Chapter 9-5a

Unbalanced:

$$PCl_3(\ell) + H_2O(\ell) \longrightarrow H_3PO_3(aq) + HCl(g)$$

Balanced:

$$PCl_3(\ell) + 3H_2O(\ell) \longrightarrow H_3PO_3(aq) + 3HCl(g)$$

Chapter 9-5b

Unbalanced:

$$Xe F_2(g) + H_2O(\ell) \longrightarrow Xe(g) + HF(g) + O_2(g)$$

Balanced:

$$2Xe F_2(g) + 2H_2O(\ell) \longrightarrow 2Xe(g) + 4HF(g) + O_2(g)$$

Chapter 9-14a & 14b

Goal:

1) Calculate number of moles of each product
2) Calculate number of grams of each product

Starting Info:

1) 0.50 moles of red reactant

Reaction: 14a

$$NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$$

Solution: Stoichiometry!

1) Equation is balanced

$$0.50 \text{ moles } NH_3 \times \frac{1 \text{ mol } NH_4Cl(s)}{1 \text{ mol } NH_3(g)} = 0.50 \text{ moles } NH_4Cl(s)$$

$$0.50 \text{ moles } NH_4Cl(s) \times \frac{53.491 \text{ g } NH_4Cl(s)}{1 \text{ mol } NH_4Cl(s)} = 27 \text{ g } NH_4Cl(s)$$

14b See start as 14a

Reaction: Balanced!

$$CH_4(g) + 4S(s) \longrightarrow CS_2(\ell) + 2H_2S(g)$$

Solution:

$$0.50 \text{ moles } S(s) \times \frac{1 \text{ mol } CS_2(\ell)}{4 \text{ mol } S(s)} = 0.13 \text{ moles } CS_2(\ell)$$

$$0.50 \text{ moles } S(s) \times \frac{2 \text{ mol } H_2S(g)}{4 \text{ mol } S(s)} = 0.25 \text{ moles } H_2S(g)$$

$$0.13 \text{ moles } CS_2(\ell) \times \frac{76.139 \text{ g } CS_2(\ell)}{1 \text{ mol } CS_2(\ell)} = 9.9 \text{ g } CS_2(\ell)$$

$$0.25 \text{ moles } H_2S(g) \times \frac{34.1 \text{ g } H_2S(g)}{1 \text{ mol } H_2S(g)} = 8.5 \text{ g } H_2S(g)$$

Chapter 9-16a+b

Goal:

1) Calculate the moles of the first product if 0.675 moles of the second product form

Reaction: Not Balanced!

$$KO_2(s) + H_2O(\ell) \longrightarrow O_2(g) + KOH(s)$$

Balanced

$$4KO_2(s) + 2H_2O(\ell) \longrightarrow 3O_2(g) + 4KOH(s)$$

Stoichiometry!

$$0.675 \text{ moles } KOH(s) \times \frac{3 \text{ mol } O_2(g)}{4 \text{ mol } KOH(s)} = .469 \text{ moles } O_2(g)$$

Part b:

Reaction: Not balanced!

$$SeO_2(g) + H_2Se(g) \longrightarrow Se(s) + H_2O(g)$$

Balanced

$$SeO_2(g) + 2H_2Se(g) \longrightarrow 3Se(s) + 2H_2O(g)$$

Stoichiometry!

$$.625 \text{ moles } H_2O(g) \times \frac{3 \text{ moles } Se(s)}{2 \text{ moles } H_2O(g)} = .938 \text{ moles } Se(s)$$

Chapter 9-24a+b

Goal:

Calculate the number of moles of the second reactant required to react completely with 0.557 g of the first reactant.

