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VCE Chemistry ¾
AOS 2 Revision I [2.5]
Test Solutions

20 Marks. 1 Minute Reading. 16 Minutes Writing

Results:

Test Questions	_____ / 15
Extension	_____ / 5

Section A: Test Questions (15 Marks)

Question 1 (2 marks)

Tick whether the following statements are **true** or **false**.

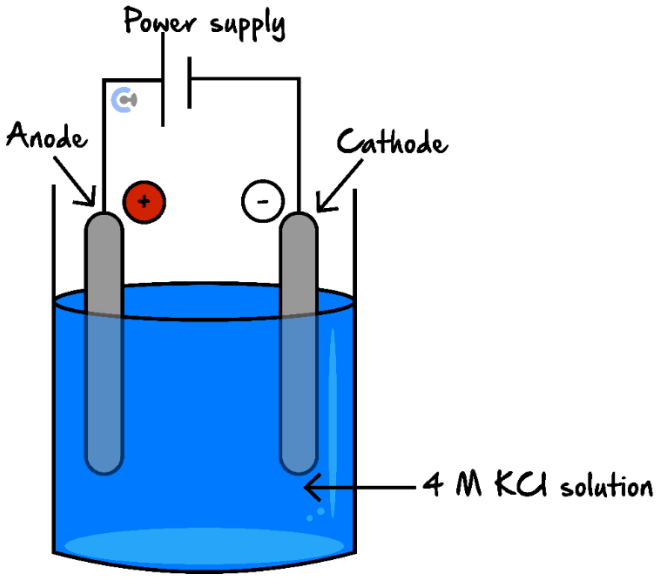
Statement	True	False
a. In a secondary cell, during recharge, the polarities of the electrodes swap compared to their polarities during discharge.		✓
b. The artificial photosynthesis cell is constructed to produce hydrogen gas, and does so by converting sunlight directly into chemical energy.	✓	
c. The life of a battery can be extended by storing it in warm conditions so that the chemicals do not freeze and clog up the electrodes.		✓
d. In electroplating, the concentration of the electrolyte remains constant, regardless of the choice of material at the anode.		✓

Space for Personal Notes

Question 2 (13 marks)

Potassium hydroxide, KOH, is made commercially by the electrolysis of concentrated potassium chloride, KCl, solution.

A chemist aims to make a solution of aqueous potassium hydroxide, KOH(aq) using electrolysis. The electrolysis cell is shown below. It is operated at standard laboratory conditions (SLC).



a.

i. Explain why potassium bromide, KBr, or potassium iodide, KI could not replace KCl as the electrolyte solution, using the cell shown above. (2 marks)

- KI as an electrolyte would produce $I_2(s)$ which would contaminate the solution / react with OH^-.
- KBr as an electrolyte would produce $Br_2(l)$ which would contaminate the solution / react with OH^-.
- Using KCl leads to the production of $Cl_2(g)$ which would bubble off from the solution.

One mark each was awarded for:

- Either or both products- **solid I_2 or liquid Br_2** OR indication that **Cl_2 is a gas.**
- **Associated effect-** contamination of solution / reaction with $OH^-(aq)$ / escape of $Cl_2(g)$.

ii. When the power supply is turned on, the chemist observes bubbles forming at the anode. Use the electrochemical series to predict the gas formed at the anode. (1 mark)

$Cl_2(g)$ and $O_2(g)$ could be formed

iii. A faint smell of chlorine was detected above the anode. Explain this observation. (2 marks)

Cl_2 gas is being produced because $Cl^-(aq)$ ions are being oxidised in preference to H_2O as the conditions are non-standard / concentration not 1 M.

One mark each was awarded for:
- Cl^- ions being oxidised in preference to H_2O.
- Non-standard conditions or concentration effect.

iv. Write a balanced [illegible] that is consistent with the explanation

Either:
- $2H_2O(l) + 2KCl(aq) \longrightarrow 2KOH(aq) + H_2(g) + Cl_2(g)$
- $2H_2O(l) + 2Cl^-(aq) \longrightarrow 2OH^-(aq) + H_2(g) + Cl_2(g)$

One mark each was awarded for:
- Correct species.
- Correct balancing.

v. Identify a safety issue with this cell and how the risk(s) can be minimised. (2 marks)

H_2 and Cl_2 gases can form an explosive mixture and should be collected separately. H_2 is explosive if sparked in air and should be collected away from any source of ignition. Cl_2 is poisonous so a fume hood/appropriate extraction should be used.

