1.8

Exponents

Recall that the product is the answer to multiplication
Factors - numbers being multiplied.

ex $2 \cdot 5 = 10$

- 2 & 5 are factors, 10 is product

Exponent - used to indicate repeated multiplication.

Base - number repeatedly multiplied.

ex $3^4 = (3)(3)(3)(3) = 81$, read "three to the 4th power" or "the 4th power of 3"

↑ exponent
base

$3 \cdot 5^2 = 3 \cdot 5 \cdot 5 = 3 \cdot 25 = 75$

$(-2)^2 = (-2)(-2) = 4$

$-2^2 = -(2)(2) = -4$

$3x^2 = 3 \cdot x \cdot x$

$a \cdot a \cdot a \cdot a \cdot 4 = 4a^4$

BE CAREFUL! Exponents are multiplication, addition is $3+3+3+3 = 4(3)$
the 2nd power is 'squared', the 3rd is 'cubed'

Order of Operations

Consider the expression $5+2 \cdot 8$, there are two ways to continue

Method 1: Multiply 1st

$5+2 \cdot 8 = 5+16$
$= 21$

Method 2: Add 1st

$5+2 \cdot 8 = 7 \cdot 8$
$= 56$

So which answer is correct?

We need order of operations

Multiply (doing exponents 1st)
Divide
Add
Subtract

ex $12 - 2 \cdot 5 = 12 - 10$
$= 2$

$\frac{6}{3} + 2 \cdot 9^2 = \frac{6}{3} + 2 \cdot 81$
$= \frac{6}{3} + 162$
$= 2 + 162$
$= 164$

$\frac{3 \cdot 6}{9} + (4^2)(2^3) - 7 \cdot 2 = \frac{18}{9} + (16)(8) - 14$
$= \frac{18}{9} + 128 - 14$
$= 2 + 128 - 14$
$= 130 - 14$
$= 116$

Grouping Symbols

What if we want to evaluate an expression in a different order, we use grouping symbols.

new order of operations

Do all calculations within grouping symbols (following order of operations) starting at 'innermost'

↓ means the ones on the inside

Multiplication (including exponents)
Divide
Add
Subtract

Grouping symbols are ( ), [ ], { }, —

ex $20-(6+2)=20-8$
$=12$

$(5-2)^2+4=3^2+4$
$=9+4$
$=13$

$5^2-2(2+3\cdot2)=5^2-2(2+6)$
$=5^2-2(8)$
$=25-16$
$=9$

$\frac{3(2+1)-5}{3\cdot4-2^2}=\frac{3(3)-5}{3\cdot4-2^2}$
$=\frac{9-5}{12-4}$
$=\frac{4}{8}$
$=\frac{1}{2}$

$2+4[5-(3\cdot2+2)]=2+4[15-(6+2)]$
$=2+4[15-8]$
$=2+4[7]$
$=2+28$
$=30$

■

Applications

(ex) The amount that Julie likes Fred, denoted L, depends on the # of nice things Fred does, n by this formula

$$L = 1.2n + 0.7$$

If Fred has done 10 nice things, how much does Julie like him?

$$L = 1.2(10) + 0.7$$
$$L = 12 + 0.7$$
$$L = 12.7$$

Lots of Examples

(ex) $12 - 2 \cdot 3 = 12 - 6 = 6$

$15 + (30 - 4) = 15 + (26) = 41$

$100 - 8(10) + 60 = 100 - 80 + 60$
$= 20 + 60$
$= 80$

Groups
Powers
Multiplies
Divides
Adds } left to right
Subtracts }

$8.5 - 4 \div 2 = 40 - 4 \div 2 = 40 - 2 = 38$

$5(150 - 3^3) = 5(150 - 27) = 5(123) = 615$

CAREFUL! When using a fraction bar, we really have ( )/( )

$$\frac{(6-5)^4 + 21}{27 - 4^2} = \frac{[(6-5)^4 + 21]}{(27 - 4^2)} = \frac{[(1)^4 + 21]}{(27 - 16)} = \frac{(1+21)}{(11)} = \frac{22}{11} = 2$$

CAREFUL when using your calculator!