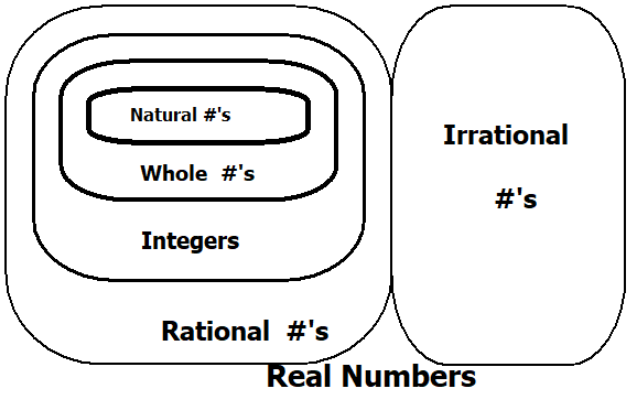
NATURAL NUMBERS (N):
1, 2, 3, 4 . . .
POSITIVE INTEGERS ($^{+}\mathrm{Z}$ or $^{+}\mathrm{I}$):

WHOLE NUMBERS (W):
0, 1, 2, 3, 4 . . .



INTEGERS (Z or I): Whole numbers and their opposites.
. . . −4, −3, −2, −1, 0, 1, 2, 3, 4 . . .

OPPOSITE OF THE NATURAL NUMBERS :
. . . −4, −3, −2, −1
NEGATIVE INTEGERS ($^{-}\mathbf{Z}$ or $^{-}\mathbf{I}$):

RATIONAL NUMBERS (Q): Any number that <u>can be</u> expressed as the ratio of two integers, or any number that <u>can be</u> expressed as a repeating decimal number.

$\frac{2}{3}$, $-\frac{1}{10}$, $\frac{11}{4}$, $4.\overline{3}$, $-6.1\overline{78}$

$8 \rightarrow \frac{8}{1} \rightarrow 8.\overline{0}$, $0 \rightarrow \frac{0}{1} \rightarrow 0.\overline{0}$

$-3\frac{4}{5} \rightarrow -\frac{19}{5} \rightarrow -3.8,$

$6\frac{3}{11} \rightarrow \frac{69}{11} \rightarrow 6.\overline{27}$

$\sqrt{100} \rightarrow 10 \rightarrow \frac{10}{1}, \rightarrow 10.\overline{0}$

IRRATIONAL NUMBERS (Ir): Any number whose decimal representation <u>can **not** be</u> expressed as the ratio of two integers, or any number whose decimal representation <u>can **not** be</u> expressed as a repeating decimal number.

$\sqrt{5} \rightarrow 2.236067977 \ldots,$

$\sqrt[3]{25} \rightarrow 2.924017738 \ldots$

$1.232332333 \ldots,$

$105.467269765488541...$

$\pi \approx 3.1415926 \ldots$

REAL NUMBERS (R): Any number that is either rational or irrational (every number you have ever worked with is probably a real number.)

List as many of the symbols, **R, Q, Ir, Z, W, N,** that represent sets to which the given number belongs.

1. 2.5 :_____
2. $-\frac{4}{9}$:_____
3. 15 :_____
4. $-\sqrt{36}$:_____
5. $8\frac{7}{8}$:_____
6. 0.515515551 . . . :_____
7. $6.\overline{243}$:_____
8. -534 :_____
9. $\sqrt{5}$:_____
10. 0 :_____

Given the set of numbers $\left\{-50,\ 1.\overline{5},\ 0,\ \sqrt{10},\ \frac{4}{5},\ 30,\ -4\frac{2}{3},\ 4.636633666333...,\ 5.2,\ \sqrt{9},\ -\frac{24}{8}\right\}$, list the numbers from the set that belong to each number set.

Natural Numbers:_____ Integers_____

Real Numbers:_____ Whole Numbers:_____

Rational Numbers_____ Irrational Numbers_____

Mathematical Expressions: A number, a variable or a combination of a number(s) and/or variable(s) joined together by mathematical operations and/or functions.

Mathematical Sentences: Two expressions joined together by an equal sign (making an"equation") or by and inequality symbol (making an "inequality").

Order Property for Real Numbers: If $a > b$, then a is located to the right of b on the real number line.

Absolute Value: The absolute value is a measure of the number's distance from zero on the number line.

$|9| = 9$ $|-12| = 12$ $\left|-\frac{3}{5}\right| = \frac{3}{5}$ $|-1.325| = 1.325$ $|x| = \begin{cases} x & if\ x \geq 0 \\ -x & if\ x < 0 \end{cases}$

$\left|-\frac{9}{10}\right| =$ _____ $\left|5\frac{3}{4}\right| =$ _____ $|-6.002| =$ _____ $|.0003| =$ _____ $|0| =$ _____

Mathematical Sentences: Place a "=" , "<", or ">" between the expressions to make a true statement.

