Multiplicative unit conversions:

Convert *a(unit m)* to *b(unit k)*

(#a stands for the number for *a*, #b stands for the number for *b*, #1 stands for the number for 1 and #2 stands for the number for 2)

Thus, below *a* = <#a>(*unit m*) and *b* = (#b)(*unit k*)

Operation	**Operation about to be performed**
-	From the definitions of *(unit m)* and *(unit k)*
<#1> (*unit m*) = <#2>(*unit k*)	The two unit factors from the conversion equation
$1 = \frac{\langle \#1 \rangle (unit\ k)}{\langle \#2 \rangle (unit\ m)}$ and $\frac{\langle \#2 \rangle (unit\ m)}{\langle \#1 \rangle (unit\ k)} = 1$	multiplying *a* by the appropriate unit factor.
$b = \langle \#a \rangle (unit\ m) \frac{\langle \#1 \rangle (unit\ k)}{\langle \#2 \rangle (unit\ m)}$	Eliminate (*unit m*)
$b = \langle \#a \rangle \frac{\langle \#1 \rangle (unit\ k)}{\langle \#2 \rangle}$	Evaluate right side.
$b = \left(\frac{\langle \#a \rangle \langle \#1 \rangle}{\langle \#2 \rangle} \right) (unit\ k)$ which is: $b = \langle \#b \rangle (unit\ k)$	Answer (or continue)
-	-

Use this technique **only** for converting multiplicative unit conversions.

Examples:

Convert 50.00 yd. to meters. The conversion factor is: 39.37 in = 1 m (exactly by definition)

-	Parsing
x = 50.00 yd.	Conversion factor yd ↔ in
1 yd = 36 in	2 unit factors
$1 = \frac{36\ \text{in}}{1\ \text{yd}}$ and $\frac{1\ \text{yd}}{36\ \text{in}} = 1$	Multiply 50 yd by correct unit facto
$x = (50.00\ \text{yd})\frac{36\ \text{in}}{1\ \text{yd}}$	Eliminate yd
$x = (50.00)\frac{36\ \text{in}}{1}$	Evaluate right side
x = 1800 in	conversion factor in ↔ m
39.37 in = 1 m	2 unit factors
$1 = \frac{1\ \text{m}}{39.37\ \text{in}}$ and $\frac{39.37\ \text{in}}{1\ \text{m}} = 1$	Multiply 1800 in by correct unit factor
$x = (1800\ \text{in})\frac{1\ \text{m}}{39.37\ \text{in}}$	eliminate in
$x = (1800)\frac{1\ \text{m}}{39.37}$	Evaluate right side
x = 45.72 m	
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Parsing a question:

Given the physical quantities *a*, *b* and *c*, and the unknown *x* .

a = <value>, *b* = <value>, *c* = <value>, *x* = ?	Parsing the question

Example:

Calculate the volume of a rectangular solid with the dimensions of 20 cm by 30 cm by 15 cm.

x = 20 cm, *y* = 30 cm, *z* = 15 cm *V* = ?	Parsing the question
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Presentation of Equations.

<number>) < definition equation>	Definition of <whatever> (Use a number for reference.)
<number>) <derived equation>	Derived equation.
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Example from the question above.

1) $\rho = \frac{m}{V}$	Definition of density
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Mathematical Manipulations:

Evaluation

$(2.0\ \text{g mL}^{-1})(10\ \text{mL}) = m$	Evaluate the left side
$m = 20\ \text{g}$	
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Multiplication:

$a = \frac{x}{b}$	Multiply both sides by “b”
$ba = x$	

Example:

$20\ \text{g mL}^{-1} = \frac{x}{10\ \text{mL}}$	Multiply both sides by “10 mL”
$(20\ \text{g mL}^{-1})(10\ \text{mL}) = x$	Evaluate the left side
$x = 200\ \text{g}$	

Division:

$bx = a$	Divide both sides by “b”
$x = \frac{a}{b}$	

Example:

$(0.20\ \text{mol L}^{-1})V = 0.010\ \text{mol}$	Divide both sides by “0.20 mol L^{-1} ”
$V = \frac{0.010\ \text{mol}}{0.20\ \text{mol L}^{-1}}$	Evaluate right side
$V = 0.050$ L	

