2-4xy$

27. The width of a rectangle is x metres. The height of the rectangle is three times the width. Determine a simplified expression to represent the perimeter of the rectangle.

28. A square has a side length of $5a$ cm. A triangle has a base of $4a$ cm and a height of $7a$ cm. Determine a simplified expression to represent the difference in the areas of these two shapes. Which shape has the greater area?

29. A circle has a radius that is twice the length of a smaller circle's radius. If the radius of the larger circle is r cm, determine a simplified expression to represent the exact difference in the areas of the two circles.

ANSWERS

CHECK YOUR UNDERSTANDING

1. a) 3 b) 4 c) 3 d) 5

2. a) 2, 3 b) 4, 3 c) 4, 9

3. a) like terms b) unlike terms c) like terms d) unlike terms

4. a) 8 b) 15 c) -4 d) 1 e) -1

5. a) $4x$ b) $7y$ c) $8x$ d) $8a$ e) 0 f) $-4k$ g) $-3w$ h) $-z$

6. a) $2x+3y$ b) $7a+16b$ c) $7g+13h$ d) $6c+5d$ e) $-3x+y$ f) $-m+4n$

7. Shagun's claim is incorrect. $5x$ and 2 are not like terms and thus cannot be combined into a single term.

8. Both Kalani and Marc were correct, since adding -7 has the same effect as subtracting 7 (moving left 7 on the number line).

9. a) $8x-3$ b) $-4x+6$ c) $8x-4y$ d) $-9a+4b$

10. a) $7x+14$ b) $11x+5$ c) $-2p+16$ d) $-3y-4$ e) $5t-4$ f) $-4x+11$

11. a) $-2x$ b) $-6x$ c) $17x+8y$ d) $3a+6$ e) $-5x+3$ f) $-15m+11$

12. a) $5x+13y\,;-37$ b) $-3x+7\,;-2$ c) $-5y-2\,;18$

13. No. Nikola has only shown that the two expressions are equal when $x=3$. He has not shown that the expressions are equal for all values of x. Simplifying the expressions by collecting like terms gives $6x+7$ and $5x+10$, which are not equivalent.

14. a) unlike terms b) like terms c) like terms d) unlike terms

15. a) $6x^2+18x$ b) $17x^2+3x$ c) $-3y^2+5y$

d) $-24x^2-x$ e) $9a^2+2a$ f) $2x^2-7x$

16. a) $4x^2-3x\,;22$ b) $8x^2-x-9\,;25$ c) $x^2+6y^2\,;58$ d) $-6y^2+13y-8\,;-23$

e) $-10y^2+y+20\,;-67$ f) $3x^2+2y-8y^2\,;-54$

17. a) equivalent b) equivalent c) not equivalent d) equivalent e) not equivalent

f) equivalent

18. a) $2x = x + x$, whereas $x^2 = x \times x$.

b) 0 and 2. When $x = 0$, both expressions work out to 0. When $x = 2$, both expressions work out to 4.

19. a) $17t + 100$ b) $15t + 200$ c) $32t + 300$

20. a) $\frac{2}{3}x^2$ b) $\frac{19}{15}a + \frac{2}{15}b$ c) $-\frac{1}{6}x + \frac{19}{3}$

21. Multiplying x by $\frac{1}{2}$ is equivalent to dividing x by 2. Also, $\frac{1}{2}x = \frac{1}{2} \times x = \frac{1}{2} \times \frac{x}{1} = \frac{1 \times x}{2 \times 1} = \frac{x}{2}$.

The simplified expression is $\frac{7}{4}x$ $\left(\text{or } \frac{7x}{4}\right)$.

22. Multiplying x by $\frac{2}{3}$ is equivalent to multiplying x by 2 and then dividing the result by 3. Also, $\frac{2}{3}x = \frac{2}{3} \times x = \frac{2}{3} \times \frac{x}{1} = \frac{2 \times x}{3 \times 1} = \frac{2x}{3}$. The simplified expression is $\frac{2}{9}x$ $\left(\text{or } \frac{2x}{9}\right)$.

23. a) $\frac{19}{12}x - \frac{1}{6}y$ $\left(\text{or } \frac{19x}{12} - \frac{y}{6}\right)$ b) $\frac{2}{3}v + \frac{5}{4}$ $\left(\text{or } \frac{2v}{3} + \frac{5}{4}\right)$

c) $-\frac{17}{14}m + \frac{19}{8}n$ $\left(\text{or } -\frac{17m}{14} + \frac{19n}{8}\right)$

24. $4x + 6y$

25. a) $6x + 5y - 2z$ b) $2x - 5xy$ c) $5a + 11ab - 7abc$

26. a) $5x^2y - 4xy$ b) $4xy^2 + x^2y$ c) $-9a^2b - a^2b^2 + 8ab^2$ d) $6x^2 + 12xy + 2y^2$

27. $8x$ m

28. $11a^2$ cm^2; the square has the greater area

29. $\frac{3}{4}\pi r^2$ cm^2

ANSWERS