

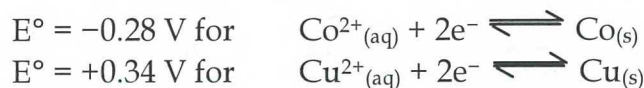
Chemistry ATAR Unit 3+4

Electrochemical Cells Test

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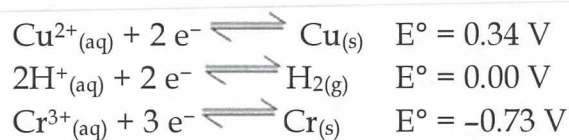
Total Marks = 51

1. Given these standard reduction potentials:



What is E° for $\text{Co}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \rightleftharpoons \text{Co}^{2+}(\text{aq}) + \text{Cu}(\text{s})$?

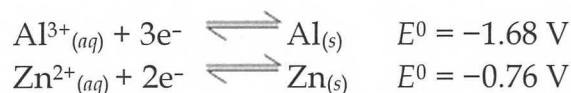
- (a) +0.06 V
 - (b) +0.62 V**
 - (c) +1.24 V
 - (d) Non spontaneous
2. Given the standard reduction potentials, which statement is correct?



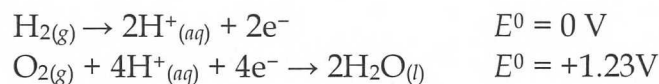
- (a) $\text{Cr}(\text{s})$ will react with acid.**
- (b) $\text{Cu}(\text{s})$ will react with acid.
- (c) $\text{Cu}^{2+}(\text{aq})$ will react with acid.
- (d) $\text{Cu}(\text{s})$ will react with $\text{Cr}^{3+}(\text{aq})$.

Use the following information to answer questions 3-4.

A galvanic cell is constructed by placing a strip of zinc into a 1.0 mol L⁻¹ solution of zinc nitrate and a strip of aluminum into a 1.0 mol L⁻¹ solution of aluminum nitrate. The two metal strips are connected to a voltmeter by wires and a salt bridge connects the solutions. The temperature is 25 °C. The following standard reduction potentials apply:



3. What is E^0 for the cell described above?
- (a) 2.43 V
(b) -2.43 V
(c) -0.92 V
(d) 0.92 V
4. In the cell described above, where does reduction occur?
- (a) in the salt bridge
(b) in the aluminum nitrate solution
(c) at the zinc electrode
(d) at the aluminum electrode
5. Which of the following statements regarding a 'salt bridge' is **not** correct?
- (a) A salt bridge allows ions to move between half-cells.
(b) A salt bridge prevents build up of charge in half-cells.
(c) A salt bridge allows electrons to move between half cells.
(d) A salt bridge takes no part in the chemical reaction occurring in either half-cell.
6. The Proton exchange membrane fuel cell which uses oxygen and hydrogen from the air is based on the spontaneous reaction that occurs when the following half-reactions are combined:



Which of the following statements regarding the oxygen-hydrogen fuel cell is true?

- (a) The hydrogen electrode is the anode.
(b) The cell potential depends on pH.
(c) Oxidation occurs at the oxygen electrode.
(d) Electrons flow from the oxygen electrode to the hydrogen electrode.

