

Chapter 2 Rules

1. *Identity Property of Addition* p56: For every number n , $n + 0 = n = 0 + n$.

Examples: $17 + 0 = 17 = 0 + 17$ $-5 + 0 = -5 = 0 + -5$
 $x + 0 = x = 0 + x$ $rs + 0 = rs = 0 + rs$

2. *Inverse Property of Addition* p56: For every real number n , there is an additive inverse $-n$ such that $n + (-n) = 0 = (-n) + n$.

Examples: $12 + (-12) = 0 = (-12) + 12$ $x + (-x) = 0 = (-x) + x$
 $-7 + (-^{-}7) = -7 + (7) = 0 = (-^{-}7) + -7 = (7) + -7$
 $2yz + (-2yz) = 0 = (-2yz) + 2yz$

3. *Adding Numbers with the Same Sign* p57: To add two numbers with the same sign, add their absolute values. The sum has the same sign as the addends.

Examples: $-5 - 6 = -(|-5| + |-6|) = -(5 + 6) = -(11) = -11$
 $-2 - 13 = -(|-2| + |-13|) = -(2 + 13) = -(15) = -15$

4. *Adding Numbers with Different Signs* p57: To add two numbers with different signs, find the difference of their absolute values. The sum has the same sign as the addend with the greater absolute values.

Examples: Find $-4 + 5$. Since $|-4| = 4 < 5 = |5|$ then $|5| - |-4| = 1$

Find $-21 + 16$. Now $|-21| - |16| = 21 - 16 = 5$ and since $|-21| = 21 > 16 = |16|$ then our answer is -5 .

5. *Matrices:*

Adding Matrices: $\begin{bmatrix} 1 & 0 \\ -2 & 4 \end{bmatrix} + \begin{bmatrix} 5 & -1 \\ -4 & 1 \end{bmatrix} = \begin{bmatrix} 1+5 & 0+^{-}1 \\ -2+^{-}4 & 4+1 \end{bmatrix} = \begin{bmatrix} 6 & -1 \\ -6 & 5 \end{bmatrix}$

Subtracting Matrices: $\begin{bmatrix} 7 & 11 \\ -3 & 2 \end{bmatrix} - \begin{bmatrix} 4 & -4 \\ -12 & 1 \end{bmatrix} = \begin{bmatrix} 7-4 & 11-^{-}4 \\ -3-^{-}12 & 2-1 \end{bmatrix} = \begin{bmatrix} 3 & 15 \\ 9 & 1 \end{bmatrix}$

Multiplying by a constant: $7 \begin{bmatrix} 5 & 6 \\ -3 & 2 \end{bmatrix} = \begin{bmatrix} 7 \cdot 5 & 7 \cdot 6 \\ 7 \cdot (-3) & 7 \cdot 2 \end{bmatrix} = \begin{bmatrix} 35 & 42 \\ -21 & 14 \end{bmatrix}$

6. *Identity Property of Multiplication:* For any real number n , $n \cdot 1 = n = 1 \cdot n$.

Examples: $3 \cdot 1 = 3 = 1 \cdot 3$ $25 \cdot 1 = 25 = 1 \cdot 25$
 $x \cdot 1 = x = 1 \cdot x$

7. *Multiplication Property of Zero*: For any real number n , $n \cdot 0 = 0 = 0 \cdot n$.

Examples: $1 \cdot 0 = 0 = 0 \cdot 1$ $12 \cdot 0 = 0 = 0 \cdot 12$
 $x \cdot 0 = 0 = 0 \cdot x$ $5xy \cdot 0 = 0 = 0 \cdot 5xy$

8. *Multiplication Property of -1*: For any real number n , $n \cdot (-1) = -n = (-1) \cdot n$.

