Practice Question Set For A-Level
**Subject : Chemistry**
**Paper-1 Topic: Physical 1_Electrode Potentials And Electrochemical Cells**

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**Name of the Student**:_____
**Max. Marks : 15 Marks** **Time : 15 Minutes**

Q1.

In this question consider the data below.

| | $E^{\ominus}$ / V |
|---|---|
| $Ag^{+}(aq) + e^{-} \rightarrow Ag(s)$ | +0.80 |
| $2H^{+}(aq) + 2e^{-} \rightarrow H_2(g)$ | 0.00 |
| $Pb^{2+}(aq) + 2e^{-} \rightarrow Pb(s)$ | −0.13 |

The e.m.f. of the cell $Ag(s) \mid Ag^{+}(aq) \parallel Pb^{2+}(aq) \mid Pb(s)$ is

**A** 0.93 V

**B** 0.67 V

**C** −0.67 V

**D** −0.93 V

**(Total 1 mark)**

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Q2.

A disproportionation reaction occurs when a species $\mathbf{M^+}$ spontaneously undergoes simultaneous oxidation and reduction.

$$2M^+(aq) \rightarrow M^{2+}(aq) + M(s)$$

The table below contains $E^\ominus$ data for copper and mercury species.

| | $E^\ominus$/ V |
|---|---|
| $Cu^{2+}(aq) + e^- \rightarrow Cu^+(aq)$ | + 0.15 |
| $Cu^+(aq) + e^- \rightarrow Cu(s)$ | + 0.52 |
| $Hg^{2+}(aq) + e^- \rightarrow Hg^+(aq)$ | + 0.91 |
| $Hg^+(aq) + e^- \rightarrow Hg(l)$ | + 0.80 |

Using these data, which one of the following can be predicted?

**A** Both Cu(I) and Hg(I) undergo disproportionation.

**B** Only Cu(I) undergoes disproportionation.

**C** Only Hg(I) undergoes disproportionation.

**D** Neither Cu(I) nor Hg(I) undergoes disproportionation.

**(Total 1 mark)**

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Q3.

In this question consider the data below.

| | $E^{\ominus}$ / V |
|---|---|
| $Ag^+(aq) + e^- \rightarrow Ag(s)$ | +0.80 |
| $2H^+(aq) + 2e^- \rightarrow H_2(g)$ | 0.00 |
| $Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$ | −0.13 |

The e.m.f. of the cell Pt(s) | $H_2(g)$ | $H^+(aq)$ || $Ag^+(aq)$ | Ag(s) would be increased by

**A** increasing the concentration of $H^+(aq)$.

**B** increasing the surface area of the Pt electrode.

**C** increasing the concentration of $Ag^+(aq)$.

**D** decreasing the pressure of $H_2(g)$.

**(Total 1 mark)**

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Q4.

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$ $\quad E^\ominus = +1.33$ V

$Br_2(aq) + 2e^- \rightarrow 2Br^-(aq)$ $\quad E^\ominus = +1.09$ V

$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$ $\quad E^\ominus = +0.77$ V

$VO^{2+}(aq) + 2H^+(aq) + e^- \rightarrow V^{3+}(aq) + H_2O(l)$ $\quad E^\ominus = +0.34$ V

$SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow H_2SO_3(aq) + H_2O(l)$ $\quad E^\ominus = +0.17$ V

Based on the above data, which one of the following could reduce 0.012 mol of bromine to bromide ions?

**A** 40 $cm^3$ of a 0.10 mol $dm^{-3}$ solution of $Cr_2O_7^{2-}(aq)$

**B** 80 $cm^3$ of a 0.30 mol $dm^{-3}$ solution of $Fe^{3+}(aq)$

**C** 50 $cm^3$ of a 0.24 mol $dm^{-3}$ solution of $V^{3+}(aq)$

**D** 50 $cm^3$ of a 0.24 mol $dm^{-3}$ solution of $H_2SO_3(aq)$

**(Total 1 mark)**

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Q5.

