Unit 5 · Electrochemistry

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

1 Key words [4]

Write True or False in the box beside each sentence. Correct each false sentence. Each carries 0.5 mark.

i. A galvanic cell turns the energy of a spontaneous redox reaction into electrical energy. ☐

ii. In a galvanic cell, oxidation takes place at the cathode. ☐

iii. The potential of the standard hydrogen electrode is taken as 0 V. ☐

iv. The lower the standard reduction potential of a metal, the stronger it is as an oxidizing agent. ☐

v. A salt bridge completes the circuit and keeps both solutions electrically neutral. ☐

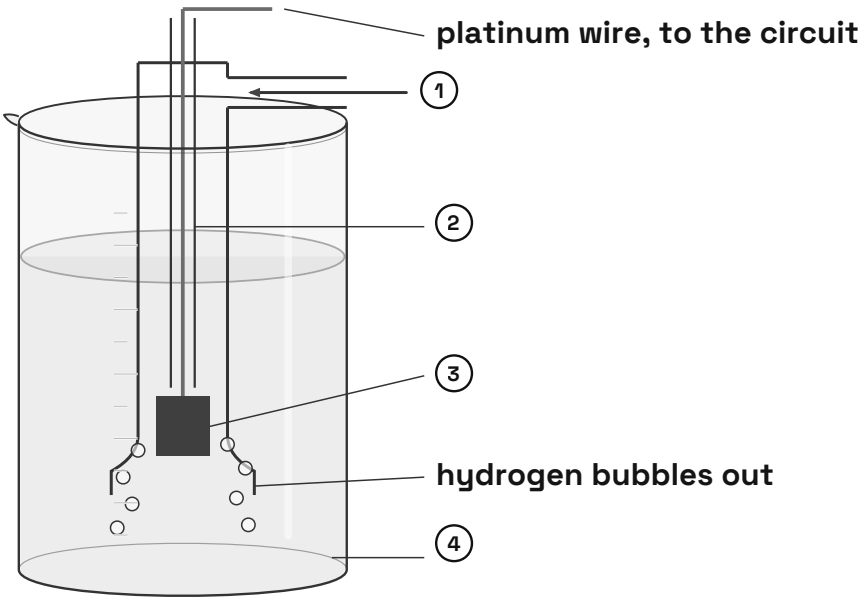
vi. A cell reaction with a positive cell potential has a positive ΔG. ☐

vii. A dry cell is a primary cell: it can't be recharged. ☐

viii. Galvanizing protects iron with a coat of tin. ☐

2 Label the diagram [2]

The diagram shows the standard hydrogen electrode. Write the names of the parts 1 to 4. Each carries 0.5 mark.



1. _____ 2. _____

3. _____ 4. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. Which of these is used as a secondary reference electrode, because it is easier to handle than the hydrogen electrode? [1]

a. the zinc electrode
b. the calomel electrode
c. the copper electrode
d. the silver electrode

ii. Which of these metals does not give hydrogen gas with dilute hydrochloric acid? [1]

a. zinc
b. iron
c. nickel
d. copper

iii. For a cell Ni(s) | Ni^{2+}(aq) || Cu^{2+}(aq) | Cu(s), with E° of Ni^{2+}/Ni −0.26 V and of Cu^{2+}/Cu +0.34 V, the standard cell potential is: [1]

a. 0.08 V
b. −0.60 V
c. 0.60 V
d. 0.34 V

iv. Zinc blocks are bolted to the steel hull of a ship. They protect the hull because zinc: [1]

a. has a higher reduction potential than iron
b. is oxidized in place of the iron
c. does not react with sea water
d. makes the sea water less salty

v. The product of a hydrogen–oxygen fuel cell is: [1]

a. hydrogen peroxide
b. carbon dioxide
c. water
d. ozone

4 Short answers [7]

Write short answers to the following questions.

a. What is an electrode potential? Why can't the potential of a single electrode be measured on its own? [2]

b. Write two uses of the electrochemical series. [2]

c. For a cell made of a zinc electrode in 1 M $ZnSO_4$ and a silver electrode in 1 M $AgNO_3$ (E° of Zn^{2+}/Zn −0.76 V, Ag^+/Ag +0.80 V), write the cell notation, the half-reaction at each electrode and the balanced cell reaction. **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

What is corrosion? Explain the rusting of iron as an electrochemical process, with the reactions at the anode and the cathode. Write two ways of protecting iron from rusting.

6 Numerical problems **[8]**

Solve the following problems. Show your working. Take E° (V): Ag^+/Ag +0.80, Ni^{2+}/Ni −0.26, Zn^{2+}/Zn −0.76; $F = 96{,}485\ C\ mol^{-1}$; the Nernst equation at 25 °C, $E = E^\circ - \frac{0.0592}{n}\log Q$.

a. A cell is made of a nickel electrode in Ni^{2+} solution and a silver electrode in Ag^+ solution. **[4]**

i. Write the cell reaction, and find the standard cell potential.

ii. Find ΔG° for the cell reaction as written.

iii. Find the cell potential at 25 °C when $[Ni^{2+}] = 0.10$ M and $[Ag^+] = 0.010$ M.

iv. Is the reaction still spontaneous at these concentrations? Why?

Answer:

b. A cell is made of a zinc electrode in Zn^{2+} solution and a nickel electrode in Ni^{2+} solution. **[4]**

i. Which electrode is the anode? Find the standard cell potential.

ii. Find the equilibrium constant of the cell reaction at 25 °C.

iii. Find the cell potential when $[Zn^{2+}] = 1.0$ M and $[Ni^{2+}] = 0.010$ M.

iv. Which electrode gains mass as the cell runs, and why?

Answer: _____

7 Think **[3]**

A student keeps a copper sulphate solution in an iron bucket overnight. Next morning the bucket has a hole and a brown-red powder on its floor, and the blue color of the solution has faded. Explain what happened, using the electrochemical series. In what kind of vessel should copper sulphate solution be kept?

8 Activity: Which nail rusts first? (not marked)

Set up four test tubes, each with a clean iron nail rubbed with sandpaper: one in tap water, one in salt water, one in boiled water with a layer of oil on top (to keep air out), and one galvanized (zinc-coated) nail in salt water. Look at them every day for a week.

Test tube	After 1 day	After 3 days	After 7 days
Iron nail, tap water			
Iron nail, salt water			
Iron nail, boiled water under oil			
Galvanized nail, salt water			

Which nail rusted most, and which not at all? Explain each with the cell on the nail's surface.