0 _____ -7 -11 _____ -20 -2 _____ 1 $\frac{10}{5}$ _____ 2 $-\frac{3}{8}$ _____ $-.375$ 0 _____ $\frac{1}{9}$

0 _____ $|-5|$ $\left|-\sqrt{9}\right|$ _____ $|3|$ $|-0.\overline{5}|$ _____ $\left|\frac{5}{9}\right|$ $|-7.2|$ _____ $|3.5190654|$

Prime Numbers: Any natural number (other than 1) for which the only integer factors are the number "1" and the number itself. 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, etc…

Composite Numbers: The natural numbers (other than 1) that are not prime.

4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24, 25, 26, 27, 28, 30, etc….

Fundamental Principle of Fractions: If $\frac{a}{b}$ is a fraction of relatively prime numbers and c is a nonzero real number, then $\frac{a \cdot c}{b \cdot c} = \frac{a}{b}$. Note**: *a* and *b* are relatively prime means they have no common factor.**

$\frac{10}{15} = \frac{2 \cdot 5}{3 \cdot 5} = \frac{2}{3}$ $-\frac{24}{20} = -\frac{6 \cdot 4}{5 \cdot 4} = -\frac{6}{5}$ $\frac{45}{72} = \frac{5 \cdot 9}{8 \cdot 9} = \frac{5}{8}$ $-\frac{144}{84} = -\frac{12 \cdot 12}{7 \cdot 12} = -\frac{12}{7}$ or $-1\frac{5}{7}$

$\frac{40}{50} =$ $-\frac{64}{24} =$ $\frac{150}{180} =$

A **fraction of relatively prime i**ntegers is said to be in **lowest terms** or **simplified** form.

Examples: $\frac{9}{10}, \frac{6}{25}, \frac{8}{15}, \frac{4}{21}, \frac{15}{16}, \frac{21}{100}, \frac{36}{25}, \frac{12}{35}, \frac{45}{32}, \frac{81}{100}, \frac{27}{16}$ these fractions cannot be reduced or simplified any further. "1" is the greatest common factor of each pair of numerator and denominator.

Prime Factorization: $12 = 4 \cdot 3$, $12 = 2 \cdot 2 \cdot 3$; $24 = 4 \cdot 6$, $24 = 2 \cdot 2 \cdot 2 \cdot 3$, $24 = 2^3 \cdot 3$; $60 = 6 \cdot 10$, $60 = 2 \cdot 3 \cdot 2 \cdot 5$, $60 = 2^2 \cdot 3 \cdot 5$; $900 = 9 \cdot 100$, $900 = 3 \cdot 3 \cdot 10 \cdot 10$, $900 = 3 \cdot 3 \cdot 2 \cdot 5 \cdot 2 \cdot 5$, $900 = 2^2 \cdot 3^2 \cdot 5^2$

$\frac{18}{24} = \frac{2 \cdot 3 \cdot 3}{2 \cdot 2 \cdot 2 \cdot 3} = \frac{3}{2 \cdot 2} \cdot \frac{2}{2} \cdot \frac{3}{3} \cdot = \frac{3}{4}$ $\quad$ $\frac{60}{80} = \frac{2 \cdot 2 \cdot 3 \cdot 5}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 5} = \frac{3}{2 \cdot 2} \cdot \frac{2}{2} \cdot \frac{2}{2} \cdot \frac{5}{5} \cdot = \frac{3}{4}$

$\frac{108}{160} = \frac{2 \cdot 2 \cdot 3 \cdot 3 \cdot 3}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 5} = \frac{3 \cdot 3 \cdot 3}{2 \cdot 2 \cdot 2 \cdot 5} \cdot \frac{2}{2} \cdot \frac{2}{2} = \frac{27}{40}$ $\quad$ $\frac{90}{105} = \frac{2 \cdot 3 \cdot 3 \cdot 5}{3 \cdot 5 \cdot 7} = \frac{2 \cdot 3}{7} \cdot \frac{3}{3} \cdot \frac{5}{5} = \frac{6}{7}$

$\frac{96}{160} =$

$\frac{244}{360} =$

Multiplying Fractions:

$\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$, *if* $b \neq 0$ *and* $d \neq 0$ multiply the tops together and multiply the bottoms together

Examples: $\frac{2}{3} \cdot \frac{4}{5} = \frac{8}{15}$ $\quad$ $\frac{5}{8} \cdot \frac{2}{7} = \frac{10}{56} = \frac{5}{28}$ $\quad$ $\frac{11}{15} \cdot \frac{8}{9} = \frac{88}{135}$

$\frac{10}{27} \cdot \frac{9}{25} = \frac{2 \cdot 5}{3 \cdot 9} \cdot \frac{9}{5 \cdot 5} = \frac{2}{15}$

$\frac{7}{30} \cdot \frac{25}{28} = \frac{7}{5 \cdot 6} \cdot \frac{5 \cdot 5}{4 \cdot 7} = \frac{5}{24}$ $\quad$ $\frac{88}{45} \cdot \frac{25}{36} = \frac{4 \cdot 22}{5 \cdot 9} \cdot \frac{5 \cdot 5}{4 \cdot 9} = \frac{110}{81}$

$\frac{7}{11} \cdot \frac{2}{3} =$ $\quad$ $\frac{15}{16} \cdot \frac{20}{27} =$ $\quad$ $\frac{8}{15} \cdot \frac{25}{32} =$

Dividing Fractions: $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c}$, *if* $b \neq 0$, d $\neq 0$ *and* c $\neq 0$ **Reciprocal** of $\frac{c}{d}$ *is* $\frac{d}{c}$. Their product is 1.

