1.2: Exponents, Square roots, and the order of operations

Exponents: "What is four squared?" $\boxed{16}$

"What is negative four squared?"

$$-4^2 = \boxed{-16}$$

$$(-4)^2 = \boxed{16}$$

Example:

$$3^4 = (3)(3)(3)(3) = 81$$

$$2^5 = (2)(2)(2)(2)(2) = 32$$

$$(-5)^3 = (-5)(-5)(-5) = 25(-5) = -125$$

$$(-5)^4 = (-5)(-5)(-5)(-5)$$

$$= 25(-5)(-5)$$

$$= -125(-5)$$

$$= \boxed{625}$$

on calculator:

2^5

or

2 y^x 5

x^y

Square roots:

Example: "What are the square roots of 81?"

("What can you square to get 81?")

Answers: 9 and -9

$\sqrt{}$ means the principal square root, which is the positive one.

So, $\sqrt{81} = \boxed{9}$

Note: $\sqrt{0} = \boxed{0}$

$\sqrt{16} = \boxed{4}$

Order of Operations:

Key ideas:

- Operations within grouping symbols are done first.

Grouping symbols: Parentheses ( )

Brackets [ ] - act like parentheses

Fraction bars

Absolute Value

Square roots

- multiplication and division are done before addition and subtraction.

- multiplication and division are done left to right.

- exponents apply only to their base.

Ex: $3-7(5)$ Same as $3-7\cdot5$

$= 3-35$

$= \boxed{-32}$

Ex: (Part d from RR 2): $6-2(3+4)$

$6-2(7)$

$6-14 = \boxed{-8}$

Ex: $50 \div 10 \cdot 3 \div 2$

$= 5 \cdot 3 \div 2$

$= 15 \div 2$

$= \boxed{\frac{15}{2}}$ or $\boxed{7\frac{1}{2}}$ or $\boxed{7.5}$

Ex: $6 + (5 - 7(3))$

$= 6 + (5 - 21)$

$= 6 + (-16)$

$= 6 - 16 = \boxed{-10}$

Ex: $\dfrac{16 - 8 \div 4}{4 + 8 \div 4 - 2}$

$= \dfrac{16 - 2}{4 + 2 - 2}$

$= \dfrac{14}{4}$

$= \dfrac{\cancel{14}^{7}}{\cancel{4}_{2}} = \boxed{\frac{7}{2}}$

Ex: $15 - 3^2 + 4(7)$

$= 15 - 9 + 28$

$= 6 + 28 = \boxed{34}$

Ex: $4 + (3 - 2(5+1) + 4^2) - 7$

$= 4 + (3 - 2(6) + 16) - 7$

$= 4 + (3 - 12 + 16) - 7$

$= 4 + (-9 + 16) - 7$

$= 4 + (7) - 7$

$= 4 + 0$

$= \boxed{4}$

1.3: Addition of Real Numbers

Ex: $4 + (-2) + 6 + (-3)$

$= \underbrace{4 - 2}_{2} + \underbrace{6 - 3}_{3}$

$= 2 + 3$

$= \boxed{5}$

Ex: $-7 + (-12)$

$= -7 - 12$

$= \boxed{-19}$

Ex: Translate to an algebraic expression.

5 more than $\underbrace{\text{a number}}$

Let x represent the unknown number.

x is a variable.

$\boxed{x + 5}$ or $5 + x$

Ex: 3 less than $\underbrace{\text{twice a number}}_{2x}$

$\boxed{2x - 3}$

Note: $3 - 2x$ is incorrect

end of 1.3

1.4: Subtraction of Real numbers

Ex: $5+(-7)$ is the same as $5-7$ equal to $\boxed{-2}$

Ex: $-10-8$ same as $-10+(-8)$

$= \boxed{-18}$

Ex: $29-7$

$\boxed{22}$

Ex: $-29+7$

$\boxed{-22}$

Ex: $7-29$

$\boxed{-22}$

Ex: $-7+29$

$\boxed{22}$

Ex: $7+29$

$\boxed{36}$

Ex: $-7-29$

$\boxed{-36}$

Ex: $-29-7$

$\boxed{-36}$

Ex: $5-(-6)$ same as $5-1(-6)$

$= 5+6$

$= 11$

$= 5+6$

$= \boxed{11}$

Ex: $-\frac{3}{5}-\left(-\frac{1}{5}\right) = -\frac{3}{5}+\frac{1}{5}$

$= \frac{-3}{5}+\frac{1}{5} = \frac{-2}{5} = \boxed{-\frac{2}{5}}$

1.5.1

1.5: Multiplication and Division of Real Numbers

We indicate multiplication with a dot or parentheses.

Ex: $3(5) = \boxed{15}$

$3 \cdot 5 = \boxed{15}$

Ex: $3(-5) = \boxed{-15}$ (Don't write $3 \cdot -5$)

$-3(-5) = \boxed{15}$

Ex: $-3(5) = \boxed{-15}$

Ex: $\frac{1}{4}\left(\frac{3}{5}\right) = \boxed{\frac{3}{20}}$

Ex: $-\frac{2}{7}\left(-\frac{3}{4}\right) = +\frac{\cancel{6}^{3}}{\cancel{28}_{14}} = \boxed{\frac{3}{14}}$

Ex: $\frac{5}{7}(-3) = \frac{5}{7}\left(\frac{-3}{1}\right) = \boxed{-\frac{15}{7}}$ OR $\boxed{-2\frac{1}{7}}$

Division

$$\frac{40}{8} = 5$$

because $8(\underset{5}{?}) = \boxed{40}$

Ex: $\frac{-40}{8} = \boxed{-5}$

$8(\underset{-5}{?}) = -40$

$$\frac{-40}{-8} = \boxed{5}$$

$-8(\underset{5}{?}) = -40$

Note: $\frac{40}{8}$ is the same as $40 \div 8$

Ex: $\frac{0}{12} = \boxed{0}$

because $12(\underset{0}{?}) = 0$

Ex: $\frac{12}{0}$ is $\boxed{\text{undefined}}$

because $0(?) = 12$ is impossible

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Important: Division by 0 is <u>undefined</u>.
We can never have a zero denominator

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Note: $\frac{-2}{8} = -\frac{1}{4}$

$\frac{2}{-8} = -\frac{1}{4}$

$-\frac{2}{8} = -\frac{1}{4}$

So, all these are equivalent.

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

$\frac{-2}{-8} = \frac{1}{4}$

Division with fractions

$\frac{2}{3} \div 4$ Rewrite: $\frac{2}{3} \cdot \frac{1}{4} = \frac{\cancel{2}^{1}}{\cancel{12}_{6}} = \boxed{\frac{1}{6}}$

Dividing by a number is equivalent to multiplying by its reciprocal.

Note: Reciprocal is 4 is $\frac{1}{4}$. Note: $4 = \frac{4}{1}$

Reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$.

Reciprocal of $-\frac{3}{5}$ is $-\frac{5}{3}$.

Two numbers are reciprocals if you get 1 when you multiply them.

1.5.4

Ex: $\frac{3}{5} \div \frac{2}{9}$

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

Ex: $-\frac{3}{4} \div (-6)$ or $\frac{-3/4}{-6}$

$= -\frac{3}{4} \div \frac{-6}{1}$

$= -\frac{3}{4}\left(-\frac{1}{6}\right) = \frac{\cancel{3}^{1}}{\cancel{24}_{8}} = \boxed{\frac{1}{8}}$