7. Hydrogen peroxide can act as a reductant according to the half equation

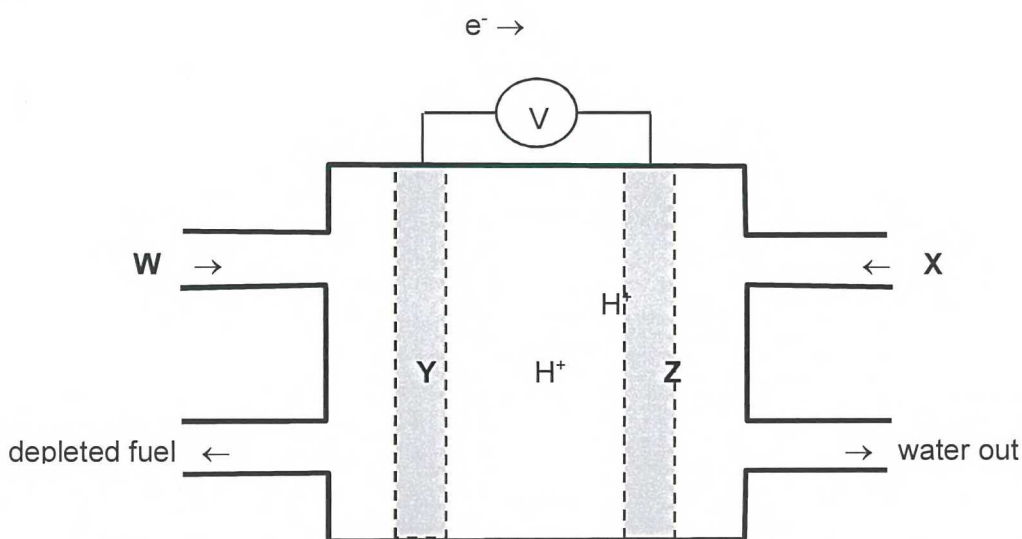


Which of the following could all be reduced by hydrogen peroxide?

- (a) $\text{Fe}^{2+}(\text{aq}), \text{Cu}(\text{s}), \text{I}^-(\text{aq})$
 (b) $\text{Ag}^+(\text{aq}), \text{Br}_2(\text{aq}), \text{H}_2\text{O}_2(\text{aq})$
 (c) $\text{Ag}(\text{s}), \text{Br}^-(\text{aq}), \text{Fe}^{2+}(\text{aq})$
 (d) $\text{I}_2(\text{s}), \text{Cu}^{2+}(\text{aq}), \text{Fe}^{3+}(\text{aq})$

Questions 8 and 9 refer to the information below.

The incomplete diagram below represents the phosphoric acid fuel cell (PAFC). As with other variations of the hydrogen / oxygen fuel cell, the only overall chemical product is water.



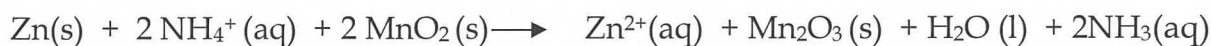
8. Which of the following **correctly** identifies the letters W, X, Y and Z in the diagram above?

	W	X	Y	Z
(a)	H_2	O_2	anode	cathode
(b)	O_2	H_2	anode	cathode
(c)	H_2	O_2	cathode	anode
(d)	O_2	H_2	cathode	anode

9. Which one of the following statements **BEST** describes the function of an anode in an electrolytic cell?

- (a) The anode is the electrode at which reduction occurs.
 (b) The anode is the only electrode at which $\text{OH}^-(\text{aq})$ ions are produced.
 (c) The anode is the electrode which attracts positive ions.
 (d) The anode is the electrode that is oxidised.

The overall redox reaction occurring in a dry cell, (Leclanché cell), is shown below.



10. Which of the following statements regarding the dry cell are correct?

- I The zinc outer casing is acting as the anode.
- II The oxidation state of manganese decreases from +4 to +3.
- III Ammonium chloride acts as an electrolyte for the cell.

- (a) I and III only.
- (b) I and II only.
- (c) II and III only.
- (d) I, II and III.

11. "A non-rechargeable cell is constructed from a nickel oxyhydroxide cathode and an anode composed of an hydrogen-absorbing alloy. This cell has the ability to produce a voltage in the range of 1.4-1.6V."

This description is consistent with a;

- (i) primary cell
- (ii) secondary cell
- (iii) electrolytic cell
- (iv) galvanic cell
- (v) fuel cell

- (a) (i) and (iii) only
- (b) (i) and (iv) only
- (c) (ii) and (iv) only
- (d) (i) and (v) only