Use the data below, where appropriate, to answer the questions which follow.

| Standard electrode potentials | $E^{\ominus}$/V |
|---|---|
| $2H^+(aq) + 2e^- \rightarrow H_2(g)$ | 0.00 |
| $Br_2(aq) + 2e^- \rightarrow 2Br^-(aq)$ | +1.09 |
| $2BrO_3^-(aq) + 12H^+(aq) + 10e^- \rightarrow Br_2(aq) + 6H_2O(l)$ | +1.52 |

Each of the above can be reversed under suitable conditions.

(a) State the hydrogen ion concentration and the hydrogen gas pressure when, at 298 K, the potential of the hydrogen electrode is 0.00 V.

*Hydrogen ion concentration* _____

*Hydrogen gas pressure* _____

**(2)**

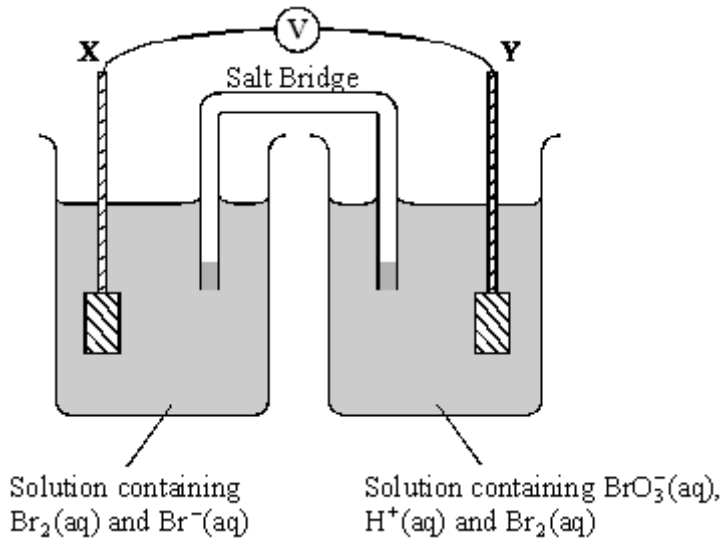
(b) The electrode potential of a hydrogen electrode changes when the hydrogen ion concentration is reduced. Explain, using Le Chatelier's principle, why this change occurs and state how the electrode potential of the hydrogen electrode changes.

*Explanation of change* _____

*Change in electrode potential* _____

**(3)**

(c) A diagram of a cell using platinum electrodes **X** and **Y** is shown below.




(i) Use the data above to calculate the e.m.f. of the above cell under standard conditions.

_____

(ii) Write a half-equation for the reaction occurring at electrode **X** and an overall equation for the cell reaction which occurs when electrodes **X** and **Y** are connected.

*Half-equation* _____

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*Overall equation* _____

_____

**(4)**
**(Total 9 marks)**

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Q6.

Use the data in the table below to answer this question.

| | $E^{\ominus}$ / V |
|---|---|
| $MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$ | + 1.52 |
| $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$ | + 1.33 |
| $Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$ | + 0.77 |
| $Cr^{3+}(aq) + e^- \rightarrow Cr^{2+}(aq)$ | − 0.41 |
| $Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$ | − 0.76 |

The most powerful oxidising agent in the table is

**A** $Mn^{2+}(aq)$

**B** $Zn(s)$

**C** $MnO_4^-(aq)$

**D** $Zn^{2+}(aq)$

**(Total 1 mark)**

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Q7.

Use the data in the table below to answer this question.

| | $E^{\ominus}$ / V |
|---|---|
| $MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$ | + 1.52 |
| $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$ | + 1.33 |
| $Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$ | + 0.77 |
| $Cr^{3+}(aq) + e^- \rightarrow Cr^{2+}(aq)$ | − 0.41 |
| $Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$ | − 0.76 |

Which one of the following statements is **not** correct?

**A** $Fe^{2+}(aq)$ can reduce acidified $MnO_4^-(aq)$ to $Mn^{2+}(aq)$

**B** $CrO_7^{2-}(aq)$ can oxidise acidified $Fe^{2+}(aq)$ to $Fe^{3+}(aq)$

**C** Zn(s) can reduce acidified $Cr_2O_7^{2-}(aq)$ to $Cr^{2+}(aq)$

**D** $Fe^{2+}(aq)$ can reduce acidified $Cr^{3+}(aq)$ to $Cr^{2+}(aq)$

**(Total 1 mark)**

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