Answers to worksheet questions

Chapter 6

Worksheet 6.1

1 The atoms of different ***elements*** all have different masses. So that we know how the masses of different atoms compare with each other, we use their ***relative atomic mass*** (A_r). This enables us to say that an atom of magnesium, for instance, is ***twice*** the mass of a carbon-12 atom. Then we can work out the relative formula mass (M_r) of a ***compound***, which is the sum of all the masses of the atoms in the compound. These masses are very useful when we are measuring out substances to ***react*** together.

2 **a** 17
b 95
c 160
d 46

3 **a** 112 g
b 168 tonnes

Worksheet 6.2

1 **a** One mole is the formula mass in grams of the substance / 6×10^{23} molecules of the substance.
b The empirical formula is the simplest whole number formula of the substance / formula expressed in the simplest whole number ratio of the elements in the compound.
c The molecular formula is the actual formula of the compound / formula showing the actual number of atoms making the molecule.

2

	Mg	O
mass	2.4 g	4.0 − 2.4 = 1.6 g
no. of moles	2.4/24 = 0.1	1.6/16 = 0.1
molar ratio	1	1
formula	*MgO*	

3

	Fe	O
mass in 100 g	72.4 g	100 − 72.4 = 27.6 g
no. of moles	72.4/56 = 1.3	27.6/16 = 1.73
molar ratio	3	4
formula	Fe_3O_4	

4 **a** 100/40 = 2.5 moles
b 22/44 = 0.5 moles
c 5.8/58 = 0.1 moles
d 30/120 = 0.25 moles
e 6.75/135 = 0.05 moles

Worksheet 6.3

1 **a** 32 g
b Sulfur is in excess.
c 11 g of FeS and 6 g of sulfur
d $56 \times (10/32) = 17.5$ g

2 **a**

H_2O	+	$NaCl$	+	NH_3	+	CO_2	→	NH_4Cl	+ $NaHCO_3$
2 moles		2 moles		2 moles		2 moles			2 moles
36 g		117 g		34 g		88 g			

b 50 moles
c 4 moles
d 318 g = 3 moles Na_2CO_3
1 mole NaCl gives 0.5 moles of Na_2CO_3
So 6 moles of NaCl would be needed to get 3 moles (318 g) of Na_2CO_3 = 351 g

Worksheet 6.4

1 **a** 60/40 = 1.5 moles
concentration = 1.5 mol/dm^3
b 1 mol/dm^3
c $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$
1 mole 1 mole
65 g
4 g Zn = 4/65 moles Zn
$(4/65) \times 24\,000 = 1477$ cm^3 of hydrogen

2 number of moles acid = $(0.5/1000) \times 20 = 0.01$ moles
1 mole NaOH reacts with 1 mole HCl
0.01 moles of NaOH in 25.0 cm^3
concentration = $(0.01/25) \times 1000 = 0.4$ moles per dm^3

3 **a** $NaOH + HCl \rightarrow NaCl + H_2O$
b number of moles acid = $(0.10/1000) \times 15 = 1.5 \times 10^{-3}$ moles
c 1.5×10^{-3} moles of NaOH
d concentration = $(1.5 \times 10^{-3}/10) \times 1000 = 0.15$ mol/dm^3

4 **a** methyl orange
b $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$
c number of moles = $(1.0/1000) \times 17.5 = 0.0175$ moles
d $0.0175/2 = 8.75 \times 10^{-3}$ moles
e mass = $8.75 \times 10^{-3} \times 106 = 0.93$ g
f $2.5 - 0.93 = 1.57$ g of water of crystallisation
g 0.0872 moles of water
h ratio is 0.00875 : 0.0872 = 1 : 10
so $x = 10$ and formula of washing soda is $Na_2CO_3.10H_2O$

Worksheet 6.5

1 An empirical formula is a formula for a compound which shows the simplest ratio of atoms present.

2 **a** N: 3.5/14 = 0.25 moles / O: 4/16 = 0.25 moles
molar ratio 1 : 1
empirical formula is NO

b S: 50/32 = 1.5625 moles / O: 50/16 = 3.1 moles
molar ratio 1 : 2
empirical formula is SO_2

c K: 39/39 = 1 mole / H: 1/1 = 1 mole / C: 12/12 = 1 mole / O: 48/16 = 3 moles
molar ratio is 1 : 1 : 1 : 3
empirical formula is $KHCO_3$

d mass of oxygen = 16.0 − 11.2 = 4.8 g
O: 4.8/16 = 0.3 moles / Fe: 11.2/56 = 0.2 moles
molar ratio of Fe : O = 2 : 3
empirical formula is Fe_2O_3

3 **a** H: 4.04/1 = 4.04 moles / C: 24.24/12 = 2.02 moles / Cl: 71.72/35.5 = 2.02 moles
molar ratio of H : C : Cl = 2 : 1 : 1
empirical formula CH_2Cl

b relative mass of CH_2Cl = 49.5 / actual molar mass = 99 g
99/49.5 = 2
therefore molecular formula is $C_2H_4Cl_2$

Worksheet 6.6

1 **a** to allow you to find the mass of the substances in it / need to subtract it from that obtained when it has substances in it

b 125.9 − 117.8 = 8.1 g

c 124.7 − 117.8 = 6.9 g

d 8.1 − 6.9 = 1.2 g

e 1.2/8.1 × 100 = 14.8%

2 Heat the crucible again cool and reweigh it. Repeat until the weight is constant. This is known as heating to constant mass.

3 **a** 208

b 18

4 moles of $BaCl_2$ = 6.9/208 = 0.0332 moles

moles of water = 1.2/18 = 0.0667 moles

molar ratio of 1 : 2

therefore $x = 2$ $BaCl_2.2H_2O$