SCH4U7

Oxidation & Reduction

Redox Practice Test

Chapter 10 Review questions

1 Match each term to an appropriate definition.

Oxidizing agent	Involves the gain of electrons
Reducing agent	An electron donor
Oxidation	Undergoes reduction during a redox reaction
Reduction	This happens to a reducing agent during a reaction

2 Give three definitions of the process of oxidation.

3 Determine the oxidation number of each element in the following species.

a NO_2 b $K_2Cr_2O_7$
c HSO_4^- d HNO_2
e H_3PO_4 f $S_2O_3^{2-}$
g $Ga_2(CO_3)_3$ h $Zn(BrO_3)_2$

4 The addition of potassium permanganate ($KMnO_4$) solution to a solution of manganese(II) sulfate ($MnSO_4$) results in the precipitation of manganese dioxide (MnO_2).

a State the oxidation number of manganese in each of the three compounds.

b Describe the reaction in terms of half-equations.

5 It is sometimes possible for an ion to undergo simultaneous oxidation and reduction. This is called disproportionation. Show that this occurs by writing half-equations for the conversion of hypochlorite ion (ClO^-) to chloride (Cl^-) and chlorate (ClO_3^-) ions.

6 Write balanced half-equations for each of the following conversions.

a Glucose ($C_6H_{12}O_6$) to sorbitol ($C_6H_8(OH)_6$)

b Sorbitol ($C_6H_8(OH)_6$) to ascorbic acid ($C_6H_8O_6$)

c Oxalate ion ($C_2O_4^{2-}$) to carbon dioxide (CO_2)

d Ethanol (CH_3CH_2OH) to ethanoic acid (CH_3COOH)

e Sulfite ions (SO_3^{2-}) to hydrogen sulfide (H_2S)

f Nitric acid (HNO_3) to nitrogen dioxide (NO_2)

7 Write a balanced equation for each of the processes below. Use oxidation numbers to show that each process is a redox reaction.

a Combustion of ethanol

b Decomposition of hydrogen peroxide to water and oxygen

8 Balance each of the following equations by first writing half-equations.

a $Al(s) + H^+(aq) \rightarrow Al^{3+}(aq) + H_2(g)$

b $Cu(s) + NO_3^-(aq) \rightarrow NO(g) + Cu^{2+}(aq)$

c $SO_2(g) + MnO_4^-(aq) \rightarrow Mn^{2+}(aq) + SO_4^{2-}(aq)$ (in acidic solution)

d $ClO^-(aq) + I^-(aq) \rightarrow Cl^-(aq) + I_2(aq)$

9 Nickel reacts with hydrochloric acid to evolve hydrogen gas and produce a green solution containing the Ni^{2+} ion.

a Write a half-equation for the oxidation reaction.

b Write a half-equation for the reduction reaction.

c Write an ionic equation for the overall reaction.

d Identify the oxidizing agent in this reaction.

10 In each of the following equations, identify the oxidizing agent and the reducing agent.

a $Zn(s) + Pb^{2+}(aq) \rightarrow Zn^{2+}(aq) + Pb(s)$

b $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

c $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(g)$

d $Cl_2(g) + 2HI(aq) \rightarrow 2HCl(aq) + I_2(s)$

11 State which species is acting as oxidizing agent and which is the reducing agent in each of the following equations.

a $Br_2(aq) + Mg(s) \rightarrow 2Br^-(aq) + Mg^{2+}(aq)$

b $2Ag^+(aq) + Sn^{2+}(aq) \rightarrow 2Ag(s) + Sn^{4+}(aq)$

c $Cu^{2+}(aq) + Pb(s) \rightarrow Cu(s) + Pb^{2+}(aq)$

d $MnO_4^-(aq) + 8H^+(aq) + 5Fe^{2+}(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(l)$

e $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

12 When a piece of zinc was left to stand overnight in an aqueous solution of tin(II) nitrate, the mass of the zinc decreased by 0.50 g. Write a balanced equation to account for the loss in mass of the zinc.