One mark each was awarded for:
- Accurate safety issue with gases given in **part.a. iv.**
- A reasonable method of overcoming this safety issue.

b. In a commercial electrolysis cell that produces KOH, the two electrodes are separated by a membrane. State one reason why this membrane exists. (1 mark)

- Prevent Cl_2 gas reacting with OH^- ions.
- Prevent unwanted reactions.
- Separate gases.

c. KOH is also used as part of a rechargeable nickel-cadmium, NiCd, battery. The chemical reactions that occur in an NiCd battery during discharge are:

$$Cd(s) + 2OH^-(aq) \longrightarrow Cd(OH)_2(s) + 2e^-$$

$$2NiO(OH)(s) + 2H_2O(l) + 2e^- \longrightarrow 2Ni(OH)_2(s) + 2OH^-(aq)$$

i. Identify the reducing agent in these reactions during **discharge**. (1 mark)

$Cd(s)$

ii. Identify the oxidising agent in these reactions during recharge. (1 mark)

$Cd(OH)_2(s)$

iii. State a purpose of KOH in the NiCd battery. (1 mark)

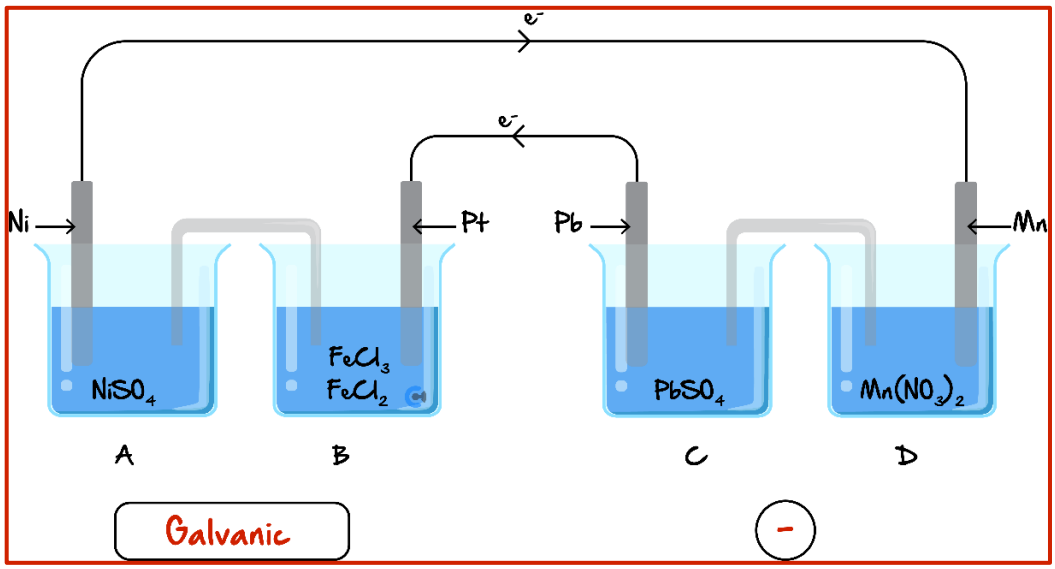
- Electrolyte
- A source of $OH^-(aq)$ ions.

Space for Personal Notes

Section B: Extension (5 Marks)

Question 3 (5 marks)

The following set-up was constructed by Shriya using aqueous 1.0 *M* solutions at SLC:



a. Determine whether the reaction is occurring between the beakers *A* and *B* is galvanic or electrolytic, and subsequently, state this in the box provided beneath (write either 'galvanic' or 'electrolytic'). (1 mark)

b. State the polarity of the electrode *D* by placing a '+' or '−' sign in the circle provided below the beaker *D*, **and** write the half-equation occurring at this electrode as the cell operates. (1 mark)

$2H_2O(l) + 2e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$

c. If this cell were operating for 10 minutes, determine which **two electrodes** would have the greatest changes in mass, and briefly explain what can be concluded about the other electrodes' masses. (2 marks)

Ni and Pb electrodes will oxidise. Pb has a large M/z ratio (207.2/2), so it would have the largest decrease in mass, followed by nickel (58.7/2) , and then the Pt and Mn electrodes would have no change in mass, and they are not reacting, nor is anything depositing onto them.

d. Had molten conditions been used, explain whether there would be any difference(s) in the reactions taking place, and if so, outline what the difference(s) would be. (1 mark)

The $Mn^{2+}(l)$ would now reduce in beaker *D* rather than water, producing Mn(l). Everything else would be unaffected.

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