Revision 3 Equilibrium, galvanic cells and organic pathways

1) Consider the reaction shown below

$2NOCl(g) \rightarrow 2NO(g) + Cl_2(g)$ ΔH is positive.

a) The equilibrium constant for this reaction is 1.23×10^{-4} M at a given temperature. What is the equilibrium constant for the reaction below, taking place at the same temperature as the reaction above.

$NO(g) + \frac{1}{2}Cl_2(g) \rightarrow NOCl(g)$

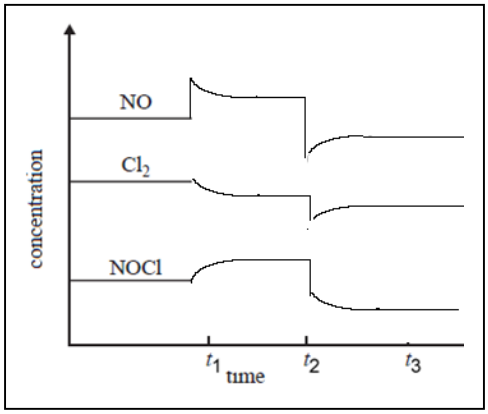
$$\sqrt{\frac{1}{1.23 \times 10^{-4}}}$$

$$=> 90.2 \text{ M}^{-\frac{1}{2}}$$

b) A concentration-time graph for the system $2NOCl(g) \rightarrow 2NO(g) + Cl_2(g)$ ΔH is positive is shown on the right.

On the graph indicate the changes that take place when at

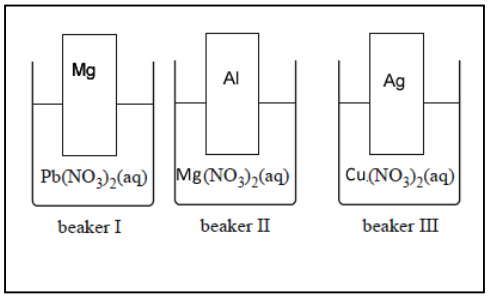
- t_1 NO is added
- t_2 the pressure was decreased by increasing the volume
- t_3 a catalyst was added at constant temperature.



2) Three pieces of metal were placed in different solutions as shown on the right.

a) In which beaker/s will a reaction occur?

Beaker I and II only

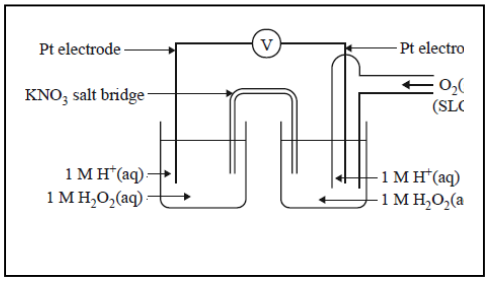


b) give the overall equation to each reaction.

$Pb^{2+}(aq) + Mg(s) \rightarrow Mg^{2+}(aq) + Pb(s)$ – Beaker I

$2Al(s) + 6H_2O(l) \rightarrow 3H_2(g) + 6OH^-(aq) + 2Al^{3+}(aq)$ Beaker II

c) A student set up the galvanic cell shown on the right.



i. Write the balanced overall equation to the reaction taking place.

$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

ii. The student, however, notices that there is no measurable voltage output.

The following students offer their opinion as to why no measurable voltage is recorded.

Student 1 " *The setup is not constructed with standard half cells*"

Student 2 "H_2O_2 will oxidise water in preference to itself"

Student 3 " *The reaction occurs too slowly* "

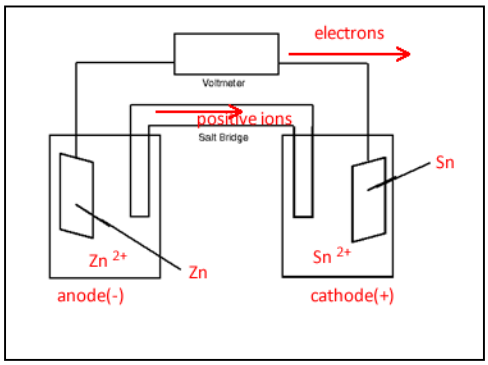
Which one of the students is likely to be correct? Explain why and suggest why the others are not correct.

Student 3 is correct. The setup is constructed with standard half cells at 1M SLC, 25°C 101.3 kPa, while H_2O_2 will not oxidise water but H_2O_2. H_2O_2 is a stronger oxidant and reductant than water according to the E^o table in the data sheet.

d) Four standard galvanic cells are set up as indicated below.
cell I a Br_2/B^{r-} standard half-cell connected to a Cu^{2+} /Cu standard half-cell
cell II an Sn^{2+}/Sn standard half-cell connected to a Zn^{2+} /Zn standard half-cell
cell III a Br_2/Br^- standard half-cell connected to an I_2/I^- standard half-cell
cell IV a Co^{2+} /Co standard half-cell connected to an Fe^{3+} /Fe^{2+} standard half-cell

Draw galvanic cell II in the diagram on the right.
Indicate the :
- EMF
- cathode and anode
- polarity of the electrodes
- what the electrodes are made from
- direction of electron flow
- direction of positive ion flow
- The oxidation half equation *$Zn(s) \rightarrow Zn^{2+}(aq) + 2e$*
  The reduction half equation *$Sn^{2+}(aq) + 2e \rightarrow Sn(s)$*

f) Which cell has the highest EMF? *Cell IV EMF 1.05 V*

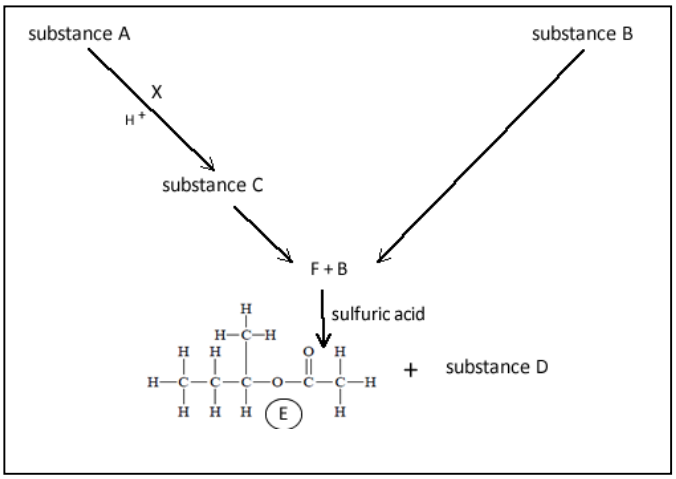


e) Explain why KNO_3 is used to form the salt bridge.

The salt used in the salt bridge must
- be soluble in water
- not react with components of either half-cell, i.e. cannot contain a strong oxidant or a strong reductant.

Also, in the cell, cations migrate towards the cathode and anions migrate towards the anode.

3) Consider the reaction pathways shown on the right.



a) Identify substance :
A –*ethanol*
B – *butan-2-ol*
C - *ethanal*
D –*water*
F – ethanoic acid

b) To what group of molecules does substance B belong to? *Secondary alcohol*

c) To what group of molecules does substance E belong to? *Ester*