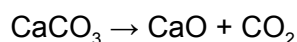


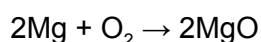
## Revision of KS4 Calculations in Chemistry for KS5 Worksheet

You will need access to a period table. I recommend using one of the UK exam boards as they produce easy to use periodic tables for GCSE and A level.

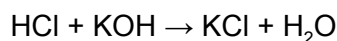
1. What is Avagadro's number?
2. How many atoms are there in one mole of any element?
3. If I had one mole of hydrogen molecules ( $H_2$ ), how many molecules would I have?
4. If I had one mole of hydrogen molecules ( $H_2$ ), how many atoms would I have?
5. Define  $A_r$  and  $M_r$
6. Write down the two formulas used to calculate moles.
7. How many moles are there in 10g of Fe?
8. How many moles are there in 25g of  $CuSO_4$ ?
9. What is the mass of 0.5 moles of Mg?
10. What is the mass of 0.1 moles of NaCl?
11. How many moles are there in  $25cm^3$  of  $0.1 mol/dm^3$  of NaOH
12. What is the concentration of a  $10cm^3$  solution of HCl that contains 0.25moles
13. What is the maximum mass of calcium oxide that could be formed when 15g of calcium carbonate is heated?



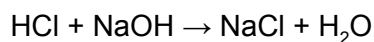
14. What is the minimum mass of Magnesium that would need to be heated with an excess of oxygen, to make 5g of Magnesium oxide?



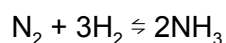
15. What volume of  $0.1 mol/dm^3$  HCl would be needed to completely neutralise  $15cm^3$  of  $0.2 mol/dm^3$  KOH



16. Calculate the atom economy for Sodium chloride, NaCl

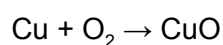


17. What is the empirical formula of a compound containing 14g of iron and 6g of oxygen?
18. Ammonia (NH<sub>3</sub>) is made during the Harber process. 100g of nitrogen is reacted with an excess of oxygen and 44g of ammonia is made. What is the percentage yield of ammonia?

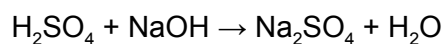


#### Extension Questions

1. What is the maximum mass of Copper oxide that could be formed if 5g of Copper is heated in an excess of oxygen?



2. What mass of NaOH would be needed to make 25cm<sup>3</sup> of a 0.2mol/dm<sup>3</sup> solution?
3. A solution of sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) has an unknown concentration. 25cm<sup>3</sup> of the solution of H<sub>2</sub>SO<sub>4</sub> requires 23cm<sup>3</sup> of 0.15mol/dm<sup>3</sup> NaOH solution. Calculate the concentration of the H<sub>2</sub>SO<sub>4</sub>.



4. When Magnesium is burnt in oxygen, magnesium oxide (MgO) is formed . Explain (without any calculations) why the atom economy is 100%. Hint you will need to write a balanced chemical equation.
5. What is the empirical formula of a compound containing 52.2% carbon, 13.0% hydrogen and oxygen only.

## Revision of KS4 Calculations in Chemistry for KS5 Worksheet - Answers

1. What is Avagrado's number?

Avagrado's number is the number of particles / atoms / molecules in one mole of any substance.  $6.02 \times 10^{23}$

2. How many atoms are there in one mole of any element?

$6.02 \times 10^{23}$

3. If I had one mole of hydrogen molecules ( $H_2$ ), how many molecules would I have?

$6.02 \times 10^{23}$

4. If I had one mole of hydrogen molecules ( $H_2$ ), how many atoms would I have?

$1.204 \times 10^{24}$  There are  $6.01 \times 10^{23}$  molecules and each molecule contains 2 atoms, so ( $6.02 \times 10^{23} \times 2$  atoms).

