**EVALUATE ALGEBRAIC EXPRESSIONS** means to find its numerical value.

**ORDER OF OPERATIONS** is a method used to evaluate an expression involving more than one operation. In algebraic expressions, it can only by evaluated if the values of the variables are known.

|  |  |
| --- | --- |
| **Step 1** | Replace the variables with their numerical values. |
| **Step 2** | Evaluate expressions inside grouping symbols. |
| **Step 3** | Evaluate all powers. |
| **Step 4** | Do all multiplications and/or divisions from left to right. |
| **Step 5** | Do all additions and/or subtractions from left to right. |

**Example**: Evaluate $z^{4}-3$, if $z=2$.

|  |  |  |  |
| --- | --- | --- | --- |
| $$z^{4}-3$$ | $$=$$ | $$2^{4}-3$$ | Replace $z$with$ 2$. |
|  | $$=$$ | $$16-3$$ | Evaluate $2^{4}$ |
| $$z^{4}-3$$ | $$=$$ | $$13$$ | Subtract $16$ and $3$ |

**Sample Problem 1**: Evaluate each expression if $x=2$, $y=4$, and $z=6$.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | $$x^{3}+10y$$ | $$=2^{3}+10⋅4$$ | $$=8+40$$ | $$=48$$ |
|  | $$\frac{22}{x}+16$$ | $$=\frac{22}{2}+16$$ | $$=11+16$$ | $$=27$$ |
|  | $$\frac{z}{3}+y$$ | $$=\frac{6}{3}+4$$ | $$=2+4$$ | $$=6$$ |
|  | $$y+z+x$$ | $$=4+6+2$$ | $$=12$$ |  |
|  | $$x+5$$ | $$=2+5$$ | $$=7$$ |  |

**GROUPING SYMBOLS**, such as parentheses $\left(\right)$ or brackets$ \left[\right]$, indicate the order in which the operations should be performed first.

**Example**: Evaluate $a^{2}-\left(b^{3}-4c\right)$, if $a=8$, $b=5$, and $c=3$.

|  |  |  |  |
| --- | --- | --- | --- |
| $$a^{2}-\left(b^{3}-4c\right)$$ | $$=$$ | $$8^{2}-\left(5^{3}-4⋅3\right)$$ | Replace $a$with$ 8$, $b$with$5$, and $c$with$3$. |
|  | $$=$$ | $$64-\left(125-4⋅3\right)$$ | Evaluate $8^{2}$ **and** $5^{3}$ |
|  | $$=$$ | $$64-\left(125-12\right)$$ | Multiply $4$and$3$ |
|  | $$=$$ | $$64-113$$ | Subtract $125$ and $12$ |
| $$a^{2}-\left(b^{3}-4c\right)$$ | $$=$$ | $$-49$$ | Subtract $64$ from $113$ |

**Sample Problem 2**: Evaluate each expression if $r=4$, $s=6$, $t=3$, and $u=12$.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | $$2r+st^{2}-u$$ | $$=2\left(4\right)+\left(6\right)\left(3^{2}\right)-12$$ | $$=8+6\left(9\right)-12$$ | $$=54-4$$ | $$=50$$ |
|  | $$tu-rs$$ | $$=\left(3\right)\left(12\right)-\left(4\right)\left(6\right)$$ | $$=36-24$$ | $$=12$$ |  |
|  | $$st-4r$$ | $$=\left(6\right)\left(3\right)-4\left(4\right)$$ | $$=18-16$$ | $$=2$$ |  |
|  | $$r^{3}+u+s^{t}$$ | $$=4^{3}+12+6^{3}$$ | $$=64+12+216$$ | $$=292$$ |  |
|  | $$tu-3r$$ | $$=\left(3\right)\left(12\right)-3\left(4\right)$$ | $$=36-12$$ | $$=24$$ |  |

**FRACTION BAR** is another type of grouping symbol. It indicates that the numerator and denominator should each be treated as a single value.

**Example**: Evaluate$ \frac{x^{2}-1}{4y^{2}}$, if $x=9$, and $y=2$.

|  |  |  |  |
| --- | --- | --- | --- |
| $$\frac{x^{2}-1}{4y^{2}}$$ | $$=$$ | $$\frac{9^{2}-1}{4⋅2^{2}}$$ | Replace $x$with$ 9$, and $y$with$2$. |
|  | $$=$$ | $$\frac{81-1}{4⋅4}$$ | Evaluate $9^{2}$ **and** $2^{2}$ |
|  | $$=$$ | $$\frac{81-1}{16}$$ | Multiply $4$and$81$ |
|  | $$=$$ | $$\frac{80}{16}$$ | Subtract $81$ from $1$ |
| $$\frac{x^{2}-1}{4y^{2}}$$ | $$=$$ | $$5$$ | Divide $80$ to $16$ |

**Sample Problem 3**: Evaluate each expression if $r=4$, $s=6$, $t=3$, and $u=12$.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | $$\frac{2r\left(s-t\right)}{tu-s}$$ | $$=\frac{2\left(4\right)\left(6-3\right)}{\left(3\right)\left(12\right)-6}$$ | $$=\frac{8\left(3\right)}{36-6}$$ | $$=\frac{24}{30}$$ | $$=\frac{4}{5}$$ |  |
|  | $$\frac{u}{s}+\frac{3s}{t^{2}}$$ | $$=\frac{12}{6}+\frac{3\left(6\right)}{3^{2}}$$ | $$=2+\frac{18}{9}$$ | $$=2+2$$ | $$=4$$ |  |
|  | $$\frac{rs^{2}-3u}{2}$$ | $$=\frac{\left(4\right)\left(6^{2}\right)-3\left(12\right)}{2}$$ | $$=\frac{4\left(36\right)-36}{2}$$ | $$=\frac{144-36}{2}$$ | $$=\frac{108}{2}$$ | $$=54$$ |
|  | $$\frac{3r+s}{t^{2}-s}$$ | $$=\frac{3\left(4\right)+6}{3^{2}- 6}$$ | $$=\frac{12+6}{9-6}$$ | $$=\frac{18}{3}$$ | $$=6$$ |  |
|  | $$\frac{2u+s^{2}}{r+2t}$$ | $$=\frac{2\left(12\right)+6^{2}}{ 4+2\left(3\right)}$$ | $$=\frac{24+36}{4+6}$$ | $$=\frac{60}{10}$$ | $$=6$$ |  |