

EXERCISE 1

Car airbags

Given:

- Molar mass g.mol^{-1} : $M_{(\text{Na})} = 23$, $M_{(\text{N})} = 14$; $M_{(\text{O})} = 16$; $M_{(\text{K})} = 39$.
- Molar volume of gas at 25°C : 22.4 L.mol^{-1} .
- The airbag of a car (Mazda), consists of sodium azide (NaN_3). The airbag comprises a flexible envelope, which may be inflated by a gas produced during a chemical reaction. During an impact, a sensor detects a sudden deceleration and sends an electrical signal that triggers the explosion of sodium azide.

The equation for the reaction that occurs during the inflation of "protective cushion" is:



Questions:

1. Write and balance the equation given above by determining the stoichiometric coefficients a , b and c .
2. Show that sodium azide NaN_3 and potassium nitrate KNO_3 are mixed in the ratio $5 / 1$ (mole) so that they disappear completely during the inflation of "protective cushion".
3. If the mass of sodium azide contained in the airbag of the car is 52 g .
Check if the quantity of matter of nitrogen (N_2) is enough to inflate the balloon of 36 L capacity.
4. If we introduce 130 g of NaN_3 and n moles of KNO_3 in the airbag of a (Toyota).
What should the value of n , so that the mixture is stoichiometric?

EXERCISE 2

Dilution of a commercial solution of HNO_3

On the label of a commercial Nitric acid we read:

Commercial Nitric acid : HNO_3	Density: $d = 1.26 \text{ g.mL}^{-1}$ 40% by mass $M(\text{HNO}_3) = 63 \text{ g.mol}^{-1}$ $C_0 = ?$
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1) Questions:

- a) Show that the molar concentration of nitric acid solution (S_0) is $C_0 = 8.0 \text{ mol L}^{-1}$.
- b) Starting with the available commercial nitric acid solution, we prepare solution (S_1) of nitric acid of concentration $C_1 = 0.32 \text{ mol L}^{-1}$.

Kit 1	Kit 2	Kit 3
10ml volumetric pipette 100ml volumetric flask	15ml volumetric pipette 500ml volumetric flask	10ml volumetric pipette 250ml volumetric flask

- 1) Among the following kits, choose by justifying each, the kit that should be used to carry out the most precise dilution.
- 2) 10 ml of solution S_1 (HNO_3) are mixed with 50 ml sodium carbonate Na_2CO_3 of concentration 0.01 mol L^{-1} . Solution of sodium nitrate (NaNO_3), water, and a gas that turns lime water turbid are formed.
 - i- Write the chemical equation of the reaction that takes place.
 - ii- Calculate the initial concentration of the reactants.
 - iii Is the reactant mixture in stoichiometric? If not, indicate the limiting reactant.
 - iv- Calculate the concentration of the chemical species present at the end of the reaction.

Given: $M \text{ g.mol}^{-1}$: $\text{Na} = 23$, $\text{N} = 14$, $\text{C} = 12$, $\text{H} = 1$, $\text{O} = 16$.