Addition:

$x - a = b$	Add "*a*" to both sides
$x - a + a = b + a$	cancel + and –
$x = b + a$	
-	-

Example:

x – 15 g = 52 g	Add 15 g to both sides
x – 15 g + 15 g = 52 g + 15 g	cancel + and –
x = 52 g + 15 g	Evaluate right side
x = 67 g	
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Subtraction:

$x + a = b$	Subtract "*a*" from both sides
$x + a - a = b - a$	cancel + and –
$x = b - a$	
-	-

Example:

x + 15 g = 52 g	Add 15 g to both sides
x + 15 g – 15 g = 52 g – 15 g	cancel + and –
x = 52 g – 15 g	Evaluate right side
x = 37 g	Answer

Substitution:

$x = a$	Parsing the question
1) $y = f(x)$	Definition of <equation>
	Substituting a for x in 1)
$y = f(a)$	
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Example:

$m = 10.0$ g, $V = 7.5$ mL	Parsing the question
1) $\rho = \frac{m}{V}$	Definition of density
	Substituting m and V into 1)
$\rho = \frac{10.0\ \text{g}}{7.5\ \text{mL}}$	Evaluating the right side
$\rho = 1.33\ \text{g mL}^{-1}$	Answer

Significant Figures:

Addition and Subtraction:

xxx.xx + yy.yyyy	Evaluate
zzz.zzzz....	+ & - rule. Least number of digits past decimal
zzz.zz	Rounded { up since next digit is 5 or greater / down since next digit is 4 or less }
-	-

Example:	
210.324 + 500.1	Evaluate
710.424	+ & - rule. Least number of digits past decimal
710.4	Rounded down since next digit is 4 or less
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Multiplication and division:

$\frac{xx.x}{y.y}$	Evaluate
z.zzzzzzz....	× & ÷ rule. Use least number of significant figures
z.z	Rounded { up since next digit is 5 or greater / down since next digit is 4 or less }
-	-

Example:

$\frac{7.5345}{13.1}$	Evaluate
0.5751527...	× & ÷ rule. Use least number of significant figures
0.575	Rounded down since next digit is 4 or less
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Answer:

Label the answer as such when finished. Example:

$\rho = 19.34\ g\ mL^{-1}$	Answer

Approximations:

$K = \frac{x(a+x)}{(a-x)}$	Ignore *x* in () by assuming $x << a$, (check later)
$K = \frac{x(a)}{(a)}$	Simplify - cancel an *a*
$K = x$	Answer
$x << a$	Approx. true ⇒ ∴ answer correct.

Example:

$1.8\times10^{-4} = \frac{(x)(0.010+x)}{(0.020-x)}$	Ignore *x* in () by assuming $x << 0.010$ (< 0.020)
$1.8\times10^{-4} = \frac{(x)(0.010)}{(0.020)}$	Evaluate right side.
$1.8\times10^{-4} = (x)(0.50)$	Divide both sides by 0.50
$\frac{1.8\times10^{-4}}{0.50} = x$	Evaluate left side.
$3.6\times10^{-4} = x$	Answer
$x << 0.010 < 0.020$	Approx. true ⇒ ∴ answer correct.

Note: If in the check $x < a$ (only smaller than but significant) then one is advised to use successive approximations to get the answer. If *x* in the check is $x > a$ then an alternative method needs to be found.

Parametric Eqautions:

<number>) < parametric eq.>	P. E. from <original equation>
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Examples:

4) $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$	P. E. from ideal gas: $PV = nRT$
5) $C_1V_1 = C_2V_2$	P.E. from *c* def: $C = \frac{n}{V}$
6) $\frac{C_1V_1}{\upsilon_1} = \frac{C_2V_2}{\upsilon_2}$	P. E. from def: $C = \frac{n}{V}$ and stoich $\frac{n_1}{\upsilon_1} = \frac{n_2}{\upsilon_2}$
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Constants:

a = <value (include units!)>	<name> constant
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Example:

R = 0.08206 L atm K^{-1} mol^{-1}	Gas constant
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