Revision Exercise – Calculations from Equations

Answer the following questions:

a)

The following equation shows the complete combustion of methane in oxygen.

$$CH_4(g) \quad + \quad 2O_2(g) \quad \rightarrow \quad CO_2(g) \quad + \quad 2H_2O(l)$$

What mass of carbon dioxide will be formed from 4g of methane?

b)

. Calculate the mass of magnesium chloride produced in the reaction of 4.9 g of magnesium with excess chlorine.

$$Mg\,(s) \quad + \quad Cl_2(g) \quad \rightarrow \quad MgCl_2(s)$$

c)

The balanced equation shows the reaction of sodium carbonate with hydrochloric acid.

$$Na_2CO_3(s) \quad + \quad 2HCl(aq) \quad \rightarrow \quad 2NaCl(aq) \quad + \quad CO_2(g) \quad + \quad H_2O(l)$$

What mass of sodium chloride is produced when 10.6g of sodium carbonate is reacted with excess hydrochloric acid?

d)

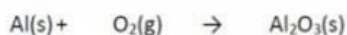Calculate the mass of hydrogen required to react with 56 g of nitrogen.

$$N_2(g) \quad + \quad H_2(g) \quad \quad \rightarrow \quad NH_3(g)$$

e)

Calculate the mass of oxygen required to react with 2.7 g of aluminium.

$$Al(s) + \quad O_2(g) \quad \rightarrow \quad Al_2O_3(s)$$

f)

Calculate the mass of copper produced in the reaction of 9.8 g of magnesium with excess copper (II) sulphate.

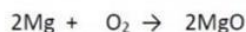$$Mg(s) + \quad CuSO_4(aq) \quad \rightarrow \quad MgSO_4(aq) \quad + \quad Cu(s)$$

g)

How much silicon can be produced from 16 kg of carbon and 32 kg of silica, SiO_2, in the reaction:

$$SiO_2(s) \quad + \quad 2C(s) \quad \rightarrow \quad Si(l) \quad + \quad 2CO(g)$$

h)

1. 0·24g is burned in 0·24 mol of oxygen. Use a calculation to decide which reactant is acting as the limiting reactant.

$$2Mg + \quad O_2 \rightarrow \quad 2MgO$$

i)

A pupil reacted 20cm^3 of silver nitrate solution of concentration 0.5mol l-1 with hydrochloric acid in excess. What mass of silver chloride will be produced in this reaction?

$$AgNO_3 \quad + \quad HCl \quad \rightarrow \quad AgCl \quad + \quad HNO_3$$

j)

The air-bag in a car fills with nitrogen gas when inflated during an accident. The nitrogen gas is generated from sodium azide according to the equation below.

$$2NaN_3 (s) \longrightarrow 2 Na (s) + 3N_2 (g)$$

The air bag requires 400g of nitrogen gas to fully inflate.

What mass of sodium azide would be required to generate this quantity of nitrogen gas?

k)

0.5g of zinc was added to 20cm^3 of silver nitrate solution of concentration 0.25mol l^{-1}. What mass of silver will be produced?
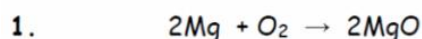
$$2AgNO_3 + Zn \rightarrow 2Ag + Zn(NO_3)_2$$

l)

A common method of preparing ammonia is to heat an ammonium salt with soda lime. A student heated 5g of each chemical together. What mass of ammonia was produced?
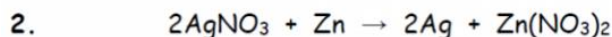
$$NH_4Cl + NaOH \rightarrow NH_3 + NaCl + H_2O$$

m)

1. $2Mg + O_2 \rightarrow 2MgO$
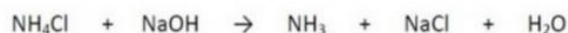
What mass of MgO would be formed from 4·86g of Mg?

n)

2. $2AgNO_3 + Zn \rightarrow 2Ag + Zn(NO_3)_2$

What mass of silver will be deposited if 1·962g Zn reacts completely?

o)

3. $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

Calculate the mass of carbon dioxide produced when 5g of calcium carbonate reacts completely with acid?

p)

4. $MgCO_3 \rightarrow MgO + CO_2$
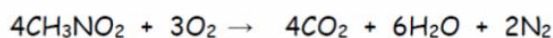
Calculate the mass of magnesium oxide formed when 100g magnesium carbonate decomposes on heating.

q)

5.   A dragster can accelerate from 0 to 270mph in 5secs. The fuel is nitromethane which burns as follows:

$$4CH_3NO_2 + 3O_2 \rightarrow 4CO_2 + 6H_2O + 2N_2$$

During a race, 45kg of fuel is used. Calculate the mass of oxygen needed to burn this fuel.

r)

6.   A Glasgow company buys in ammonia and phosphoric acid to make the fertiliser ammonium phosphate.

$$3NH_3 + H_3PO_4 \rightarrow (NH_4)_3PO_4$$
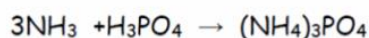
What mass of fertiliser would be made from 500g of NH_3?

s)

7.   At Grangemouth, BP make large quantities of ethanol by a process called catalytic hydration of ethene:

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

What mass of ethanol would be produced from 560kg of ethene?

t)

8.   During WW2 US Pilots carried lithium hydride tablets. If their plane crashed, the tablets reacted with sea water to produce hydrogen to fill the lifeboats.

What mass of hydrogen would be produced from 1kg of lithium hydride?

$$LiH + H_2O \rightarrow LiOH + H_2$$

u)

Octane is a compound of hydrogen and carbon found in petrol. It has chemical formula C_8H_{18}. When octane burns it produces carbon dioxide and water.

a)   Write a balanced chemical equation for the burning of octane.

b)   Calculate the mass of carbon dioxide produced if 114 tonnes of octane were burned.

c)   Some cars run on lpg, which consists of propane, chemical formula C_3H_8. It also burns to produce carbon dioxide and water.

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

What mass of carbon dioxide would be produced when 100 tonnes of lpg were used?