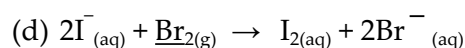
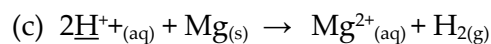
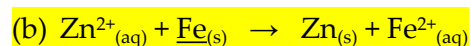
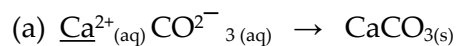


## Chemistry Unit 3+4 REDOX part 1 Test

### Multiple choice -10 marks

1. In which of the following equations is the underlined species being oxidised?



2. Which of the following statements about oxidising and reducing agents is false?

(a) Bromine water can oxidise chloride ions to chlorine.

(b) Hydrogen peroxide solution is capable of spontaneous disproportionation.

(c) Group I metals are good reducing agents.

(d) Copper metal will react with a dilute silver nitrate solution.

3. The oxidation number for iodine in the iodate ion ( $\text{IO}_3^-$ ) is:

(a) +1

(b) -1

(c) +5

(d) -5

4. A student made the following observations:

(i) Clean metal A did not react with 1.0M  $\text{B}^{2+}$

(ii) Clean metal B dissolved in 1.0M  $\text{C}^{2+}$  and crystals of C appeared

(iii) Clean metal C did not react with 1.0M  $\text{A}^{2+}$

The order of strength as a reducing agent is

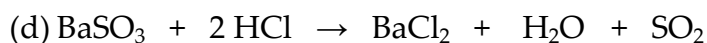
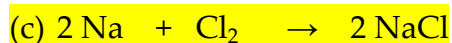
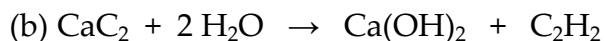
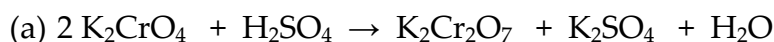
(a)  $\text{A} > \text{B} > \text{C}$

(b)  $\text{A} > \text{C} > \text{B}$

(c)  $\text{B} > \text{C} > \text{A}$

(d)  $\text{B} > \text{A} > \text{C}$

5. Which of the following is an example of an oxidation-reduction reaction?



6. Which of the following statements about oxidation and reduction is FALSE?

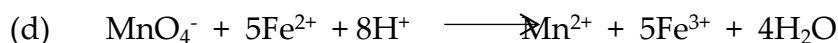
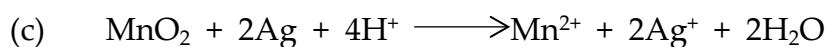
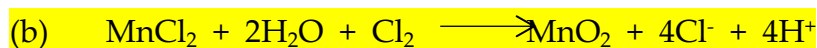
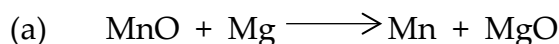
(a) Oxidation and reduction occur simultaneously.

(b) The oxidising agent is reduced.

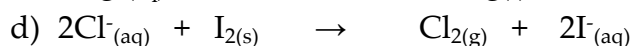
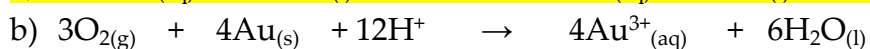
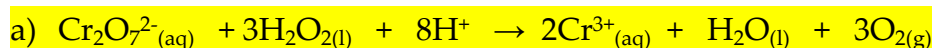
(c) More electrons are produced by the substance being oxidised than accepted by the substance being reduced.

(d) The reducing agent loses electrons in an oxidation-reduction reaction.

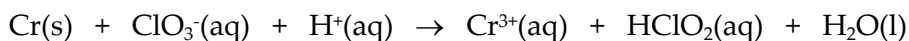
7. In which of the following reactions is the manganese containing species acting as a reducing agent?



8. Which one of the following reactions will be spontaneous under standard conditions?



9. Consider the incomplete chemical equation shown below.



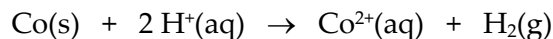
When this redox reaction is completed and balanced correctly (using whole numbers), the coefficient in front of  $\text{H}^+(\text{aq})$  will be;

- (a) 1  
 (b) 3  
 (c) 6  
 (d) 9
10. Rank the following substances in order of increasing **nitrogen** oxidation number (i.e. from species with nitrogen in lowest oxidation state to highest oxidation state).



