**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 $z^{3}-3$, if $z=1$.

|  |  |  |  |
| --- | --- | --- | --- |
| $$z^{3}-3$$ | $$=$$ | $$1^{3}-3$$ | Replace $z$with$ 1$. |
|  | $$=$$ | $$1-3$$ | Evaluate $1^{3}$ |
| $$z^{3}-3$$ | $$=$$ | $$-2$$ | Subtract $1$ and $3$ |

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | $$x^{3}+10y$$ | $$=1^{3}+10⋅2$$ | $$=1+20$$ | $$=21$$ |
|  | $$\frac{22}{x}+10$$ | $$=\frac{22}{1}+10$$ | $$=22+10$$ | $$=32$$ |
|  | $$\frac{z}{2}+2y$$ | $$=\frac{4}{2}+2(2)$$ | $$=2+4$$ | $$=6$$ |
|  | $$y+z+x$$ | $$=2+4+1$$ | $$=7$$ |  |
|  | $$x^{3}+10y$$ | $$=1^{3}+10⋅2$$ | $$=1+20$$ | $$=21$$ |

**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 $r=1$, $s=3$, $t=3$, and $u=10$.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | $$2r+st^{2}-u$$ | $$=2\left(1\right)+\left(3\right)\left(3^{2}\right)-10$$ | $$=2+3\left(9\right)-10$$ | $$=29-10$$ | $$=19$$ |
|  | $$tu-rs$$ | $$=\left(3\right)\left(10\right)-\left(1\right)\left(3\right)$$ | $$=30-3$$ | $$=27$$ |   |
|  | $$st-4r$$ | $$=\left(3\right)\left(3\right)-4\left(1\right)$$ | $$=9-4$$ | $$=5$$ |   |
|  | $$r^{3}+u+s^{t}$$ | $$=1^{3}+10+3^{3}$$ | $$=1+10+27$$ | $$=38$$ |   |
|  | $$tu-3r$$ | $$=\left(3\right)\left(10\right)-3\left(1\right)$$ | $$=30-3$$ | $$=27$$ |   |

**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 $r=2$, $s=4$, $t=6$, and $u=8$.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | $$\frac{2r\left(s-t\right)}{tu-s}$$ | $$=\frac{2\left(2\right)\left(4-6\right)}{\left(6\right)\left(8\right)-4}$$ | $$=\frac{4\left(-2\right)}{48-4}$$ | $$=\frac{-8}{44}$$ | $$=-\frac{2}{11}$$ |
|  | $$\frac{u}{s}+\frac{3s}{t^{2}}$$ | $$=\frac{8}{4}+\frac{3\left(4\right)}{6^{2}}$$ | $$=2+\frac{12}{36}$$ | $$=2+\frac{1}{3}$$ | $$=\frac{7}{3}$$ |
|  | $$\frac{rs^{2}-3u}{2}$$ | $$=\frac{\left(2\right)\left(4^{2}\right)-3\left(8\right)}{2}$$ | $$=\frac{4\left(16\right)-24}{2}$$ | $$=\frac{64-24}{2}$$ | $$=\frac{40}{2}=20$$ |
|  | $$\frac{3r+s}{t^{2}-s}$$ | $$=\frac{3\left(2\right)+4}{6^{2}-4}$$ | $$=\frac{6+4}{36-4}$$ | $$=\frac{10}{32}$$ | $$=\frac{5}{16}$$ |
|  | $$\frac{2u+s^{2}}{r+2t}$$ | $$=\frac{2\left(8\right)+4^{2}}{ 2+2\left(6\right)}$$ | $$=\frac{16+16}{2+12}$$ | $$=\frac{32}{14}$$ | $$=\frac{16}{7}$$ |