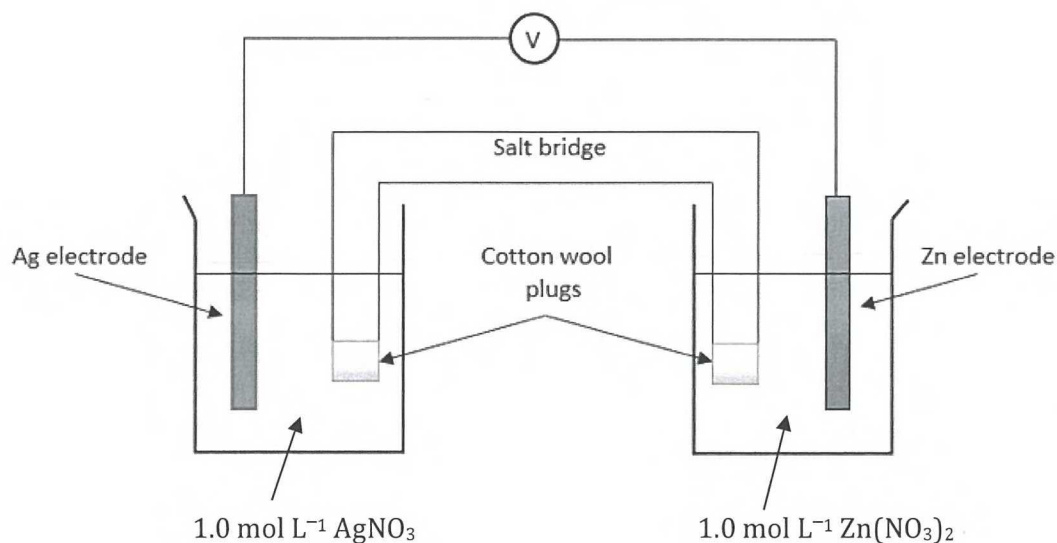
12. Consider the following statements about fuel cells.

- I A fuel cell converts chemical energy to electrical energy via a redox reaction.
- II Fuel cell technology involves the continuous supply of reactants to the cells and the continuous removal of the products.
- III A fuel cell can be recharged by reversing the direction of current flow through the cell.
- IV Fuel cells are considered a low-emission technology.

Which of the above statements about fuel cells are true?

- (a) I only
- (b) I and II
- (c) I, III and IV
- (d) I, II and IV

Questions 13-15 relate to the following electrochemical cell at 25°C:



13. Which of the following reactions will occur during the normal operation of this cell?

- (a) $2\text{Ag}^+(\text{aq}) + \text{Zn}(\text{s}) \longrightarrow 2\text{Ag}(\text{s}) + \text{Zn}^{2+}(\text{aq})$ $E^\circ = 1.56 \text{ V}$
(b) $2\text{Ag}^+(\text{aq}) + \text{Zn}(\text{s}) \longrightarrow 2\text{Ag}(\text{s}) + \text{Zn}^{2+}(\text{aq})$ $E^\circ = 0.04 \text{ V}$
(c) $\text{Zn}^{2+}(\text{aq}) + 2\text{Ag}(\text{s}) \longrightarrow \text{Zn}(\text{s}) + 2\text{Ag}^+(\text{aq})$ $E^\circ = 1.56 \text{ V}$
(d) $\text{Zn}^{2+}(\text{aq}) + 2\text{Ag}(\text{s}) \longrightarrow \text{Zn}(\text{s}) + 2\text{Ag}^+(\text{aq})$ $E^\circ = 0.04 \text{ V}$

14. Which of the following statements about the two electrodes is correct?

- (a) The mass of the silver electrode will decrease.
(b) The zinc electrode is the cathode.
(c) The mass of the zinc electrode will decrease.
(d) The silver electrode is the anode.

15. Which of the following statements about the flow of charge is INCORRECT?

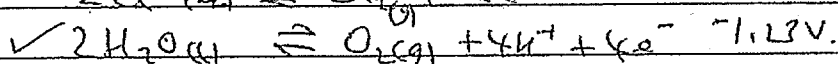
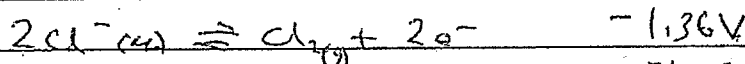
- (a) Electrons will flow from the zinc electrode to the silver electrode through the external circuit.
(b) Cations will flow through the salt bridge towards the silver half-cell.
(c) Electrons will flow from the silver electrode to the zinc electrode through the salt bridge.
(d) Anions will flow through the salt bridge towards the zinc half-cell.

Test: yr 12 Electrochemistry Name: SOLNS 2019

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ANODE

E°



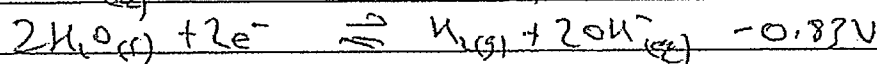
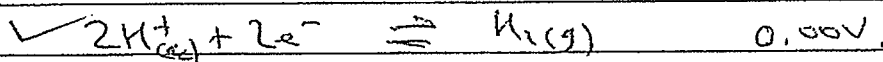
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As solution is 50.1M dilute, -1.23V requires less energy so electrolysis of H_2O occurs.