5. Define Ar and Mr

Ar - Relative atomic mass of an element (found on the periodic table)

Mr - Relative molecular mass (or formula mass), its the sum of the Ar's of all the atoms present in the substance

6. Write down the two formulas used to calculate moles.

Moles = mass/ Mr      Moles = concentration x Volume/1000

7. How many moles are there in 10g of Fe?

moles = mass/Mr (or Ar) =  $10/56 = 0.18$

8. How many moles are there in 25g of  $CuSO_4$ ?

Mr of  $CuSO_4 = 63.5 + 32 + (16 \times 4) = 159.5$

moles = mass/Mr =  $25/159.5 = 0.16$

9. What is the mass of 0.5 moles of Mg?



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$$\text{mass} = \text{moles} \times \text{Mr (or Ar)} = 0.5 \times 24 = 12$$

10. What is the mass of 0.1 moles of NaCl?

$$\text{Mr of NaCl} = 23 + 35.5 = 58.5$$

$$\text{mass} = \text{moles} \times \text{Mr} = 0.1 \times 58.5 = 5.9$$

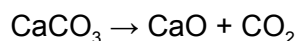
11. How many moles are there in 25cm<sup>3</sup> of 0.1 mol/dm<sup>3</sup> of NaOH

$$\text{moles} = \frac{\text{vol} \times \text{conc}}{1000} = \frac{(25 \times 0.1)}{1000} = 2.5 \times 10^{-3}$$

12. What is the concentration of a 10cm<sup>3</sup> solution of HCl that contains 0.25moles

$$\text{conc} = \frac{\text{moles} \times 1000}{\text{vol}} = \frac{(0.25 \times 1000)}{10} = 25 \text{ mol/dm}^3$$

13. What is the maximum mass of calcium oxide that could be formed when 15g of calcium carbonate is heated?

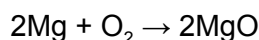


$$\text{Mr of CaCO}_3 = 40 + 12 + (16 \times 3) = 100 \quad \text{Mr of CaO} = 40 + 16 = 56$$

$$\text{moles of CaCO}_3 = \text{mass/Mr} = 15/100 = 0.15 = \text{moles of CaO}$$

$$\text{mass of CaO} = \text{moles} \times \text{Mr} = 0.15 \times 56 = 8.4\text{g (don't forget the units)}$$

14. What is the minimum mass of Magnesium that would need to be heated with an excess of oxygen, to make 5g of Magnesium oxide?

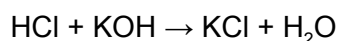


$$\text{Ar of Mg} = 24 \quad \text{Mr of MgO} = 24 + 16 = 40$$

$$\text{moles of MgO} = \text{mass/Mr} = 5/40 = 0.125 = \text{moles of Mg (2:2 ratio)}$$

$$\text{mass of Mg} = \text{moles} \times \text{Ar} = 0.125 \times 24 = 3\text{g (don't forget the units)}$$

15. What volume of 0.1 mol/dm<sup>3</sup> HCl would be needed to completely neutralise 15cm<sup>3</sup> of 0.2 mol/dm<sup>3</sup> KOH



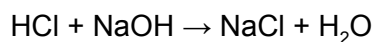
$$\text{moles of KOH} = \frac{\text{vol} \times \text{conc}}{1000} = \frac{(15 \times 0.2)}{1000} = 3 \times 10^{-3} = \text{moles of HCl}$$

$$\text{vol of HCl} = \frac{\text{moles} \times 1000}{\text{conc}} = \frac{(3 \times 10^{-3} \times 1000)}{0.1} = 30\text{cm}^3$$



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16. Calculate the atom economy for Sodium chloride, NaCl



$$\% \text{Atom Economy} = \frac{\text{mass of desired product}}{\text{total mass of all reactants}} \times 100 = \frac{23+35.5}{1+35.3+23+16+1} \times 100 = 76.5\%$$

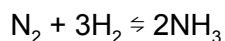
17. What is the empirical formula of a compound containing 14g of iron and 6g of oxygen?

$$\text{Fe } 14/56 = 0.25 \quad 0.25/0.25 = 1$$

$$\text{O } 6/16 = 0.375 \quad 0.375/0.25 = 1.5 \text{ Double both get the whole number ratio } 2:3$$

