Stoichiometry: BCA Table vs. Dimensional Analysis - Two methods to solve.

Both require the mole ratio from the balanced equation.

Use the following balanced equation to answer Questions 1-4. **$2\,C\,(s) + 2\,H_2O\,(l) \rightarrow CH_4\,(g) + CO_2\,(g)$**

1. Using **B-C-A**, what mass in grams of CH_4 would be produced from the complete reaction of 4.00 mole of carbon?

	$2C(s)$	+	$2H_2O(\ell)$	→	$CH_4(g)$	+	$CO_2(g)$
B:	4.00 mole		.....		∅ ?		.....
C:	-4.00 mole				$+4.00\,\text{mole}\left(\frac{1\,CH_4}{2C}\right)$		
A:	∅ mole C				2.00 mol CH_4		

$$2.00\,\text{mol}\,CH_4 \left| \frac{16.05\,g\,CH_4}{1\,\text{mole}\,CH_4} \right. = \boxed{32.1\,g\,CH_4}$$

2. Using **dimensional analysis**, what mass in grams of CH_4 would be produced from the complete reaction of 4.00 mole of carbon?

$2C + 2H_2O \rightarrow CH_4 + CO_2$

$$4.00\,\text{mol}\,C \left| \frac{1\,\text{mol}\,CH_4}{2\,\text{mol}\,C} \right| \frac{16.05\,g\,CH_4}{1\,\text{mol}\,CH_4} = \boxed{32.1\,g\,CH_4}$$

From Rxn ↑ Conversion ↑

3. Using **B-C-A**, how many moles of H_2O are needed to produce 25.0 grams of CH_4?

$$25.0\,g\,CH_4 \left| \frac{1\,\text{mole}\,CH_4}{16.05\,g\,CH_4} \right. = 1.56\,\text{mol}\,CH_4$$

	$2C$	+	$2H_2O$	→	CH_4	+	CO_2
B:	.....		? ∅		1.56 mol		.....
C:			$+1.56\,\text{mol}\left(\frac{2H_2O}{1\,CH_4}\right)$		-1.56 mol		
A:			$\boxed{3.12\,\text{mol}\,H_2O}$				

4. 4. Using **dimensional analysis**, how many moles of H_2O are needed to produce 25.0 grams of CH_4?

$2C + 2H_2O \rightarrow 1CH_4 + CO_2$

$$25.0\,g\,CH_4 \left| \frac{1\,mol\,CH_4}{16.05\,g\,CH_4} \right| \frac{2\,mol\,H_2O}{1\,mol\,CH_4} = 3.12\,mol\,H_2O$$

(1st fraction: conversion; 2nd fraction: from RXN)

Dimensional Analysis Conclusion Set- Up

Number with **unit** & **start** substance **formula** *from problem*	conversion: **1 mole** with **start** substance **formula**	From RXN: **Coefficients** from rxn **mole** with **end** substance **formula**	Conversion: **conversion value** desired **unit** with **end** substance **formula**
	conversion value of with **start** substance **formula**	**Coefficients** from rxn **mole** with **start** substance **formula**	**1 mole** with **end** substance **formula**

5. How many grams of ammonia, NH_3, are produced when 3.6×10^{23} molecules of nitrogen react with hydrogen?

$N_2 + 3\,H_2 \rightarrow 2\,NH_3$

$$3.6\times10^{23}\,molecules\,N_2 \left| \frac{1\,mole\,N_2}{6.02\times10^{23}\,molecules\,N_2} \right| \frac{2\,mol\,NH_3}{1\,mol\,N_2} \left| \frac{17.04\,g\,NH_3}{1\,mol\,NH_3} \right| = 20.\,g\,NH_3$$

6. When sulfur dioxide reacts with oxygen at STP, how many molecules of oxygen are needed to produce 19.8 L of sulfur trioxide? **$2\,SO_2 + O_2 \rightarrow 2\,SO_3$**

$$19.8\,L\,SO_3 \left| \frac{1\,mol\,SO_3}{22.4\,L\,SO_3} \right| \frac{1\,mol\,O_2}{2\,mol\,SO_3} \left| \frac{6.02\times10^{23}\,molecule\,O_2}{1\,mol\,O_2} \right|$$

$2.66\times10^{23}\,molecule\,O_2$

4. 4. Using **dimensional analysis**, how many moles of H_2O are needed to produce 25.0 grams of CH_4?

$$\frac{25.0\text{ g } CH_4}{16.05\text{ g } CH_4} \times \frac{1\text{ mole } CH_4}{1\text{ mol } CH_4} \times \frac{2\text{ mol } H_2O}{1\text{ mol } CH_4}$$

↑ Conversion ↑ ratio from Rxn

Dimensional Analysis Conclusion Set- Up

	Conversion	Ratio From Rxn	Conversion
Number with **unit** & **start** substance **formula** *from problem*	**1 mole** with **start** substance **formula**	**Coefficients** from rxn **mole** with **end** substance **formula**	**conversion value** desired **unit** with **end** substance **formula**
	conversion value of with **start** substance **formula**	**Coefficients** from rxn **mole** with **start** substance **formula**	**1 mole** with **end** substance **formula**

5. How many grams of ammonia, NH_3, are produced when 3.6×10^{23} molecules of nitrogen react with hydrogen?

$N_2 + 3\,H_2 \rightarrow 2\,NH_3$

$$\frac{3.6 \times 10^{23}\text{ molecules } N_2}{6.02 \times 10^{23}\text{ molecules } N_2} \times \frac{1\text{ mole } N_2}{} = 0.60\text{ mole } N_2$$

	N_2	+ $3H_2$	→ $2NH_3$
B:	0.6mole		?
C:	−0.6mole		+0.6mole $(\frac{2}{1})$
	Ø		1.2mole

$$\frac{1.2\text{ mole } NH_3}{1\text{ mole}} \times \frac{17.04\text{ g } NH_3}{} = 20.\text{g } NH_3$$

6. When sulfur dioxide reacts with oxygen at STP, how many molecules of oxygen are needed to produce 19.8 L of sulfur trioxide? $2\,SO_2 + O_2 \rightarrow 2\,SO_3$

$$\frac{19.8\text{ L}}{22.4\text{ L}} \times \frac{1\text{ mole}}{} = 0.884\text{ mol } SO_3$$

	$2SO_2$	+ O_2	→ $2SO_3$
		?	0.884 mol
		+0.884$(\frac{1}{2})$	−0.884
		0.442 mole O_2	

$$\frac{0.442\text{ mol } O_2}{1\text{ mol}} \times \frac{6.02 \times 10^{23}\text{ molecules}}{} = 2.66 \times 10^{23}\text{ molecules } O_2$$