Answers

WORKSHEET 10

OXIDATION AND REDUCTION

Syllabus reference 9.2.4

1 Classify each of the following statements as true (T) or false (F). For those statements that are false, rewrite the statement so it is correct.

a A displacement reaction involves the transfer of protons between a metal and a metal ion. — F (e⁻)

b Reduction is the gain of electrons by a substance. — T

c When copper loses two electrons to form Cu^{2+} it is reduced. — F (oxidized.)

d An oxidation reaction is always accompanied by a reduction reaction. — T

e A more active metal will displace a less active metal from a solution of its ions. — T

f For positive monatomic ions the oxidation state is always +1. — F (same as its charge)

g The oxidation number of manganese in MnO_2 is +1. — F (+4)

h For any redox reaction the number of electrons lost must be equal to the number of electrons gained. — T

i In the reaction $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(l)$ copper goes from an oxidation state of +1 to 0. — F (+2)

j For any neutral compound the sum of the oxidation numbers of the atoms in the molecule must equal zero. — T

2 By referring to the Activity Series select four metals which will displace:

a nickel from a solution of nickel nitrate

Fe, Cr, Zn, Al

b copper from a solution of copper sulfate

Pb, Sn, Ni, Co

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3 **a** In which direction (left to right) will the following reactions occur? If no reaction occurs write 'no reaction'.

i $Ag^+ + Ni \rightarrow Ag + Ni^{2+}$ right

ii $Fe + Al^{3+} \rightarrow Fe^{2+} + Al$ left

iii $Fe + Hg^{2+} \rightarrow Fe^{2+} + Hg$ right

b Write the correct balanced equation for each of the reactions above.

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

$3Fe(s) + 2Al^{3+}(aq) \leftarrow 3Fe^{2+}(aq) + 2Al(s)$

$Fe(s) + Hg^{2+}(aq) \rightarrow Fe^{2+}(aq) + Hg(l)$

4 **a** Which is the strongest reductant (reducing agent) out of Pb, Al, Fe and Cu, and which is the weakest?

Strongest - Al

Weakest - Cu

b Which is the strongest oxidant (oxidising agent) out of K^+, Ag^+, Al^{3+} and Ni^{2+}, and which is the weakest?

strongest - Ag^+

weakest - K^+

5 Write balanced ionic equations for the following.

a zinc is placed in a copper sulfate solution

$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$ (overall)

$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$ (ionic)

b lead is added to a solution containing Ag^+ ions

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

c iron is placed in a solution containing Na^+ and Pb^{2+} ions

$Fe(s) + Na^+ \rightarrow$ no rxn

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

6 Give the oxidation number of each of the following elements.

a potassium bromide KBr K(+1) Br(-1)

b magnesium Mg (0)

c aluminium oxide Al_2O_3 Al(+3) O(-2)

d iron(II) chloride $FeCl_2$ Fe(+2) Cl(-1)

e iodine I_2 (0)

f iron(III) chloride $FeCl_3$ Fe(+3) Cl(-1)

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7 Identify the species that is oxidised and the species that is reduced in each of the following reactions. Name the oxidant and reductant.

a $Cl_2 + 2HBr \rightarrow 2HCl + Br_2$
(0) (+1)(-1) (+1)(-1) (0)

$Cl_2(0) \rightarrow Cl(-1)$ reduction — oxidant => Cl

$Br(-1) \rightarrow Br_2(0)$ oxidation — reductant => Br

b $I_2O_5 + 5CO \rightarrow I_2 + 5CO_2$
(+5)(-2) (+2)(-2) (0) (+4)(-2)

$I(+5) \rightarrow I(0)$ reduction

$C(+2) \rightarrow C(+4)$ oxidation

c $6Mn^{3+} + I^- + 6OH^- \rightarrow 6Mn^{2+} + IO_3^- + 3H_2O$
(+3) (-1) (-2)(+1) (+2) (+5)(-2) (+1)(-2)

$Mn(+3) \rightarrow Mn(+2)$ reduction

$I(-1) \rightarrow I(+5)$ oxidation

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