**Balancing equations**

1. Balance the following equations:
   1. H2 + O2 🡪 H2O 6. HCl + NaOH 🡪 NaCl + H2O
   2. N2 + H2 🡪 NH3 7. NH3 + H2SO4 🡪(NH4)2SO4
   3. Na + Cl2 🡪 NaCl 8. Mg + HCl 🡪 MgCl2 + H2
   4. Mg + O2 🡪 MgO 9. CaCO3 🡪 CaO + CO2
   5. CH4 + O2 🡪 H2O + CO2 10. C3H8 + O2 🡪 CO2 + H2O

**Moles**

1. State the equation linking moles, mass and relative formula mass (Mr).
2. Calculate the number of moles (mol) for the following:

***Show all of your workings to maximum of 2.d.p***

***Relative atomic mass: H = 1; O = 16; C = 12; Na = 23; Ca = 40; Mg = 24; S = 32; Al = 27; Si = 28; N = 14; Cl = 35.5***

* 1. Mass Mg = 10g 6. Mass NaCl = 3.2g
  2. Mass S = 80,000g 7. Mass HCl = 438g
  3. Mass CaCO3 = 45.7g 8. Mass C2H6 = 15g
  4. Mass H2O = 27.2g 9. Mass NaOH = 140g
  5. Mass Ca = 9.8g 10. Mass Na2CO3 = 4240g

1. Calculate the mass (g) for the following:

***Show all of your workings***

***Relative atomic mass: H = 1; O = 16; C = 12; Na = 23; Ca = 40; Mg = 24; S = 32; Al = 27; Si = 28; N = 14; Cl = 35.5***

* 1. S = 2.4mol 6. CaCl2 = 1mol
  2. CO2 = 62.5mol 7. NH3 = 1.5mol
  3. Cl2 = 200mol 8. Ca(OH)2 = 1.6mol
  4. Mg = 6.2mol 9. CH4 = 1.58mol
  5. O2 = 10.5mol 10. C6H12O6 = 2.4mol

1. State the equation linking concentration, moles and volume.
2. Calculate the concentration (mol/dm3) for the following; some questions will require you to convert the units:

***Show all of your workings to maximum of 2.d.p***

* 1. 1mol of HCl in 0.5dm3 water
  2. 5mol of H2SO4 in 2.5dm3 water
  3. 0.5mol HCl in 5dm3 water
  4. 0.2mol of H2SO4 in 2dm3 water
  5. 0.65mol of HCl in 1.5dm3 water
  6. 0.65mol of HCl in 2dm3 water
  7. 2mol of H2SO4 in 2dm3 water
  8. 2mol NaOH in 0.75dm3 water
  9. 2mol NaOH in 100cm3 water
  10. 0.5 mol HCl in 1500cm3 water

1. Work out the following, some questions will require you to convert the units. State the units.

***Show all of your workings to maximum of 2.d.p***

***Relative atomic mass: H = 1; O = 16; C = 12; Na = 23; Ca = 40; Mg = 24; S = 32; Al = 27; Si = 28; N = 14; Cl = 35.5***

* 1. Calculate the volume: 1mol/dm3 containing 2mol of NaOH
  2. Calculate the concentration: 5.65g NaOH in 1dm3 water
  3. Calculate the concentration: 1 mol of HCl in 100cm3 water
  4. Calculate the volume: 0.4mol/dm3 containing 0.1mol HCl
  5. Calculate the mass: 0.24mol of C
  6. Calculate the moles: 84g of Na
  7. Calculate the moles: 0.124Kg of C2H6
  8. Calculate the concentration: 450cm3 water containing 2g NaOH
  9. Calculate the volume: 0.4mol/dm3 containing 0.1mol HCl
  10. Calculate the mass of NaCl needed to make: 240cm3 of a 0.35g/dm3

**Relative formula mass**

1. Work out the relative formula mass of the following compounds:

***Relative atomic mass: H = 1; O = 16; C = 12; Na = 23; Ca = 40; Mg = 24; S = 32; Al = 27; Si = 28; N = 14***

* 1. NaOH 6. MgSO4
  2. CH4 7. H2SO4
  3. NaCO3 8. C6H12O6
  4. C6H9 9. NH4NO3
  5. Ca(OH)2 10. Ca(Al2Si2)O8

**Examination style questions**

**1** The following reaction produces ethanoic acid (CH3COOH) from methanol (CH3OH) and carbon monoxide.

**CH3OH + CO 🡪 CH3COOH**

***Relative atomic mass: H = 1; O = 16; C = 12***

**(a)** Calculate the maximum mass of ethanoic acid that can be produced from 160g methanol, assuming the carbon monoxide is in excess.