- (a)  $\text{NH}_4^+ < \text{N}_2 < \text{N}_2\text{O} < \text{HNO}_2 < \text{NO}_3^-$   
 (b)  $\text{NO}_3^- < \text{N}_2\text{O} < \text{HNO}_2 < \text{N}_2 < \text{NH}_4^+$   
 (c)  $\text{NH}_4^+ < \text{HNO}_2 < \text{N}_2 < \text{NO}_3^- < \text{N}_2\text{O}$   
 (d)  $\text{N}_2 < \text{NH}_4^+ < \text{NO}_3^- < \text{N}_2\text{O} < \text{HNO}_2$

11. Consider the following reaction between cobalt metal and hydrochloric acid.



Which of the following statements is **correct**?

- (a) Electrons are transferred from  $\text{Co(s)}$  to  $\text{H}^+(\text{aq})$ .  
 (b) Electrons are transferred from  $\text{H}^+(\text{aq})$  to  $\text{Co(s)}$ .  
 (c) Both  $\text{Co(s)}$  and  $\text{H}^+(\text{aq})$  will each gain and lose some electrons.  
 (d) Electrons are not transferred, as this is not a redox reaction.
12. In which of the following species is the oxidation state of sulfur the lowest?

- (a)  $\text{SO}_3$
- (b)  $\text{SO}_3^{2-}$
- (c)  $\text{S}_2\text{O}_4^{2-}$
- (d)  $\text{S}_2\text{O}_6^{2-}$

Questions 13 and 14 refer to the information below.

Corrosion occurs when metals are oxidised by coming into contact with oxygen. This process is increased in the presence of water or acidic and basic conditions. When iron is corroded it often forms rust.

13. Which of the following is **correct** in relation to the rusting of iron metal?
- (a) Oxygen gas is the reducing agent / reductant
  - (b) Liquid water is the reducing agent / reductant
  - (c) The oxidation number of iron would decrease
  - (d) The presence of salt water would increase the rate of rusting
14. Using your table of standard reduction potentials, choose the metal that is **not** likely to corrode under standard conditions.
- (a) Zn
  - (b) Ni
  - (c) Pb
  - (d) Au
15. Which of the following halogen displacement reactions would **not** occur under standard conditions?
- (a)  $\text{Cl}_2(\text{aq}) + 2 \text{Br}^-(\text{aq}) \rightarrow 2 \text{Cl}^-(\text{aq}) + \text{Br}_2(\text{aq})$
  - (b)  $\text{I}_2(\text{aq}) + 2 \text{Br}^-(\text{aq}) \rightarrow 2 \text{I}^-(\text{aq}) + \text{Br}_2(\text{aq})$
  - (c)  $\text{Cl}_2(\text{aq}) + 2 \text{I}^-(\text{aq}) \rightarrow 2 \text{Cl}^-(\text{aq}) + \text{I}_2(\text{aq})$
  - (d)  $\text{Br}_2(\text{aq}) + 2 \text{I}^-(\text{aq}) \rightarrow 2 \text{Br}^-(\text{aq}) + \text{I}_2(\text{aq})$

Short answer - 36 marks

1. a.  $\text{Mg} \rightarrow \text{Mg}^{2+}$  or  $\text{MgO}$  (½ each)  
b.  $\text{H}_2\text{O} \rightarrow \text{H}_2$  (½ each)  
c.  $\text{H}_2\text{O}$  (1 mark)  
d.  $\text{Mg}$  (1 mark)

(4 marks)

2. Two beakers contained separate samples of zinc bromide solution,  $\text{ZnBr}_2(\text{aq})$ . To one beaker a piece of tin metal,  $\text{Sn}(\text{s})$ , was added. To the second beaker a piece of magnesium metal,  $\text{Mg}(\text{s})$ , was added. In one beaker, a reaction took place, while in the other beaker no reaction was observed.

- (a) Which of these metals (i.e. magnesium or tin) is the strongest reducing agent? Explain your answer.