13 For each of the equations given below, state whether the bolded chemical is being oxidized, reduced, neither oxidized nor reduced, or both oxidized and reduced.

a $\mathbf{Pb^{2+}}(aq) + Fe(s) \rightarrow Pb(s) + Fe^{2+}(aq)$

b $Mg(s) + 2\mathbf{H_2O}(l) \rightarrow Mg(OH)_2(aq) + H_2(g)$

c $\mathbf{Ba(NO_3)_2}(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2HNO_3(aq)$

14 Using the activity series shown in table 10.4.1 (p. 320), write ionic equations for any reactions that would occur when:

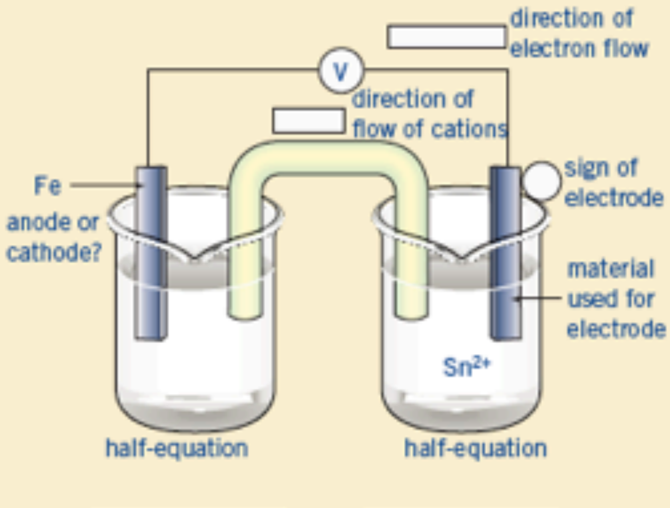
a cadmium (Cd) is added to a solution of $Cu(NO_3)_2$

b lead (Pb) is added to a solution of $Zn(NO_3)_2$.

Reaction at anode (–)	Reaction at cathode (+)	Overall reaction equation	Oxidizing agent	Reducing agent
$Ni(s) \rightarrow Ni^{2+}(aq) + 2e^-$	$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$			
	$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$			K(s)
		$MnO_4^-(aq) + 8H^+(aq) + 5Fe^{2+}(aq) \rightarrow Mn^{2+}(aq) + 4H_2O(l) + 5Fe^{3+}(aq)$		
$Sn(s) \rightarrow Sn^{2+}(aq) + 2e^-$			$Sn^{4+}(aq)$	

15 Copy and complete the table above.

16 Complete the labelling of the voltaic cell shown, which uses the reaction between Fe(s) and Sn^{2+}(aq).



17 A voltaic cell is constructed using the half-cells Ni^{2+}/Ni and Zn^{2+}/Zn. For this cell:

a For this cell, which electrode (Ni or Zn):

i is the anode?

ii has a negative charge?

iii will lose mass?

b Name a chemical suitable for use in the salt bridge.

18 Explain why it would be unwise to store silver nitrate solution ($AgNO_3(aq)$) in a copper container.

19 A solution of hydrogen peroxide reacts with itself over time to produce water and oxygen gas, and so solutions of hydrogen peroxide are generally kept in the refrigerator.

a By first writing the relevant half-equations, deduce an overall equation for this reaction.

b Why are solutions of hydrogen peroxide refrigerated?

c The addition of a small quantity of manganese dioxide to a hydrogen peroxide solution results in the vigorous evolution of oxygen gas. What is the role of MnO_2 in this reaction?

20 Use the electrochemical series to deduce whether or not a reaction of any significant extent would occur in each of the following cases. Where a reaction would be expected, write the relevant partial equations and the overall equation.

a Copper filings are sprinkled into a solution of silver nitrate.

b A strip of magnesium is placed into a solution of hydrochloric acid.

c Solutions of potassium bromide and zinc nitrate are mixed.

d Chlorine gas is bubbled through a solution of tin(II) chloride.

e Hydrogen sulfide gas is bubbled through a solution of copper(II) sulfate.

21 A student is given a beaker containing an unknown solution of $Q(NO_3)_2$ and is asked to displace metal Q from the solution. The relevant half-equation is:

$$Q^{2+}(aq) + 2e^- \rightarrow Q(s) \qquad E^\circ = -0.55\ V$$

By consulting the electrochemical series, deduce which of the following metals would be suitable to perform this function: iron, copper, zinc or lead.

22 A chemist made the following observations using clean metal surfaces.

- Metal B dissolved in 1 mol dm^{-3} $C(NO_3)_2$ solution, forming a deposit of metal C.
- Metal C would not dissolve in 1 mol dm^{-3} $A(NO_3)_2$ solution.
- Metal A would not dissolve in 1 mol dm^{-3} $B(NO_3)_2$ solution.

List metals A, B and C in order from the strongest reducing agent to the weakest.