ELECTROCHEMISTRY – GALVANIC CELL

A. Objective questions (5 marks)

1. Which of the following half-cell notation is **not** correctly written?

   A. $Pb^{2+}(aq) \mid Pb(s)$

   B. $Pt(s) \mid Cu^{+}(aq), Cu^{2+}(aq)$

   C. $H_2(g), H^{+}(aq) \mid Pt(s)$

   D. $Pt(s) \mid [Fe(CN)_6]^{4-}(aq), [Fe(CN)_6]^{3-}(aq)$

2. Pick the correct statement about S.H.E.

   A. S.H.E is used as reference electrode to measure standard reduction potential of half-cell.
   B. S.H.E consists of a gold plate immersed in a basic solution.
   C. Standard reduction potential for S.H.E is 1.00 V.
   D. Hydrogen gas at 1 atm and 0°C is pumped through S.H.E.

3. $Cr^{3+} + e^{-} \rightarrow Cr^{2+}$ $E^{o} = -0.41$ V
   $Mg^{2+} + 2e^{-} \rightarrow Mg$ $E^{o} = -2.38$ V
   $Pb^{4+} + 2e^{-} \rightarrow Pb^{2+}$ $E^{o} = +1.80$ V

   Which of the following is the strongest oxidising agent?

   A. Mg^{2+} B. Cr^{3+} C. Cr^{2+} D. Pb^{4+}

4. $Cr^{3+} + e^{-} \rightarrow Cr^{2+}$ $E^{o} = -0.41$ V
   $Mg^{2+} + 2e^{-} \rightarrow Mg$ $E^{o} = -2.38$ V
   $Pb^{4+} + 2e^{-} \rightarrow Pb^{2+}$ $E^{o} = +1.80$ V

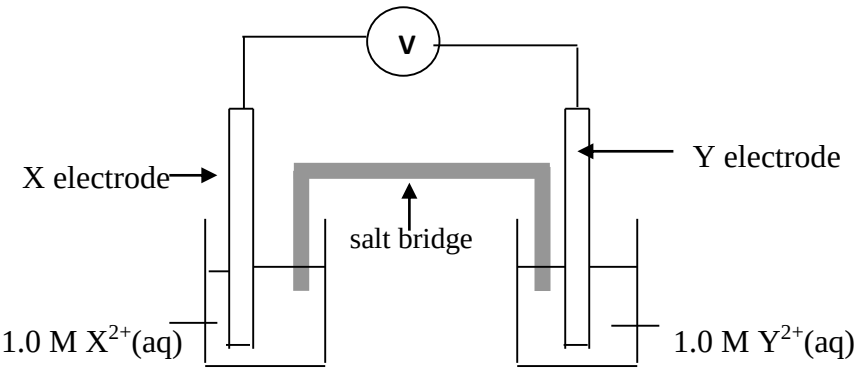
   Which of the following is the strongest reducing agent?

   A. Cr^{2+} B. Mg C. Pb^{4+} D. Pb^{2+}

5. The electrode potentials for standard metals X and Y are given below:

   $X^{2+}(aq) \mid X(s)$ $E^{o} = -0.25$ V
   $Y^{2+}(aq) \mid Y(s)$ $E^{o} = +0.80$ V

   The cell made up of the above two half-cells is shown as follows:



   Which description is correct ?

	Cathode	E^{o}_{cell} (V)	Direction of e^{-} flow	Electrode at which cations enter the solution
A.	X	+0.55	X to Y	X
B.	X	+1.05	Y to X	Y
C.	Y	+1.05	X to Y	X
D.	Y	+0.55	Y to X	Y

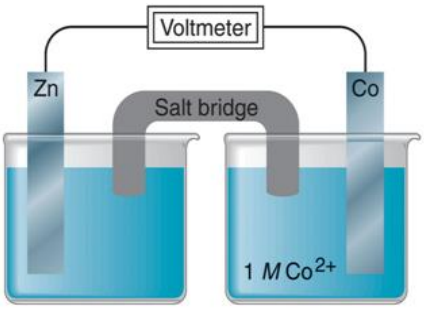
B. Subjective Questions

1. Based on the cell notation below:

   $Pt(s) \mid H_2(g, 1\ atm) \mid H^+(aq, 1.0M) \parallel Ag^+(aq, 1.0M) \mid Ag(s)$

   (a) Write the half-equation for the oxidation and reduction reactions and a balanced overall chemical equation for the cell. [3 marks]

   (b) Determine the E^o cell.
   Given $E°_{Ag^+|Ag} = +0.80$ V [2 marks]

2. 

   For the above electrochemical cell, the standard electrode potentials involved are as follows :
   $E°_{Zn^{2+}|Zn} = -0.76$ V and $E°_{Co^{2+}|Co} = -0.28$ V

   (a) In which half-cell does reduction occurs ?
   (b) Which direction do electrons flow in external circuit ?
   (c) Which electrode increases in mass during operation of the cell ? Explain.
   (d) Suggest a solution for the half-cell containg the Zn electrode.
   (e) Write the cell notation.

   [5 marks]

ANSWERS

1.	2.	3.	4.	5.
C	**A**	**D**	**B**	**C**

NO.	PART	SUGGESTED ANSWER
1.	**(a)**	Oxidation: $H_2(g, 1\ atm) \rightarrow 2H^+(aq, 1.0\ M) + 2e^-$ 1 Mark Reduction: $[Ag^+(aq) + e^- \rightarrow Ag(s)] \times 2$ 1 Mark Overall cell equation: $\mathbf{H_2(g) + 2Ag^+(aq) \rightarrow 2H^+(aq) + 2Ag(s)}$ 1 Mark
	(b)	$E°_{cell} = E°_{cathode} - E°_{anode}$ 1 Mark $= \mathbf{E°_{Ag^+ \mid Ag} - E°_{H^+ \mid H_2}}$ $= + 0.80 - 0.00$ $= \mathbf{+0.80\ V}$ @ $E°_{cell} = E°_{red} + E°_{ox}$ $= \mathbf{E°_{Ag^+ \mid Ag} - E°_{H_2 \mid H^+}}$ $= +0.80 + 0.00$ $= +0.80\ V$
		TOTAL = 5
2	**(a)**	Co^{2+}/Co half-cell @ Co half-cell 1 Mark
	(b)	From Zn electrode to Co electrode. 1 Mark
	(c)	Co electrode because Co^{2+} ions are reduced to Co and deposited on the Co electrode. 1 Mark
	(d)	1 M $ZnSO_4$ solution or 1 M Zn^{2+} (aq) 1 Mark
	(e)	$Zn(s) \mid Zn^{2+}(aq, 1\ M) \parallel Co^{2+}(aq, 1.0M) \mid Co(s)$ 1 Mark
		TOTAL = 5