- Percent Yield

Q# 2, 4, 5, 7, 10 pg 321

2. theoretical yield - amount of product predicted on paper (in theory)

actual yield - amount produced in the lab

analogy - actual yield = mark recieved on a test
theoretical yield = test total

4. $AgNO_3(aq) + KBr(aq) \rightarrow AgBr(s) + KNO_3(aq)$

		actual 14.64 g
m	14.00 g	?
M	169.872 g/mol	187.772 g/mol

$$n_{AgNO_3} = \frac{14.00\ g}{169.872\ g/mol} = 0.082415\ mol$$

$$n_{AgBr} = 0.082415\ mol\ AgNO_3 \times \frac{1\ mol\ AgBr}{1\ mol\ AgNO_3} = 0.082415\ mol$$

$$m_{AgBr} = 0.082415\ mol \times 187.772\ \frac{g}{mol} = 15.48\ g$$

$$\%\ yield = \frac{14.64\ g}{15.48\ g} \times 100 = 94.57\ \%$$

∴ the % yield is 94.57 %

5. $2Na_3PO_4(aq) + 3Ba(NO_3)_2(aq) \rightarrow Ba_3(PO_4)_2(s) + 6NaNO_3(aq)$

			7.69 g actual
m	5.00 g	10.90 g	
M	163.940 g/mol	261.335 g/mol	601.921 g/mol
n	0.03050 mol	0.041709 mol	
	2	3	
	0.01525	0.01390 smaller ∴	
		↑ LR	

$$n_{Ba_3(PO_4)_2} = 0.041709\ mol\ Ba(NO_3)_2 \times \frac{1\ mol\ Ba_3(PO_4)_2}{3\ mol\ Ba(NO_3)_2}$$

$$= 0.013903\ mol$$

$$m_{Ba_3(PO_4)_2} = 0.013903\ mol \times 601.921\ \frac{g}{mol} = 8.369\ g$$

$$\%\ yield = \frac{7.69\ g}{8.369\ g} \times 100 = 91.9\ \%$$

∴ the % yield is 91.9 %.

7. $A + B \longrightarrow C$

m_A ÷ M_A → n_A ÷ coefficient A

m_B ÷ M_B → n_B ÷ coefficient B

smaller # is LR

↓

n_C = smaller # moles × $\frac{\text{mol ratio C}}{\text{mol ratio smaller \#}}$

↓

$m_C = n_C$ answer × M_C

↓

% yield = $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100$

10. a) use glass stir rod as wood can absorb the chemicals

b) don't transfer or rinse with a bit of solvent & add to reaction beaker

c) use low heat (hot plate or oven) or dry over time in a dessicater

d) rinse graduated cylinder and add to reaction beaker

Unit Test Review

CH 7 Q# 1-8, 17, 18, 24 pg 331-332

1. b 2. d 3. c 4. b 5. d 6. a 7. a $Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$

8. $2KClO_{3(s)} \rightarrow 2KCl_{(s)} + 3O_{2(g)}$ e.

17. $2Al_{(s)} + 3Br_{2(g)} \rightarrow 2AlBr_{3(s)}$

5.0 mol ? b ? c

b) $n_{Br_2} = 5.0\,mol\,Al \times \frac{3\,mol\,Br_2}{2\,mol\,Al} = 7.5\,mol\,Br_2$

c) $n_{AlBr_3} = 5.0\,mol\,Al \times \frac{2\,mol\,AlBr_3}{2\,mol\,Al} = 5.0\,mol\,AlBr_3$

18. $Fe_{(s)} + 2HCl_{(aq)} \rightarrow FeCl_{2(aq)} + H_{2(g)}$

excess

m 6.51 g 14.59 g actual ?

M 55.845 g/mol 126.751 g/mol

$n_{Fe} = \frac{6.51\,g}{55.845\,g/mol} = 0.1166\,mol$

$n_{FeCl_2} = 0.1166\,mol\,Fe \times \frac{1\,mol\,FeCl_2}{1\,mol\,Fe} = 0.1166\,mol$

$m_{FeCl_2} = 0.1166\,mol \times 126.751\,\frac{g}{mol} = 14.78\,g$

$\%\,yield = \frac{14.59}{14.78} \times 100 = 98.71\,\%$

∴ the % yield is 98.71 %.