①

CATHODE

E°

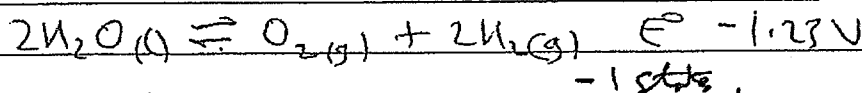


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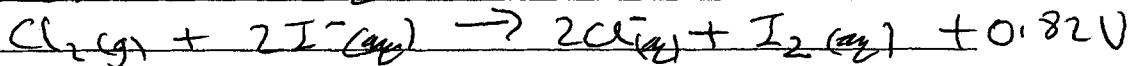
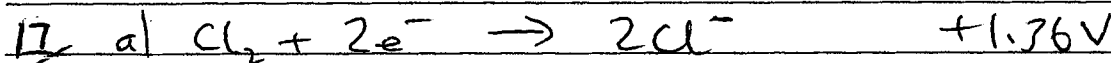
As the formation of H_2 requires less energy this occurs

①

Overall equation - balance electrons & cancel.



②

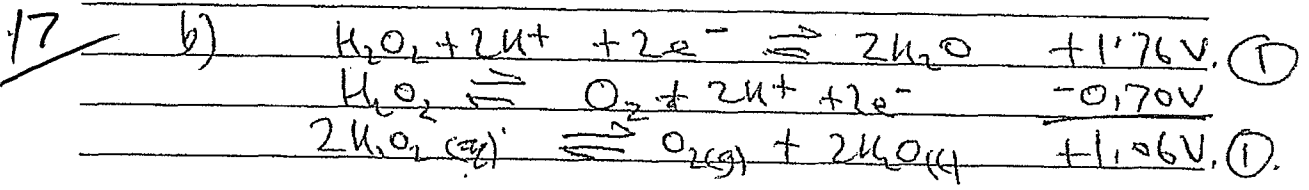


①

①

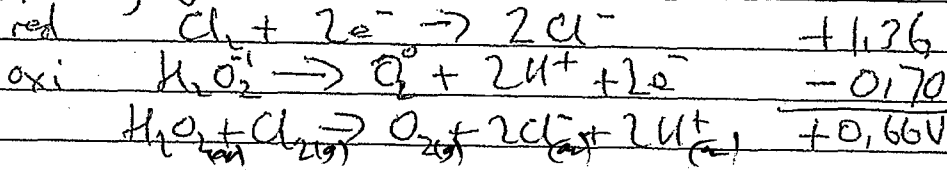
A greenish yellow (pungent) gas is bubbled through a clear and colourless solution. A brown aqueous solution appears

①

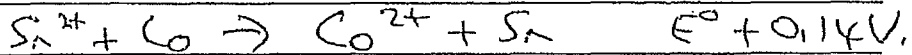
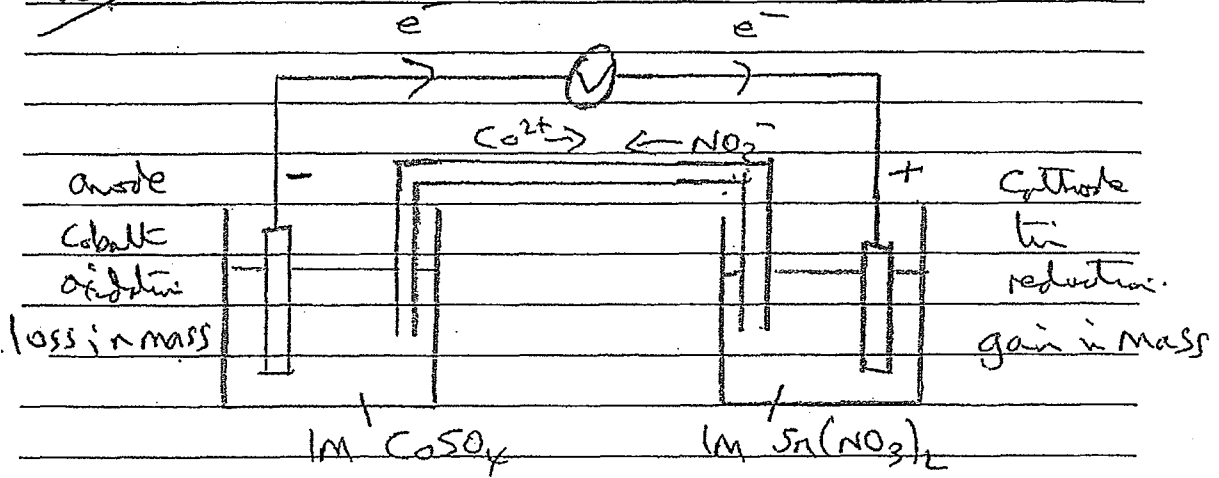


