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VCE Chemistry ¾
Galvanic Cells [1.8]
Test

20 Marks. 1 Minute Reading. 16 Minutes Writing

Results:

Test Questions	_____ / 15
Extension Questions	_____ / 5

Section A: Test Questions (15 Marks)

Question 1 (4 marks)

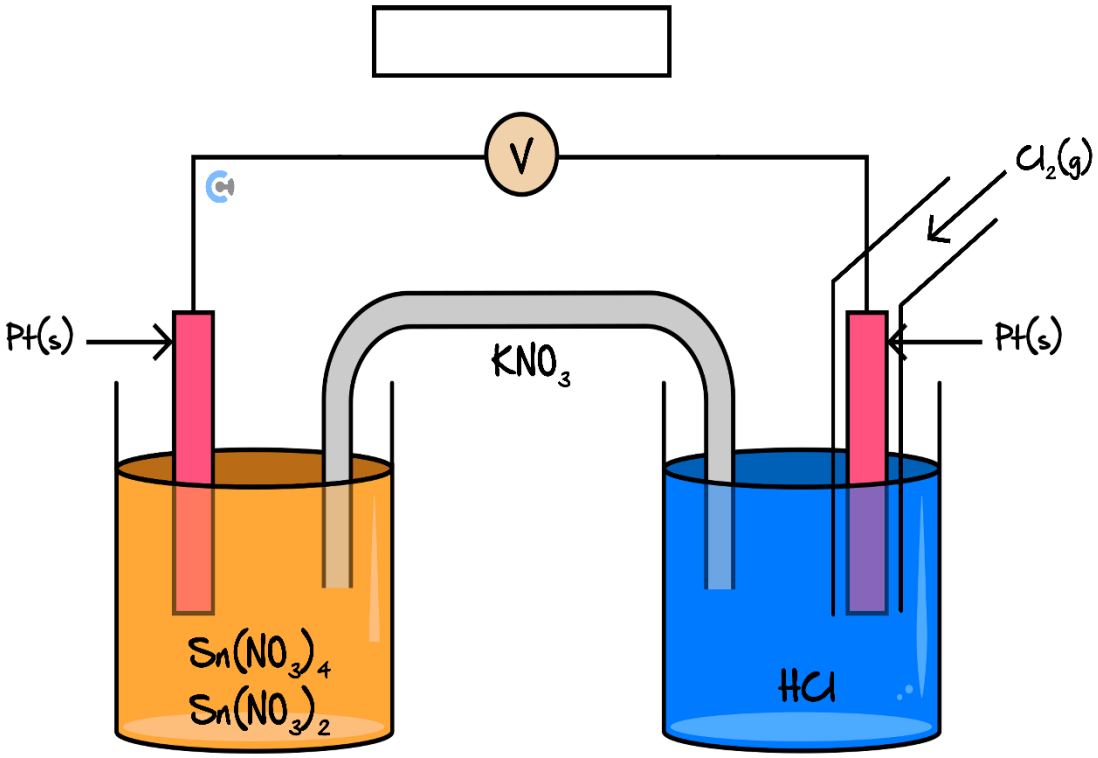
Tick whether the following statements are **True** or **False**.

	True	False
a. The electrode potential of the anode in a galvanic cell is always higher than the electrode potential of the cathode under standard conditions.		
b. In galvanic cells, the salt bridge prevents the physical mixing of the two electrolyte solutions, thereby stopping the redox reaction.		
c. Anions, which are negatively charged, from the salt bridge migrate towards the anode, which is the negative electrode.		
d. Electrons flow through the external circuit to facilitate an indirect redox reaction.		
e. In a galvanic cell, the use of an inert electrode is mandatory for reactions involving half-cells comprising gases and ions, as it serves as a conduit for electron flow.		
f. The electrolyte's concentration remains constant throughout the operation of a galvanic cell.		
g. The cathode is defined as the positive electrode in an electrochemical cell.		
h. Galvanic cells with half-cells containing the same metal in different oxidation states, such as $Fe^{2+}(aq)/Fe^{3+}(aq)$ do not require a salt bridge for operation.		

