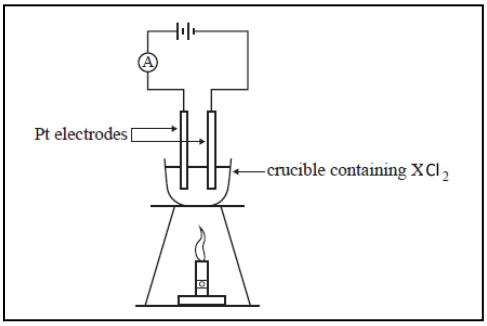
Revision 6 Galvanic cells, electrolytic cells and organic reactions

1) Electrolysis of a molten salt using an unknown metal salt, XCl_2 was performed using the apparatus shown on the right.



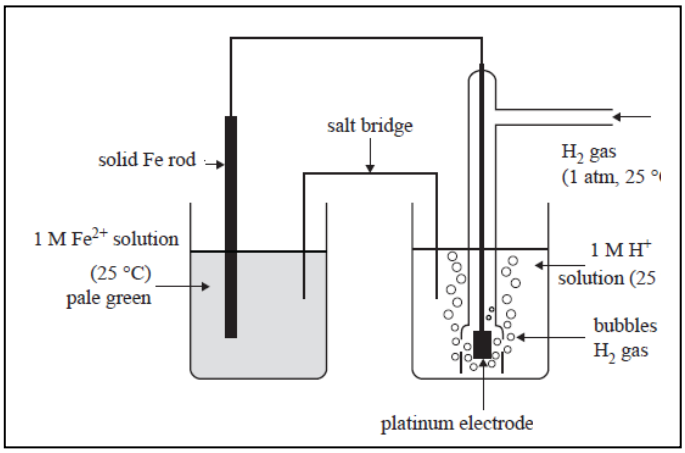
A current of 1.90 A was supplied for 2.43 hours.
5.47 grams of metal X was produced.
a) Write a balanced half equation for the reaction occurring at the:
anode
Cathode
b) Identify metal X.

c) Indicate true or false for the following statements about galvanic and electrolytic cells? Explain why for each.

i. Reduction occurs at the negative electrode in both cells.
ii. Reduction occurs at the cathode in both cells.
iii. Anions migrate to the cathode in both cells.
iv. The anode is positive in both cells.

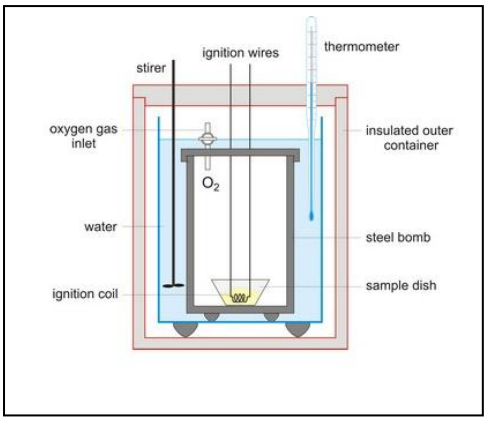
d) Fuel cells have a number of applications that offer advantages over conventional methods of electricity generation.
Which one of the following is not a feature of modern fuel cells?
A. They generate very little noise.
B. They are a cheap source of electricity.
C. They enable electricity to be generated on site.
D. They have the potential to reduce emissions of carbon dioxide into the atmosphere.

2) The galvanic cell shown on the right was setup in a laboratory.



The half-cell on the right is called the standard hydrogen electrode (SHE).
It is the standard against which all standard redox potentials are compared. Hydrogen gas, H_2, is continually bubbled into this half-cell.
When asked what would happen at the platinum electrode four students volunteered an answer.
Student 1 "Electrons would move from the platinum electrode through the acid solution towards the salt bridge."
Student 2 " The platinum electrode would act as the anode in this cell and have positive polarity."
Student 3 "The pH of the solution surrounding the platinum electrode would increase."
Student 4 "The hydrogen gas would be oxidised at the platinum electrode's surface."
Which of the four students is/are correct? Explain why.

3) 0.580 grams of butane was placed in a bomb calorimeter and ignited. After complete combustion the temperature of 100.0 grams of water, initially at 25.0 °C reached 64.0 °C.



a) Write a balanced chemical equation for the complete combustion of liquid butane.

$$\text{percentage energy loss} = \frac{(\text{theoretical value of } \Delta H - \text{experimental value of } \Delta H)}{\text{theoretical value of } \Delta H} \times \frac{100}{1}$$

b) The above expression gives the percentage energy loss to the environment. Use the known enthalpy change for butane to calculate the percentage energy loss to the environment. Answer is given to the right number of significant figures.

4) Consider the two equations on the right.

a) What type of reaction is

i.

ii.

i. $CH_2CH_2(g) + Cl_2(g) \xrightarrow{\text{UV light}} CH_2ClCH_2Cl($

ii. $CH_3CH_3(g) + Cl_2(g) \xrightarrow{\text{UV light}} CH_3CH_2Cl\ (l)$

b) Name the products of each reaction even if they are not shown in the unbalanced reaction.

c) The product of reaction ii. Above is used to synthesise an organic acid. Give the reaction pathway, clearly labelling all the reagents used, and name the product of each step.

d) Which product, of the reactions above, can be used to synthesise a diol? Write the reaction clearly naming the product and all the reagents used.