$\frac{3}{5} \div \frac{2}{7} = \frac{3}{5} \cdot \frac{7}{2} = \frac{21}{10}$ $\quad$ $\frac{9}{10} \div \frac{3}{4} = \frac{9}{10} \cdot \frac{4}{3} = \frac{3 \cdot 3}{2 \cdot 5} \cdot \frac{2 \cdot 2}{3} = \frac{6}{5}$

$\frac{20}{21} \div \frac{16}{35} = \frac{20}{21} \cdot \frac{35}{16} = \frac{4 \cdot 5}{3 \cdot 7} \cdot \frac{5 \cdot 7}{4 \cdot 4} = \frac{25}{12}$

$\frac{5}{18} \div \frac{7}{12} =$ $\quad$ $\frac{16}{9} \div \frac{8}{15} =$

$\frac{27}{40} \div \frac{63}{25} =$ $\frac{32}{45} \div \frac{28}{75} =$

To add or subtract fractions with like denominators: $\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$ and $\frac{a}{c} - \frac{b}{c} = \frac{a-b}{c}$

$\frac{2}{9} + \frac{5}{9} = \frac{2+5}{9} = \frac{7}{9}$ $\frac{7}{10} - \frac{4}{10} = \frac{7-4}{10} = \frac{3}{10}$ $\frac{17}{18} - \frac{11}{18} = \frac{17-11}{18} = \frac{6}{18} = \frac{1 \cdot 6}{3 \cdot 6} = \frac{1}{3}$

$\frac{19}{24} - \frac{7}{24} =$ $\frac{13}{30} + \frac{11}{30} =$

$12\frac{1}{3} + 4\frac{5}{6} = 12\frac{2}{6} + 4\frac{5}{6} = 16\frac{7}{6} = 17\frac{1}{6}$

$8\frac{4}{5} - 2\frac{7}{8} = 8\frac{32}{40} - 2\frac{35}{40} = 7\frac{72}{40} - 2\frac{35}{40} = 5\frac{37}{40}$

$18\frac{7}{16} + 5\frac{2}{3} =$ $10\frac{2}{9} - 4\frac{5}{6} =$

Multiply and Divide Mixed Numbers:

$2\frac{1}{2} \cdot 4\frac{2}{3} = \frac{5}{2} \cdot \frac{14}{3} = \frac{5}{2} \cdot \frac{2 \cdot 7}{3} = \frac{35}{3} = 11\frac{2}{3}$ $3\frac{1}{3} \div 1\frac{1}{4} = \frac{10}{3} \div \frac{5}{4} = \frac{10}{3} \cdot \frac{4}{5} = \frac{2 \cdot 5}{3} \cdot \frac{4}{5} = \frac{8}{3} = 2\frac{2}{3}$

$4\frac{4}{5} \cdot 2\frac{3}{16} =$ $3\frac{3}{4} \div 3\frac{1}{8} =$

$2\frac{3}{10} \cdot 5 = \frac{23}{10} \cdot \frac{5}{1} = \frac{23}{2 \cdot 5} \cdot \frac{5}{1} = \frac{23}{2} = 11\frac{1}{2}$ $4\frac{3}{8} \div 7 = \frac{35}{8} \div \frac{7}{1} = \frac{35}{8} \cdot \frac{1}{7} = \frac{5 \cdot 7}{8} \cdot \frac{1}{7} = \frac{5}{8}$

$2\frac{5}{8} \cdot 12 =$ $4\frac{4}{9} \div 50 =$

$30 \cdot 2\frac{3}{20} = \frac{30}{1} \cdot \frac{43}{20} = \frac{3 \cdot 10}{1} \cdot \frac{43}{2 \cdot 10} = \frac{3}{1} \cdot \frac{43}{2} = \frac{129}{2} = 64\frac{1}{2}$

$24 \div 6\frac{2}{5} = \frac{24}{1} \div \frac{32}{5} = \frac{24}{1} \cdot \frac{5}{32} = \frac{3 \cdot 8}{1} \cdot \frac{5}{4 \cdot 8} = \frac{3}{1} \cdot \frac{5}{4} = \frac{15}{4} = 3\frac{3}{4}$

$10 \cdot 1\frac{3}{8} =$ $25 \div 2\frac{3}{16} =$