Space for Personal Notes

Question 2 (4 marks)

The following galvanic cell was constructed in a school laboratory:



a. In the box provided above, draw an arrow to show the direction of electron flow through the wire. (1 mark)

b.

i. Write the ionic equation for the reaction taking place at the negative electrode. (1 mark)

_____

ii. Write the ionic equation for the reaction taking place at the other electrode. (1 mark)

_____

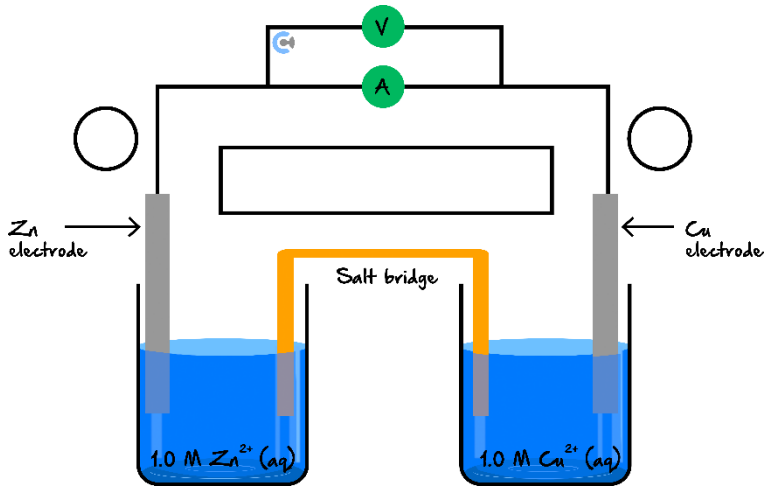
c. Propose **one** reason as to why the cell produced a voltage different to that expected from the literature. (1 mark)

_____

_____

Question 3 (7 marks)

a. The Daniell cell, a type of galvanic cell, was first constructed in the mid-1800s, and this type of cell is still in use today. A diagram of the Daniell cell is shown below.



i. Label the polarity of the electrodes by placing a positive (+) or negative (−) sign in each of the circles next to the electrodes on the diagram above. (1 mark)

ii. Use the electrochemical series to determine the theoretical voltage of this cell. (1 mark)

_____

iii. The electrolyte in the salt bridge is a Potassium nitrate solution, $KNO_3(aq)$.

In the box above the salt bridge, use an arrow to indicate the direction of flow of $K^+(aq)$ ions. (1 mark)

iv. List **two visible** changes that are likely to be observed when the Daniell cell has been operating for some time. (2 marks)

_____

_____

b. What design features of the Daniell cell structure would allow it to produce electrical energy? (2 marks)

_____

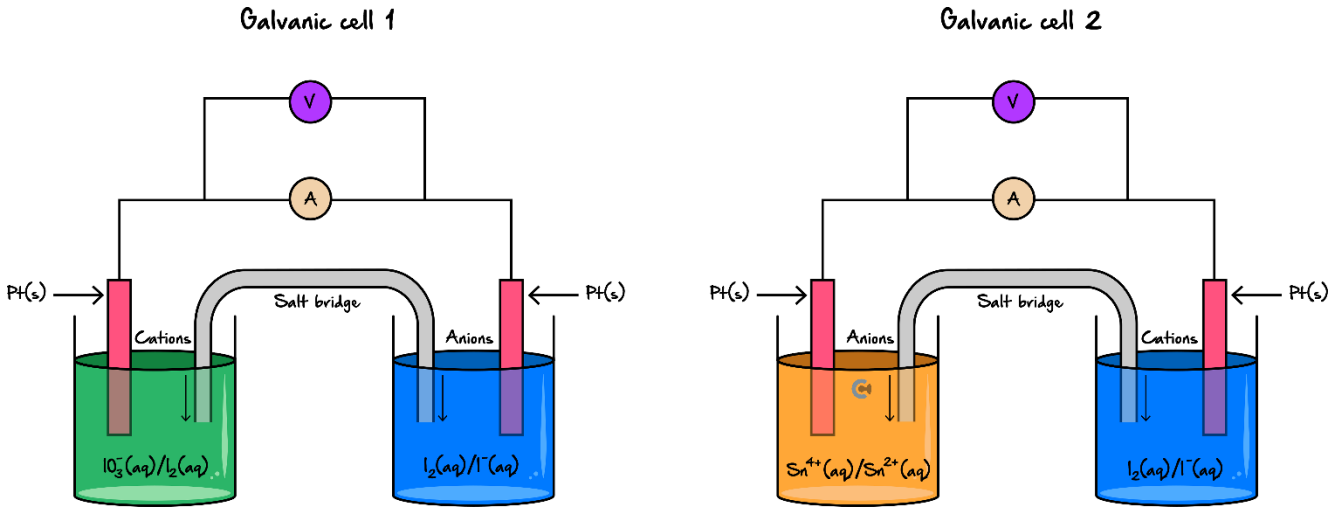
_____

_____

Section B: Extension Questions (5 Marks)

The following information applies to the two questions that follow.

The following diagrams show two galvanic cells, Galvanic cell 1 and Galvanic cell 2, with Platinum, Pt, electrodes and 1.0 *M* concentrations of salt solutions. Both cells were set up at SLC. A voltage was produced in each cell. The direction of movement of the ions in the salt bridge is indicated in each diagram.