Empirical Formula  $\text{Fe}_2\text{O}_3$

19. Ammonia ( $\text{NH}_3$ ) is made during the Harber process. 100g of nitrogen is reacted with an excess of oxygen and 44g of ammonia is made. What is the percentage yield of ammonia?



$$\text{Max. theoretical yield of } \text{NH}_3 \text{ moles of } \text{N}_2 = \text{mass}/\text{Mr} = 100/(14 \times 2) = 3.57$$

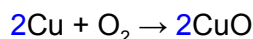
$$\text{moles of } \text{NH}_3 = \text{moles of } \text{N}_2 \times 2 = 7.14$$

$$\text{mass of } \text{NH}_3 = \text{moles} \times \text{Mr} = 7.14 \times (14+3) = 121.4\text{g}$$

$$\% \text{yield} = \frac{\text{actual yield}}{\text{max. theoretical yield}} \times 100 = \frac{44 \times 100}{121.4} = 36.2\%$$

#### Extension Questions

1. What is the maximum mass of Copper oxide that could be formed if 5g of Copper is heated in an excess of oxygen?



Balance the equation first!

$$\text{Ar of Cu} = 63.5 \quad \text{Mr of CuO} = 63.5+16 = 79.5$$

$$\text{moles of Cu} = \text{mass}/\text{Ar} = 5/63.5 = 7.9 \times 10^{-2} = \text{moles of CuO (2:2 ratio)}$$

$$\text{mass of CuO} = \text{moles} \times \text{Mr} = 7.9 \times 10^{-2} \times 79.5 = 6.3\text{g}$$

2. What mass of NaOH would be needed to make  $25\text{cm}^3$  of a  $0.2\text{mol}/\text{dm}^3$  solution?

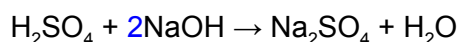
$$\text{moles of NaOH} = \frac{\text{vol} \times \text{conc}}{1000} = \frac{(25 \times 0.2)}{1000} = 5 \times 10^{-3}$$



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Mr of NaOH = (23+16+1) = 40  
mass of NaOH = moles x Mr =  $5 \times 10^{-3} \times 40 = 0.2\text{g}$

3. A solution of sulfuric acid ( $\text{H}_2\text{SO}_4$ ) has an unknown concentration.  $25\text{cm}^3$  of the solution of  $\text{H}_2\text{SO}_4$  requires  $23\text{cm}^3$  of  $0.15\text{mol/dm}^3$  NaOH solution. Calculate the concentration of the  $\text{H}_2\text{SO}_4$ .



First balance the equation!

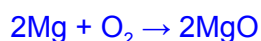
moles of  $\text{H}_2\text{SO}_4 = \frac{\text{vol} \times \text{conc}}{1000} = \frac{(23 \times 0.15)}{1000} = 3.45 \times 10^{-3}$

1 mole of  $\text{H}_2\text{SO}_4$  reacts with 2 moles of NaOH

so moles of NaOH = moles of  $\text{H}_2\text{SO}_4 \times 2 = 3.45 \times 10^{-3} \times 2 = 6.9 \times 10^{-3}$

conc of NaOH =  $\frac{\text{moles} \times \text{vol}}{1000} = \frac{6.9 \times 10^{-3} \times 25}{1000} = 1.7 \times 10^{-4} \text{mol/dm}^3$

4. When Magnesium is burnt in oxygen, magnesium oxide ( $\text{MgO}$ ) is formed . Explain (without any calculations) why the atom economy is 100%. Hint you will need to write a balanced chemical equation.



Total mass of the reactants and the products must be equal as matter cannot be created or destroyed. As  $\text{MgO}$  is the only product it will have the same mass as the total mass of the reactants.

5. What is the empirical formula of a compound containing 52.2% carbon, 13.0% hydrogen and oxygen only.

% Oxygen =  $100 - (52.2 + 13.0) = 34.8$

C  $52.2/12 = 4.35$        $4.35/2.175 = 2$

H  $13/1 = 13$                $13/2.175 = 6$

O  $34.8/16 = 2.175$        $2.175/2.175 = 1$

Empirical formula =  $\text{C}_2\text{H}_6\text{O}$