24. $2\,AgNO_3(aq) + CaCl_2(aq) \rightarrow 2\,AgCl(s) + Ca(NO_3)_2(aq)$

$126.23\,g - 124.75\,g = 1.48\,g$

actual

$2.36\,g - 1.27\,g = 1.09\,g$

M $169.872\ g/mol$ $143.321\ g/mol$

$$n_{AgNO_3} = \frac{1.48\,g}{169.872\,g/mol} = 0.008712\ mol$$

$$n_{AgCl} = 0.008712\ mol\ AgNO_3 \times \frac{2\ mol\ AgCl}{2\ mol\ AgNO_3} = 0.008712\ mol$$

$$m_{AgCl} = 0.008712\ mol \times 143.321\ \frac{g}{mol} = 1.25\,g \text{ theoretical}$$

$$\%\ yield = \frac{1.09\,g}{1.25\,g} \times 100 = 87.2\ \%$$

∴ the % yield is 87.2 %.

Unit 3 Review Pg 339

Q# 1, 2, 4-16, 18-21, 23, 26

1. (e) 163.94 g/mol

2. $N_{formu} = 3.500\ mol \times 6.022\times10^{23}\ \frac{form.\ units}{mol}$

$= 2.108\times10^{24}$ form units.

(e)

$\frac{g}{mol}$ 1 mol = 6.022×10^{23} atoms

4. (a) CO_2 5. $m_{atom} = \frac{24\ g}{6.022\times10^{23}} = 4.0\times10^{-23}\ g$ (b)

6. (e) 7. (b) 8. $n_{CH_4} = \frac{4\ g}{16.043\ g/mol} = 0.249\ mol$ (b) $n_{H_2} = \frac{8\ g}{2.016\ g/mol} = 3.97\ mol$ $n_{N_2} = \frac{28\ g}{28.014\ g/mol} = 1.00\ mol$

$n_{Cl_2} = \frac{35\ g}{70.906\ g/mol} = 0.494\ mol$ $n_{O_2} = \frac{64\ g}{31.998\ g/mol} = 2.00\ mol$

9. molecular molar mass - molecules (covalent) compounds.
formula unit molar mass - ionic compounds

10. % composition

11. empirical formula - shows the smallest whole # ratio of the elements in a compound

2. $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

m	10.0 g	?
M	28.014 g/mol	2.016 g/mol

$n_{N_2} = \frac{10.0\ g}{28.014\ g/mol} = 0.3570\ mol$

$n_{H_2} = 0.3570\ mol\ N_2 \times \frac{3\ mol\ H_2}{1\ mol\ N_2} = 1.071\ mol$

$m_{H_2} = 1.071\ mol \times 2.016\ \frac{g}{mol} = 2.16\ g$

13. glucose $C_6H_{12}O_6$ ribose $C_5H_{10}O_5$

empirical CH_2O empirical CH_2O

empirical formula is the lowest ratio # but may not be the molecular formula

14. $CaO_{(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + H_2O_{(l)}$

? 250 mol required

72 %

$$\% \text{ yield} = \frac{\text{actual}}{\text{theoretical}} \times 100$$

$$0.72 = \frac{250}{x}$$

$$x = \frac{250}{0.72}$$

$$= 347.2 \text{ mol}$$

$$n_{CaO} = 347.2 \text{ mol } CaCl_2 \times \frac{1 \text{ mol } CaO}{1 \text{ mol } CaCl_2} = 347.2 \text{ mol}$$

$$m_{CaO} = 347.2 \text{ mol} \times 56.077 \frac{\text{g}}{\text{mol}} = 19\,469.9 \text{ g} \div 1000 = 19 \text{ kg}$$

∴ the mass of CaO produced was 19 kg.

15. $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$

n $\frac{0.530 \text{ mol}}{1}$ $\frac{0.497 \text{ mol}}{2}$? 18.015 g/mol

0.530 0.2485

↑ LR ∴ smaller #.

$$n_{H_2O} = 0.497 \text{ mol } O_2 \times \frac{2 \text{ mol } H_2O}{2 \text{ mol } O_2} = 0.497 \text{ mol}$$

$$m_{H_2O} = 0.497 \text{ mol} \times 18.015 \frac{\text{g}}{\text{mol}} = 8.95 \text{ g}$$

∴ the LR was O_2 and 8.95 g of H_2O can theoretically produced.