Examples: $5 \cdot (-1) = -5 = (-1) \cdot 5$ $23 \cdot (-1) = -23 = (-1) \cdot 23$
 $x \cdot (-1) = -x = (-1) \cdot x$ $rs \cdot (-1) = -rs = (-1) \cdot rs$

9. *Multiplying Numbers with the Same Sign*:

For any two real numbers a and b both greater than zero ($a, b > 0$) then $a \cdot b = (-a)(-b) = ab > 0$

Examples: $(-4)(-5) = 20 = 4 \cdot 5$ $(-13)(-7) = 91 = 13 \cdot 7$
 $(-x)(-x) = x^2 = x \cdot x$ $(-r)(-st) = rst = (r)(st)$

10. *Multiplying Numbers with Different Signs*: For any two numbers a and b with ($a, b > 0$) then

$$(-a)b = a(-b) = -ab < 0.$$

Examples: $(-1) \cdot 3 = 1(-3) = -3$ $(-11) \cdot 2 = 11(-2) = -22$
 $(-x)y = x(-y) = -xy$ $(-3p)q = 3p(-q) = -3pq$

11. *Dividing Numbers with the Same Sign*: For any two numbers a and b with ($a, b > 0$) then

$$\frac{-a}{-b} = \frac{a}{b}.$$

Examples: $\frac{-1}{-3} = \frac{1}{3}$ $\frac{-x}{-y} = \frac{x}{y}$

12. *Dividing Numbers with Different Signs*: For any two numbers a and b with ($a, b > 0$) then

$$\frac{-a}{b} = \frac{a}{-b} = -\frac{a}{b}.$$

Examples: $\frac{-2}{3} = \frac{2}{-3} = -\frac{2}{3}$ $\frac{-xy}{z} = \frac{xy}{-z} = -\frac{xy}{z}$

13. *Inverse Property of Multiplication*: For any real number $n \neq 0$, the inverse of n is $\frac{1}{n}$ and

$$n \cdot \frac{1}{n} = 1 = \frac{1}{n} \cdot n.$$

Examples: $5 \cdot \frac{1}{5} = 1 = \frac{1}{5} \cdot 5$ $\sqrt{3} \cdot \frac{1}{\sqrt{3}} = 1 = \frac{1}{\sqrt{3}} \cdot \sqrt{3}$

$$\frac{2}{3} \cdot \frac{1}{2/3} = \frac{2}{3} \cdot \frac{3}{2} = 1 = \frac{3}{2} \cdot \frac{2}{3} = \frac{1}{2/3} \cdot \frac{2}{3}$$

14. *Multiplying Rational Expressions*: For any two rational numbers $\frac{p}{q}$ and $\frac{r}{s}$ we have,

$$\frac{p}{q} \cdot \frac{r}{s} = \frac{p \cdot r}{q \cdot s} = \frac{pr}{qs}.$$

Examples: $\frac{1}{2} \cdot \frac{3}{4} = \frac{1 \cdot 3}{2 \cdot 4} = \frac{3}{8}$ $2 \cdot \frac{3}{4} = \frac{2}{1} \cdot \frac{3}{4} = \frac{2 \cdot 3}{1 \cdot 4} = \frac{6}{4}$

$$\frac{7}{12} \cdot 5 = \frac{7}{12} \cdot \frac{5}{1} = \frac{7 \cdot 5}{12 \cdot 1} = \frac{35}{12} \qquad \frac{15}{7} \cdot \frac{3}{4} = \frac{15 \cdot 3}{7 \cdot 4} = \frac{45}{28}$$

15. *The Distributive Property*: For any three real numbers a , b , and c , we have $a(b+c) = a(b) + a(c) = ab + ac$ and $(b+c)a = (b)a + (c)a = ba + ca$.

Examples: $2(3+5) = 2(3) + 2(5) = 6 + 10 = 16$

$$1.1(3.2+4) = 1.1(3.2) + 1.1(4) = 3.52 + 4.4 = 7.92$$

$$3(x+5) = 3(x) + 3(5) = 3x + 15$$

$$2x + 3x = (2+3)x = (5)x = 5x$$

$$7(2xy+1) = 7(2xy) + 7(1) = 14xy + 7$$