(2 marks)

- **Magnesium**
- **$E^0$  value of oxidation of magnesium is 2.36 V compared to 0.14 V for tin, therefore a stronger tendency to be oxidised and thus a stronger reducing agent**

- (b) Write a balanced chemical equation for the reaction that does occur, and explain why no reaction is observed in the other beaker.

(2 marks)

- **$\text{Mg}(\text{s}) + \text{Zn}^{2+}(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{Zn}(\text{s})$**   
**OR**
- **$\text{Mg}(\text{s}) + \text{ZnBr}_2(\text{aq}) \rightarrow \text{MgBr}_2(\text{aq}) + \text{Zn}(\text{s})$**
- **No reaction observed with tin metal as  $\text{Sn}^{2+}$  has a higher reduction potential than  $\text{Zn}^{2+}$  /  $\text{Sn}^{2+}$  is a stronger oxidant than  $\text{Zn}^{2+}$  /  $\text{Zn}$  is a stronger reductant than  $\text{Sn}$**

Some chlorine water,  $\text{Cl}_2(\text{aq})$ , was added to a separate third sample of zinc bromide solution.

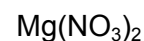
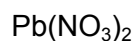
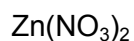
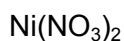
- (c) Explain what would occur when these solutions were mixed. Include in your answer the expected observations.

(2 marks)

- **a halogen displacement reaction would occur**
- **pale yellow and colourless solutions would mix to produce an orange solution**

3. Tin is a metallic element located in Group 14 of the periodic table. It is used to make many different alloys such as bronze and solder, as well as finding application in the plating of steel to produce 'tin cans' for storage.

A chemistry student had 1.0 mol L<sup>-1</sup> solutions of the following four substances;



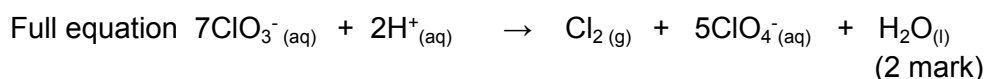
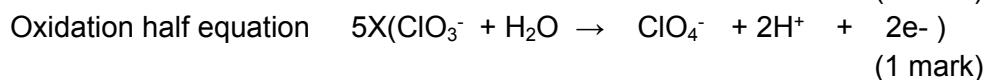
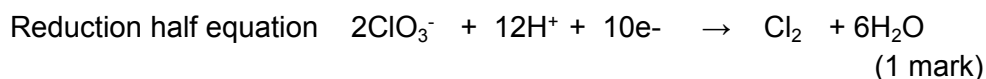
- (a) Which of these solutions could **not** be stored in a tin container? Explain your answer using a relevant chemical equation.

(3 marks)

- **Pb(NO<sub>3</sub>)<sub>2</sub>**
- **metal displacement reaction would occur OR Pb<sup>2+</sup> has higher E<sup>0</sup> value than Sn<sup>2+</sup> and will cause oxidation of tin container**
- **Pb<sup>2+</sup>(aq) + Sn(s) → Pb(s) + Sn<sup>2+</sup>(aq)**

4. In acidic conditions the chlorate ion ClO<sub>3</sub><sup>-</sup>(aq) undergoes disproportionation to Cl<sub>2</sub>(g) and ClO<sub>4</sub><sup>-</sup>(aq). Write appropriate half equations for this redox, labelling them oxidation and reduction, and the overall equation. **Include states.**

(4 marks)

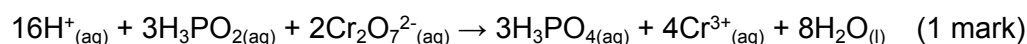
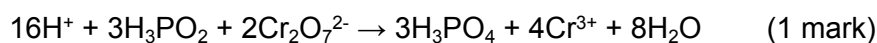
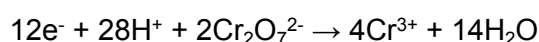
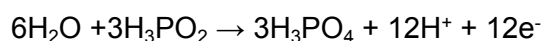
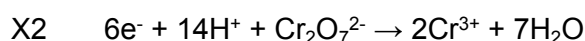
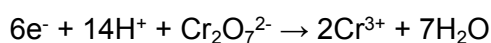
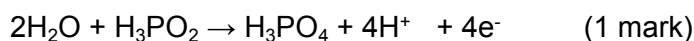


5. Consider the reaction between hypophosphorous acid (H<sub>3</sub>PO<sub>2</sub>) which is added to potassium dichromate and produces Chromium (III) ions in solution and phosphoric acid.

