Lesson 2a rates

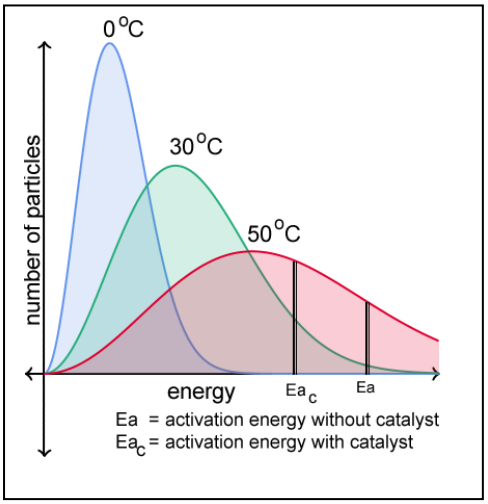
1) The ideal gas equation is given below
PV=nRT
   a) Using this equation derive formulae for
      Density _____*(P $F_m$ )/ (R T) = d*
      Formula mass _____*$F_m$ = m R T / (P V)*
      Mass _____*m = P V $F_m$ / (RT)*
      Concentration _____*C = P / (RT)*

   b) Fluorine gas ($F_2$) is kept in a 2.00 litre sealed vessel at 100.0 kPa at a temperature of 20.0 °C. Calculate the

      i. Density of the gas in g/L
      *1.56g/L*

      ii. Concentration in mol/L
      *0.0411 mol/L*

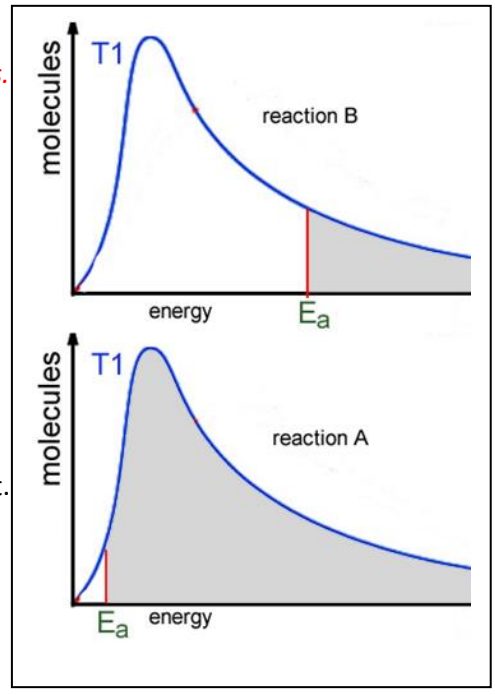
      iii. Mass of the gas in grams
      *3.12g*




2) A known quantity of gas is placed in a sealed container at 0 °C , it is then heated to 30 °C and then to 50 °C. The Maxwell-Boltzmann distribution curves for the gas at the three different temperatures are shown on the right.
a) From the graphs shown on the right, how can we tell that the number of gas particles is the same at the three different temperatures.
*Area under* the *graph should be the same for all three graphs.*

b) Using the information shown on the right, suggest why food kept at 0°C does not spoil as quickly as food kept at 50°C.
*Food spoilage is a chemical process. Very few particles have the necessary activation energy to react at 0°C, hence spoilage is slowed down.*

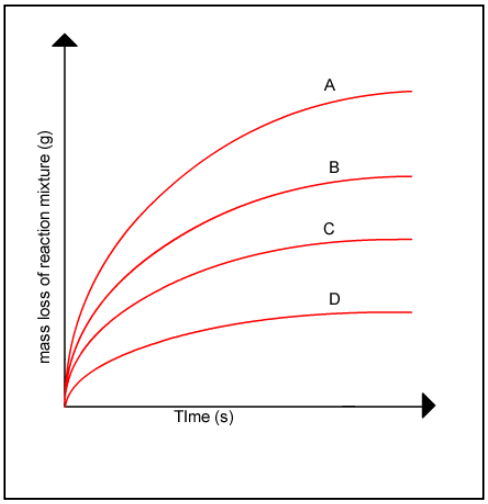
3) The Maxwell-Boltzmann distribution curves of two reactions taking place at the same temperature are shown on the right.
   a) Which reaction will have the fastest reaction rate?
      Explain
   *Reaction A as more particles have kinetic energy equal to or greater than the activation energy.*



b) Explain what is meant by $E_a$

*Activation energy is the minimum amount of energy needed by the reactant particles to undergo fruitful collisions.*

4) A reaction between a solution of 0.1M HCl and 5.00 grams of powdered $CaCO_3$ takes place under four different conditions. The mass loss from the reaction vessel is measured and plotted against time on a set of axes shown on the right.




i. Write a balanced chemical equation for the reaction taking place.

*$2HCl(aq) + CaCO_3(s) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$*

ii. Which reaction has the highest rate of reaction. Explain why.

*A - due to steeper slope.*

iii. Give one difference between the conditions of reaction C and D that could have resulted in the different shapes of the two graphs. Explain

*Either*

*Temperature increase in C or catalyst used in C but not D.*

*iv.* Give two differences between the conditions of reactions A and B that could have resulted in the different shapes of the two graphs assuming no catalysts were used. Explain *Reaction A was at a higher temperature than B because the rate of the reaction is greater and a greater volume of acid was used in reaction A than in B as the graph of reaction A levels out at a higher value indicating more $CO_2$ is released.*

v. Looking at the shapes of each graph suggest one variable , apart from temperature, that was not kept constant?

*It may be that the amount of HCl was the limiting reactant and hence volume of the HCl solution used varied since the amount of product formed varies in all four experiments.*

vi. Sulfuric acid ($H_2SO_4$), instead of HCl, was used. Write an equation for this reaction and suggest if this acid would work just as well as HCl.

*$H_2SO_4(aq) + CaCO_3(s) \rightarrow CO_2(g) + H_2Ol) + CaSO_4(s)$.*

*Yes as $CO_2$ is still produced and would result in mass loss that can be measured.*