Reaction: Un balanced!

$$Al(s) + Br_2(\ell) \longrightarrow AlBr_3(s)$$

Balanced

$$2Al(s) + 3Br_2(g) \longrightarrow 2AlBr_3(s)$$

Solution:

grams 1st → moles 1st → moles 2nd

$$.557 \text{ g } Al(s) \times \frac{1 \text{ mol } Al(s)}{26.98 \text{ g } Al(s)} \times \frac{3 \text{ mol } Br_2(g)}{2 \text{ mol } Al(s)} = .0310 \text{ moles } Br_2$$

Reaction For Part b

$$Hg(s) + HClO_4(aq) \longrightarrow Hg(ClO_4)_2(aq) + H_2(g)$$

Balanced

$$Hg(s) + 2HClO_4(aq) \longrightarrow Hg(ClO_4)_2(aq) + H_2(g)$$

Solution

$$0.557 \text{ g } Hg(s) \times \frac{1 \text{ mol } Hg(s)}{200.59 \text{ g } Hg(s)} \times \frac{2 \text{ mol } HClO_4(aq)}{1 \text{ mol } Hg(s)} = .00555 \text{ moles } HClO_4$$

Chapter 9-29

Open atmosphere

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ Balanced

Restricted $O_{2(g)}$

$2C_{(s)} + O_{2(g)} \longrightarrow 2CO_{(g)}$ Balanced

Goal:

1) Determine mass of product for each reaction when 5.00 g $C_{(s)}$ is burned.

Solution: Stoichiometry!

grams $C_{(s)}$ → moles $C_{(s)}$ → moles Product → mass Product

Rxn 1

$$5.00\,g\,C_{(s)} \times \frac{1\,mol\,C_{(s)}}{12.01\,g\,C_{(s)}} \times \frac{1\,mol\,CO_{2(g)}}{1\,mol\,C_{(s)}} \times \frac{44.01\,g\,CO_2}{1\,mol\,CO_{2(g)}} =$$

$$= 18.3\,g\,CO_2$$

Rxn 2

$$5.00\,g\,C_{(s)} \times \frac{1\,mol\,C_{(s)}}{12.01\,g\,C_{(s)}} \times \frac{2\,mol\,CO_{(g)}}{1\,mol\,CO_{2(g)}} \times \frac{28.01\,g\,CO}{1\,mol\,CO_{(g)}} =$$

$$= 23.3\,g\,CO$$

Chapter 9-35

Reaction: Balanced

$P_{4(s)} + 5O_{2(g)} \longrightarrow 2P_2O_{5(s)}$

Goal:

If 4.95 g $P_{4(s)}$ is burned, what mass of O_2 is required?

Solution: Stoichiometry!

mass $P_{4(s)}$ → moles $P_{4(s)}$ → moles $O_{2(g)}$ → mass $O_{2(g)}$

$$4.95\,g\,P_{4(s)} \times \frac{1\,mol\,P_{4(s)}}{123.9\,g\,P_{4(s)}} \times \frac{5\,mol\,O_{2(g)}}{1\,mol\,P_{4(s)}} \times \frac{32\,g\,O_{2(g)}}{1\,mol\,O_{2(g)}} =$$

$$= 6.39\,g\,O_{2(g)}$$

Chapter 9-45

Goal: Use BCA tables to determine the limiting reactant and the mass of excess reactant. Start w/ 5.00 moles of each reactant

Reaction: Unbalanced

$Ca_2C_{(s)} + H_2O_{(g)} \longrightarrow Ca(OH)_{2(s)} + C_2H_{2(g)}$

Balanced

$Ca_2C_{(s)} + 2H_2O_{(g)} \longrightarrow Ca(OH)_{2(s)} + C_2H_{2(g)}$

	$Ca_2C_{(s)}$	$2H_2O_{(g)}$	$Ca(OH)_{2(s)}$	$C_2H_{2(g)}$
B	5.00	5.00	0	0
C	−2.50	−5.00	+2.50	+2.50
A	2.50	0	2.50	2.50
	Excess	Limiting		

Mass of Excess:

$$2.50\,mol\,Ca_2C_{(s)} \times \frac{64.099\,g\,Ca_2C_{(s)}}{1\,mol\,Ca_2C_{(s)}} = 160.\,g\,Ca_2C_{(s)}$$

Chapter 9-48 a+b

Goal:

1) Determine the limiting reactant, and calculate the mass of the Red Product. 1.00 g of each reactant is present

Reaction: Unbalanced!

