

Chemical reactions & stoichiometry

1.- Calculate the number of moles and molecules which are found in 5 grams of graphite (carbon), 125 grams of water and 250 grams of gypsum (calcium sulphate).

Atomic masses: carbon: 12; hydrogen: 1; oxygen: 16; sulphur: 32; calcium: 40

Sol: 0.417, 6.94 and 1.84 moles; $2.5 \cdot 10^{23}$, $4.18 \cdot 10^{24}$ and $1.1 \cdot 10^{24}$ molecules

2.- Calculate the number of moles and molecules in the volume of air inside a classroom, which has 30 m^2 and its height is 4 m, at 25°C and 745 mm Hg. Calculate the mass of air, knowing that the average molecular mass of air is $28.8 \text{ g} \cdot \text{mol}^{-1}$

Sol: 4810 moles; $2.9 \cdot 10^{27}$ molecules; 137 kg

3.- A tennis ball contains about 40 g of sulphur hexafluoride. How many moles of this substance are inside the ball? What is the pressure of the gas, knowing that the volume of the ball is 300 cm^3 at 20°C ?

Sol: 0.27 moles; 21 at

4.- A gas cylinder contains 5 kg of butane, whose formula is C_4H_{10} . Calculate the number of moles of butane and the number of molecules which are inside the gas cylinder. What is the pressure inside the cylinder if its volume is 2 l? What is the volume of this amount of gas at 700 mm Hg and 20°C ?

Sol: 86.2 moles; $5.2 \cdot 10^{25}$ molecules; 1035 at; 2250 litres

5.- A 2.5 litre-gas cylinder filled with oxygen (O_2) contains 500 g of gas. Calculate the pressure inside the cylinder at 25°C . What is the pressure inside the cylinder? What is the volume occupied by this amount of gas at 30°C and 700 mm Hg? 1 at = 760 mm Hg Atomic mass of oxygen: 16

Sol: 170 at; 421 litres

6.- Four grams of sulphur react with 14.25 grams of fluorine, producing a compound made up of these two elements. Calculate the mass of product and the formula of this substance Atomic masses: sulphur: 32; fluorine: 19

Sol: 18.25 g; SF_6

7.- The combustion of 3 tones of coal, which has 3 % of sulphur, produces sulphur dioxide and, eventually, acid rain. Balance the chemical equation and calculate the mass of sulphur dioxide produced and its volume at STP (Standard Temperature and Pressure).

Atomic masses: sulphur: 32; oxygen: 16

Sol: 180 kg; 63 m^3

8.- Natural gas is mainly methane, whose formula is CH_4 . Write the chemical equation of the combustion of this substance, in which methane and oxygen yields carbon dioxide and water. What is the mass of carbon dioxide produced by the combustion of 1 m^3 of natural gas at 25°C and 1.5 at? How many litres of oxygen at 20°C and 740 mm Hg do we have to use to carry out the combustion?

9.- The reaction between magnesium hydride with water yields magnesium hydroxide and hydrogen (H_2). Write and balance the chemical equation. If a 20 grams-pill of magnesium hydride reacts with water, how many moles and molecules of water do we need? What is the mass of magnesium hydroxide produced? What is the volume of hydrogen, at 15°C and 730 mm de Hg formed?

Sol: 0.77 moles; $9.63 \cdot 10^{23}$ molecules; 44.6 g; 38 l

10.- The reaction between calcium carbide, CaC_2 , and water yields calcium hydroxide and acetylene (C_2H_2). Write and balance the chemical equation and calculate the mass of water needed to produce 200 g of acetylene

Sol: 277.2 g

11.- Calculate the volume of oxygen at STP needed to burn 10.4 litres of acetylene at the same conditions. What is the volume of air (whose composition is 20 % oxygen and 80 % nitrogen) at 17°C and 700 mm de Hg

Sol: 26 l; 150 l