

# Chem!stry

Name: ..... ( )

Class: .....

Date: ..... / ..... / .....

## Mole Concept Assignment One

Use decimal, not fractions. Final answers to 3 significant figures. Include units where necessary.

### Question 1:

There are different nitrogen oxides with different formulae and properties.

Two oxides of nitrogen have the same empirical formulae. The table shows some data from experiments to analyse the mass of nitrogen and oxygen in samples of both oxides:

	Mass of Nitrogen / g	Mass of Oxygen / g
<b>Oxide 1</b>	0.35	0.78
<b>Oxide 2</b>	0.68	1.63

a) Use the data to work out the empirical formulae of both oxides and show that they are the same:

b) Further experiments showed that **Oxide 1** has a relative molecular mass of 46, **Oxide 2** has a relative molecular mass of 92. What are the molecular formulae of the two oxides?

For **Oxide 1**:

For **Oxide 2**:

**Question 2:**

Many cars are fitted with air-bags which inflate in an accident. Air-bags contain the solid sodium azide,  $\text{NaN}_3$ , which decomposes rapidly to form sodium and nitrogen. The nitrogen that is formed fills the air-bag.

- a) Construct the equation, **including state symbols**, for the decomposition of sodium azide:

.....

- b) In a crash, the air-bag fills with  $96.0 \text{ dm}^3$  of nitrogen at room temperature and pressure. What mass of sodium azide is needed to provide the nitrogen?

**Question 3:**

Iron carbonyl is a volatile liquid with the formula  $\text{Fe}(\text{CO})_n$ . In an experiment,  $4.9 \text{ g}$  of iron carbonyl vapour sample was found to have a volume of  $600 \text{ cm}^3$  at room temperature and pressure.

- a) Calculate the number of moles of iron carbonyl present in the sample. Hence, find the value of  $n$ :

- b) A single tablet of a multivitamin supplement contains  $14 \text{ mg}$  of  $\text{Fe}$  in the form of iron carbonyl. What is the mass of iron carbonyl present?

**Question 4:**

10.0 cm<sup>3</sup> of oxygen gas were mixed with 25.0 cm<sup>3</sup> of chlorine. A reaction took place to give a gaseous oxide of chlorine (Cl<sub>x</sub>O<sub>y</sub>). The products occupied 25.0 cm<sup>3</sup> and 5.0 cm<sup>3</sup> of this were found to be unreacted chlorine.

a) What volumes of oxygen, chlorine and the oxide of chlorine were involved in this reaction?

b) Calculate the formula of the oxide of chlorine:

**Question 5:**

50 cm<sup>3</sup> of hydrogen peroxide, which has a concentration of 2.0 mol/dm<sup>3</sup>, is decomposed. The equation for the reaction is:



a) How many moles of hydrogen peroxide are used in the reaction?

b) How many moles of oxygen are produced in the reaction?

c) Calculate the volume of oxygen that is produced in the reaction at r.t.p.:

**Question 6:**

Calcium carbonate decomposes on heating according to the following balanced chemical equation:



25.0 g of calcium carbonate was heated until there was no change in its mass. If 9.50 g of calcium oxide was obtained, find the percentage yield of calcium oxide:

**Question 7:**

Ammonia is used to produce nitric acid. The first step in the manufacturing process is the reaction between ammonia and oxygen to produce gaseous nitrogen monoxide and steam.

a) Write the balanced chemical equation, including state symbols, for the reaction:

.....

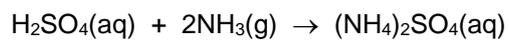
b) 0.5 mol of ammonia gas was allowed to react with 0.5 mol of oxygen.

i) Which is the limiting reagent in the reaction?

ii) Calculate the theoretical yield, in grams, of gaseous nitrogen oxide:

**Question 8:**

In the manufacture of the fertilizer ammonium sulphate, 20 dm<sup>3</sup> of 1 mol/dm<sup>3</sup> sulphuric acid and 1440 dm<sup>3</sup> of ammonia were reacted according to the equation given below:



- a) What is the limiting reagent in the mixture?
- b) What is the maximum mass of ammonium sulphate that can be obtained from the reaction?

- Scan the QR code below for the answers to this assignment.



[http://www.chemist.sg/mole/assignments/mole\\_one\\_ans.pdf](http://www.chemist.sg/mole/assignments/mole_one_ans.pdf)