1.2 Exercise 3 - Ideal Gas Equation

Remember: R = 8.31 $JK^{-1}mol^{-1}$, 0 K = -273 ^oC

1. Calculate the volume occupied by one mole of a gas at 25 ^oC and 100 kPa.

2. Calculate the pressure of a gas given that 0.2 moles of the gas occupy 10 dm^3 at 20 ^oC.

3. Calculate the temperature of a gas if 0.5 moles occupy 1.2 dm^3 at a pressure of 200 kPa.

4. Calculate the mass of a sample of carbon dioxide which occupies 20 dm^3 at 27 ^oC and 100 kPa.

5. Calculate the relative molecular mass of a gas if a 500 cm^3 sample at 20 ^oC and 1 atm has a mass of 0.66 g.

6. At 25 ^oC and 100 kPa a gas occupies a volume of 20 dm^3. Calculate the new temperature of the gas if
   a) the volume is decreased to 10 dm^3 at constant pressure.
   b) the pressure is decreased to 50 kPa at constant volume.

7. 10.0 g of calcium nitrate is heated at 100 kPa and a temperature of 300 ^oC, at which temperature it fully decomposes. Calculate
   a) the volume of nitrogen dioxide evolved
   b) the volume of oxygen evolved
   c) the total volume of gas evolved
   Equation: $2Ca(NO_3)_2(s) \rightarrow 2CaO(s) + 4NO_2(g) + O_2(g)$

8. Calculate the volume of oxygen produced at 298 K and 100 kPa by the decomposition of 30 cm^3 of 0.1 $moldm^{-3}$ hydrogen peroxide.
   Equation: $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

9. Lead (IV) oxide dissolves in concentrated hydrochloric acid according to the following equation: $PbO_2(s) + 4HCl(aq) \rightarrow PbCl_2(s) + Cl_2(g) + 2H_2O(l)$
   Starting with 37.2 g of lead (IV) oxide, calculate:
   a) the volume of 12 $moldm^{-3}$ HCl needed to completely dissolve it
   b) the mass of $PbCl_2$ produced
   c) the volume of chlorine produced at 298 K and 100 kPa.

10. What mass of magnesium, and what volume of 2.0 $moldm^{-3}$ hydrochloric acid, will be required to produce 100 cm^3 of hydrogen gas at 298 K and 100 kPa?
    Equation: $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$

11. 0.52 g of sodium was added to 100 cm^3 of water. Calculate:
    a) The volume of hydrogen evolved at 298 K and 100 kPa
    b) The concentration of the sodium hydroxide solution produced, assuming the volume of water does not change.
    Equation: $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$