- (a) Write the skeletal equation for the reaction and identify what has been oxidised and reduced. Then from 1<sup>st</sup> principles balance the half equations and derive the full equation, be sure to include states for the final equation.

(6 marks)





(b) **Detail a full observation** of the reaction.

(b) A colourless solution is added to an orange solution. Upon addition the solution turns a deep green.

(1 mark)

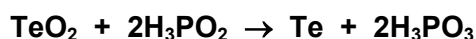
6. Tellurium (Te) is a rare, silver metalloid that can be used in solar panels and as a semiconducting material. It can be produced by reacting the mineral tellurite ( $\text{TeO}_2$ ) with hypophosphorous acid ( $\text{H}_3\text{PO}_2$ ). This produces tellurium metal and phosphorous acid ( $\text{H}_3\text{PO}_3$ ).

Write the oxidation and reduction half-equations and the overall redox equation for this reaction, assuming acidic conditions. **No states required.**

(3 marks)

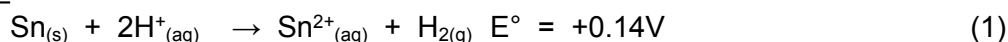
Oxidation half-equation	$\text{H}_3\text{PO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_3 + 2\text{H}^+ + 2\text{e}^-$
Reduction half-equation	$\text{TeO}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow \text{Te} + 2\text{H}_2\text{O}$

Overall redox  
equation



7. Determine whether the following reactions represent SPONTANEOUS redox reactions or NOT. Be sure to justify your answer with working showing half equations with  $E^\circ$  values, and the full equations with **phases** for all reactions. Where a reaction is not spontaneous you must state this as well, and show your working to justify this conclusion.

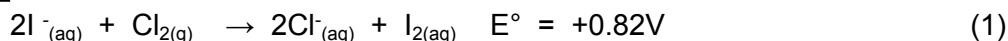
- Tin filings added to dilute sulfuric acid.
- Chlorine gas bubbled through a solution of calcium iodide.
- Magnesium ribbon added to a solution of lead (II) sulfate.
- Acidified potassium permanganate solution and hydrogen peroxide.



Positive  $E^\circ$  value, therefore reaction IS spontaneous.

(1)

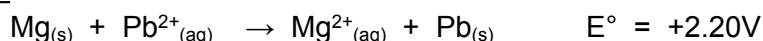
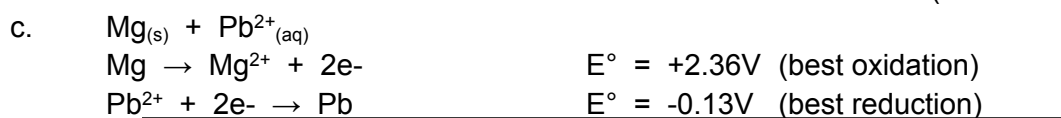
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Positive  $E^\circ$  value, therefore reaction is IS spontaneous.

(1)

(2 marks total)

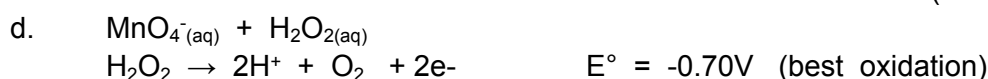


(1)

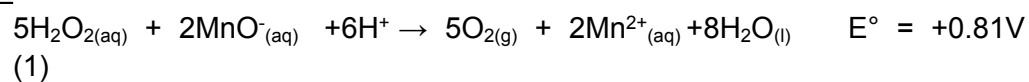
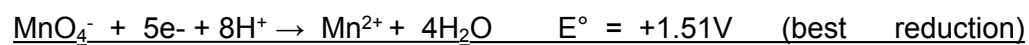
Positive  $E^\circ$  value, therefore reaction IS spontaneous.

(1)

(2 marks total)







Positive  $E^\circ$  value, therefore reaction IS spontaneous.

(1)

(2 marks total)

Total = 50 marks
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