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**(b)** Show that the atom economy for this reaction is 100%.

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**2** Sulfur dioxide (SO2) reacts with oxygen to form sulfur trioxide (SO3).

**(a)** Write a balanced symbol equation for this reaction.

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**(b)** 1.67 moles of SO3 are produced in the reaction. How many moles of O2 reacted to produce 1.67 moles of SO3? Show your working.

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**3** The following reaction produces aluminium oxide from the combustion of aluminium in oxygen.

**Al + O2 🡪 Al2O3**

***Relative atomic mass: Al = 27; O = 16***

**(a)** Write a balanced symbol equation for the reaction.

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**(b)** How many moles of oxygen would react with 1 mole of aluminium to form aluminium oxide?

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**(c)** Calculate the number of moles of aluminium in 10g.

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**(d)** Calculate the mass of aluminium oxide produced when 10g of aluminium is burned in excess oxygen. Calculate to 2.s.f.

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**Answers**

**a** **(1)** **2**H2 + O2 🡪 **2**H2O

**(2)** N2 + **3**H2 🡪 **2**NH3

**(3)** **2**Na + Cl2 🡪 **2**NaCl

**(4)** **2**Mg + O2 🡪 **2**MgO

**(5)** CH4 + **2**O2 🡪 **2**H2O + CO2

**(6)** HCl + NaOH 🡪 NaCl + H2O

**(7)\*** **2**NH3 + H2SO4 🡪(NH4)2SO4

**(8)** Mg + **2**HCl 🡪 MgCl2 + H2

**(9)** CaCO3 🡪 CaO + CO2

**(10)\*** C3H8 + **5**O2 🡪 **3**CO2 + **4**H2O

**b** moles = mass ÷ Mr (any correctly rearranged)

**c** **(1)** 0.42 **(6)** 0.06

**(2)** 2500 **(7)** 12

**(3)** 0.46  **(8)** 0.5

**(4)** 1.51 **(9)** 3.5

**(5)** 0.25 **(10)** 40

**d** **(1)** 76.8 **(6)** 111

**(2)** 2750 **(7)** 25.5

**(3)** 14,200  **(8)** 118.4

**(4)** 148.8 **(9)** 25.28

**(5)** 336 **(10)** 432

**e** Moles = concentration x volume (any correctly rearranged)

**f** **(1)** 2 **(6)** 0.33

**(2)** 2 **(7)** 1

**(3)** 0.1  **(8)** 2.67

**(4)** 0.1 **(9)\*** 20

**(5)** 0.43 **(10)\*** 0.33

**g** **(1)** 2 dm3

**(2)** 5.65 g/dm3

**(3)\*** 10 mol/dm3

**(4)** 0.25 dm3

**(5)** 2.88 g

**(6)** 3.65 mol

**(7)\*** 4.13 mol

**(8)\*** 4.44 g/dm3

**(9)** 0.25 dm3

**(10)\*** 0.08 g

**h** **(1)** 40 **(6)** 120

**(2)** 16 **(7)** 98

**(3)** 83  **(8)** 180

**(4)** 81 **(9)** 80

**(5)** 74 **(10)** 278

**Examination style questions**

**1** **(a)\*** Mr methanol = 32;

Moles methanol = 5;

Mr ethanoic acid = 60;

Mass ethanoic acid = 300g

**(b)** Only 1 product;

Mass desired product = total mass products

**2** **(a)** **2**SO2 + O2 🡪 **2**SO3

**(b)** Ratio 2SO3:O2; 0.835mol

**3** **(a)\*** **4**Al+ **3**O2 🡪 **2**Al2O3

**(b)\*** 0.75 mol

**(c)** 0.37 mol

**(d)\*** Ratio 2Al2O3:4Al; Mr Al2O3 = 102; mass Al2O3 = 19g

**Questions marked with an asterisk \* may be more challenging due to changes in units, or the complexity of the equation.**