16: $86.5 = \frac{38.5\,g}{x} \times 100$

$0.865 = \frac{38.5\,g}{x}$

$x = 44.5\,g$

$K_2Cr_2O_{7(aq)} + 6NaI_{(aq)} + 7H_2SO_{4(aq)} \rightarrow Cr_2(SO_4)_{3(aq)} + 3I_{2(s)} + 7H_2O_{(l)} + 3Na_2SO_{4(aq)} + K_2SO_{4(aq)}$

m	?		44.5 g
M	294.181 g/mol		253.808 g/mol

$n_{I_2} = \frac{44.5\,g}{253.808\,g/mol} = 0.1753\,mol$

$n_{K_2Cr_2O_7} = 0.1753\,mol\ I_2 \times \frac{1\,mol\ K_2Cr_2O_7}{3\,mol\ I_2}$

$= 0.05844\,mol$

$m_{K_2Cr_2O_7} = 0.05844\,mol \times 294.181\,\frac{g}{mol} = 17.2\,g$

∴ 17.2 g of potassium dichromate would be needed.

18. $\%\ K = \frac{2.7\,g}{10.0\,g} \times 100 = 27\%$

$\%\ Cr = \frac{3.5\,g}{10.0\,g} \times 100 = 35\%$

$\%\ O = \frac{3.8\,g}{10.0\,g} \times 100 = 38\%$

∴ % composition is 27% K, 35% Cr and 38% O.

19. $\%\ Na = \frac{2(22.990)}{2(22.990) + 32.065 + 4(15.999)} \times 100$

$= \frac{45.98}{142.041} \times 100$

$= 32.37\%$

$\%\ S = \frac{32.065}{142.041} \times 100$

$= 22.57\%$

$\%\ O = \frac{4(15.999)}{142.041} \times 100$

$= 45.05\%$

∴ %Na is 32.37% and %S is 22.57% and %O is 45.05%.

20. Assume 100 g sample

$m_{Pb} = 51.89\,g$ $\quad m_S = 16.06\,g$ $\quad m_O = 32.05\,g$

$n_{Pb} = \frac{51.89\,g}{207.2\,g/mol} = 0.2504\,mol$

$n_S = \frac{16.06\,g}{32.065\,g/mol} = 0.5009\,mol$

$n_O = \frac{32.05\,g}{15.999\,g/mol} = 2.003\,mol$

Pb	:	S	:	O
$\frac{0.2504}{0.2504}$	:	$\frac{0.5009}{0.2504}$	:	$\frac{2.003}{0.2504}$
1	:	2	:	8

∴ the empirical formula is $Pb_1S_2O_8$ $\quad PbS_2O_8$

empirical molar mass $= 207.2\,\frac{g}{mol} + 2(32.065\,\frac{g}{mol}) + 8(15.999\,\frac{g}{mol})$

$= 399.322\,\frac{g}{mol}$

molecular multiplier $= \frac{798.7\,\frac{g}{mol}}{399.322\,g/mol} = 2$

$Pb_2(SO_4)_4$.

∴ molecular formula $PbS_2O_8 \times 2$

$\boxed{Pb_2S_4O_{16}}$

lead IV sulfate

21. $m_S = 5.096 - 3.653 = 1.443\,g$

$m_A = 3.653\,g$

$\%\,A = \frac{3.653\,g \times 100}{5.096\,g} = 71.68\,\%$

$\%\,S = \frac{1.443\,g \times 100}{5.096\,g} = 28.32\,\%$

23. a) 18.0% C 2.5% H 63.5% I 16.0% O

b) 400 g/mol

a) Assume 100 g sample

$m_C = 18.0\,g$ $\quad m_H = 2.5\,g$ $\quad m_I = 63.5\,g$ $\quad m_O = 16.0\,g$

$n_C = \frac{18.0\,g}{12.011\,g/mol} = 1.499\ mol$ $\quad n_H = \frac{2.5\,g}{1.008\,g/mol} = 2.480\,mol$ $\quad n_I = \frac{63.5\,g}{126.904\,g/mol} = 0.5004\,mol$ $\quad n_O = \frac{16.0\,g}{15.999\,g/} = 1.000\,mol$

C : H : I : O

$\frac{1.499}{0.5004}$ $\quad \frac{2.480}{0.5004}$ $\quad \frac{0.5004}{0.5004}$ $\quad \frac{1.000}{0.5004}$

3 : 5 : 1 : 2

∴ empirical formula is $\boxed{C_3H_5I_1O_2}$

b) empirical mass $= 3(12.011) + 5(1.008) + 126.904 + 2(15.999)$

$= 199.975\ g/mol$

molecular multiplier $= \frac{400\ g/mol}{199.975\,g/mol} = 2$

∴ molecular formula is $\boxed{C_6H_{10}I_2O_4}$

26.

- sample dissolves in the solvent
- sample passes through filter paper
- sample impurity (starting material)
- side reactions ?
- sample (reactants left in beaker)