Question 4 (1 mark)

Which one of the following statements is true?

A. The weakest reducing agent is Sn^{2+}.

B. The strongest oxidising agent is I^-.

C. The strongest oxidising agent is IO_3^-.

D. The weakest reducing agent is I^-.

Question 5 (1 mark)

A correctly balanced half-equation occurring in Galvanic cell 1 is:

A. $IO_3^-(aq) + 6H^+(aq) + 6e^- \rightarrow I^-(aq) + 3H_2O(l)$

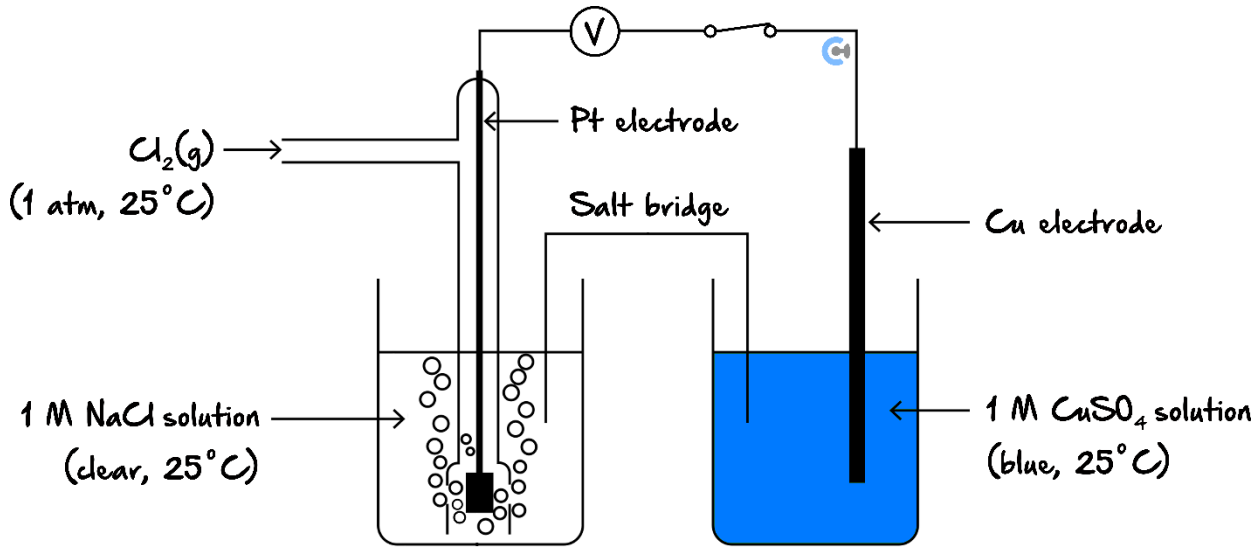
B. $I^-(aq) + 3H_2O(l) \rightarrow IO_3^-(aq) + 6H^+(aq) + 6e^-$

C. $I_2(aq) + 6H_2O(l) \rightarrow 2IO_3^-(aq) + 12H^+(aq) + 10e^-$

D. $2IO_3^-(aq) + 12H^+(aq) + 10e^- \rightarrow I_2(aq) + 6H_2O(l)$

The following information applies to the two questions that follow.

The Galvanic cell shown below is set up under a fume hood by a Chemistry student at a university. Chlorine gas, Cl_2, is continually bubbled through the left half-cell.



Question 6 (1 mark)

When the cell begins to operate:

A. The cell voltage will start at $1.02\ V$, then slowly drop.

B. The Cu electrode will have positive polarity and act as the cathode.

C. Electrons will move out of the Pt electrode and along the wiring to the Cu electrode.

D. Anions in the salt bridge will move into the copper sulphate solution.

Question 7 (1 mark)

What is the student most likely to observe in the Cu half-cell sometime after the switch is turned on?

A. Bubbles forming over the electrode.

B. The Cu electrode looking corroded.

C. The solution becoming lighter blue in colour.

D. Crystals of Cu growing over the electrode.

Space for Personal Notes

Question 8 (1 mark)

Consider the following statements about an unknown chemical species, X.

- A 1 *M* solution of X^{4+} reacts with $H_2(g)$ and X(s).
- Bubbles of gas are observed when 1 *M* solution of $H^+(aq)$ is added to X(s).

What is the order of the standard half-cell potentials of each oxidising and reducing pair, from lowest to highest?

A. $X^{4+}|X^{2+} < H^+|H_2 < X^{2+}|X$

B. $H^+|H_2 < X^{4+}|X^{2+} < X^{2+}|X$

C. $H^+|H_2 < X^{2+}|X < X^{4+}|X^{2+}$

D. $X^{2+}|X < H^+|H_2 < X^{4+}|X^{2+}$

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