A greenish-yellow pungent gas is bubbled through a clear and colourless solution. Upon addition a clear and colourless solution remains with a effervescence of a colourless, odourless gas. (1)

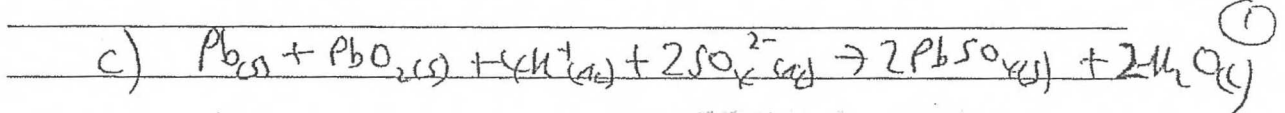
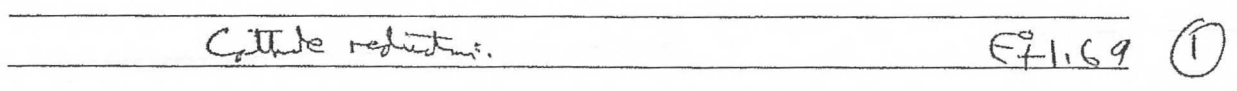
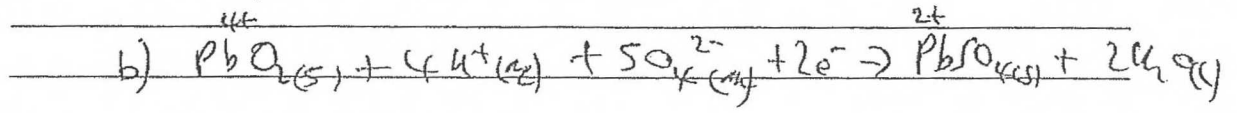
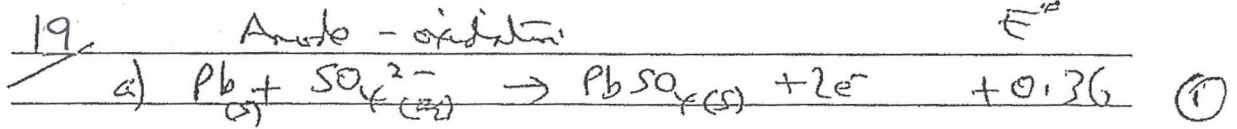
If they go - I make it all correct.



18



- (1) Flow of electrons
- (1) Anode
- (1) Cathode
- (1) Overall E^0 cell
- (1) Flow of ions.
- (1) Anode loss mass, Cathode gain in mass.
- (1) Correct equation for cell
- (1) Correct circuit - minus (1) if anything missing e.g. signs, Voltmeter



d) 2.05V (1)

e) Six cells connected in series $6 \times 2.05 = 12\text{V}$ (1)

f) Secondary - can be recharged (1)

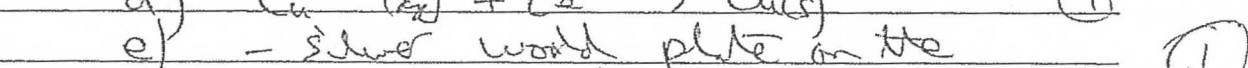
g) advantages - discharge/charge cycle - last 5 years
- delivers high current.

disadvantages - heavy, H_2SO_4 corrosive (2)
low environmental issue if not disposed properly

20 a) - Cell potential is for reaction 0V ~~non spontaneous~~ (1)
- therefore external voltage required to drive (1)
reaction - if no voltage - no change at anode/cathode.

b) X - Pure copper
Y - Copper Sulphate (acidified) (3)
Z - impure / blister copper.

c) X - Cathode (1)



e) - silver would plate on the
Copper Cathode - a lower reduction potential (1)