$C_2S_{(\ell)} + O_{2(g)} \longrightarrow CO_{2(g)} + SO_{2(g)}$

Balanced

$C_2S_{(\ell)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2SO_{2(g)}$

1) Need moles for BCA table

$$1.00\,g\,C_2S_{(\ell)} \times \frac{1\,mol\,C_2S_{(\ell)}}{76.139\,g\,C_2S_{(\ell)}} = 0.0131\,moles\,C_2S_{(\ell)}$$

$$1.00\,g\,O_{2(g)} \times \frac{1\,mol\,O_{2(g)}}{32\,g\,O_{2(g)}} = .0313\,moles\,O_{2(g)}$$

2) Construct BCA Table

	$C_2S_{(\ell)}$	$2O_{2(g)}$	$CO_{2(g)}$	$2SO_{2(g)}$
B	.0131	.0313	0	0
C	−.0131	−.0262	+.0131	+.0262
A	0	.0051	.0131	.0262
	Limiting	Excess		

need mass

$$.0131\,moles\,CO_{2(g)} \times \frac{44.01\,g\,CO_{2(g)}}{1\,mol\,CO_{2(g)}} = 0.578\,g\,CO_{2(g)}$$

Part B Same strategy as Part A

Reaction: Unbalanced

$NH_{3(g)} + CO_{2(g)} \longrightarrow CN_2H_4O_{(s)} + H_2O_{(g)}$

Balanced

$2NH_{3(g)} + CO_{2(g)} \longrightarrow CN_2H_4O_{(s)} + H_2O_{(g)}$

1) Need moles for BCA Table

$$1.00\,g\,NH_{3(g)} \times \frac{1\,mol\,NH_{3(g)}}{17.03\,g\,NH_{3(g)}} = .0587\,mol\,NH_{3(g)}$$

$$1.00\,g\,CO_{2(g)} \times \frac{1\,mol\,CO_{2(g)}}{44.01\,g\,CO_{2(g)}} = .0227\,mol\,CO_{2(g)}$$

44.01 g CO_2(g)

	$2NH_3$(g)	+ CO_2(g)	→ CN_2H_4O(s)	+ H_2O(g)
B	.0527	.0227	0	0
C	−.0454	−.0227	+.0227	+.0227
A	.0153	0	.0227	.0227
		Limiting		

Need mass

.0227 moles H_2O(g) × $\frac{18.02\ g\ H_2O(g)}{1\ mol\ H_2O(g)}$ = .409 g H_2O(g)

Chapter 9-90

Goal: How many moles of each product are formed when 20.0 g of each reactant is present? How many grams?

Reaction: Balanced

$N_2H_4(\ell) + O_2(g) \rightarrow N_2(g) + 2H_2O(g)$

1) Need moles for BCA table

20.0 g N_2H_4(ℓ) × $\frac{1\ mol\ N_2H_4(\ell)}{32.05\ g\ N_2H_4(\ell)}$ = .624 mol N_2H_4(ℓ)

20.0 g O_2(g) × $\frac{1\ mol\ O_2(g)}{32\ g\ O_2(g)}$ = .675 mols O_2(g)

Construct BCA

	N_2H_4(ℓ)	+ O_2(g)	→ N_2(g)	+ $2H_2O$(g)
B	.624	.675	0	0
C	−.624	−.624	+.624	+1.25
A	0	.001	.624	1.25
	Limiting	Excess		

Need mass

.624 moles N_2(g) × $\frac{28.02\ g\ N_2(g)}{1\ mol\ N_2(g)}$ = 17.5 g N_2(g)

1.25 moles H_2O(g) × $\frac{18.02\ g\ H_2O(g)}{1\ mole\ H_2O(g)}$ = 22.5 g H_2O(g)