Raffles Institution Raffles Programme
Secondary Three Chemistry
Notes – Redox Agents

Reducing and Oxidising Agents

Substances which cause oxidation are called **oxidising agents** and those which cause reduction are called **reducing agents**.

An oxidising agent will itself undergo reduction. A reducing agent will itself be oxidised.

Laboratory Tests for Reducing and Oxidising Agents

There are reactants that undergo reduction or oxidation with observable colour changes. Some of these chemicals are common in the laboratory and may be used to test the oxidising or reducing properties for another substance.

The chemicals or reagents commonly used to test for the presence of reducing agents are **potassium manganate(VII), $KMnO_4$,** and **potassium dichromate(VI), $K_2Cr_2O_7$**. A reagent commonly used to test for oxidising agent is **potassium iodide, KI**.

A Test for reducing agents using aqueous potassium manganate(VII), $KMnO_4$

Manganate(VII) ions can undergo reduction to manganese(II) ions.

	MnO_4^- manganate(VII) ion	**Mn^{2+} manganese(II) ion**
Oxidation state of Mn	+7	+2
Colour	purple	colourless

Preparation of reagent:
1 cm^3 of potassium manganate(VII) solution is poured into a test tube, followed by 1 cm^3 of dilute sulfuric acid.

Test procedure:
A few drops of the **acidified potassium manganate(VII)** (prepared above) is added to the unknown substance (solution).

Observation and conclusion:
If the **purple MnO_4^-** solution turns **colourless**, then MnO_4^- has been **reduced** to Mn^{2+}. This means the unknown substance caused the reduction and hence contains a **reducing agent**.

B **Test for reducing agents using aqueous potassium dichromate(VI), $K_2Cr_2O_7$**

Dichromate(VI) ions can undergo reduction to chromium(III) ions.

	$Cr_2O_7^{2-}$ dichromate(VI) ion	**Cr^{3+} chromium(III) ion**
Oxidation state of Cr	+6	+3
Colour	orange	green

Preparation of reagent:
1 cm^3 of potassium dichromate(VI) solution is poured into a test tube, followed by 1 cm^3 of dilute sulfuric acid.

Test procedure:
A few drops of the **acidified potassium dichromate(VI)** is added to the unknown substance (solution).

Observation and conclusion:
If the **orange $Cr_2O_7^{2-}$** solution turns **green**, then $Cr_2O_7^{2-}$ has been **reduced** to Cr^{3+}. This means the unknown substance caused the reduction and hence contains a **reducing agent**.

Question:
Name a gas that can be tested for by bubbling the gas through acidified aqueous potassium dichromate(VI).
What can be deduced about a property of the gas from this test?
Sulphur dioxide, ammonia gas, carbon monoxide

C **Test for oxidising agents using aqueous potassium iodide, KI**

Iodide ions can be oxidised to iodine.

	I^- iodide ion	**I_2 iodine**
Oxidation state of I	-1	0
Colour	colourless	brown

Test procedure:
A few drops of the **aqueous potassium iodide** is added to the unknown substance (solution).

Observation and conclusion:
If the **colourless I^-** solution turns **brown**, then I^- has been **oxidised** to I_2. This means the unknown substance caused the oxidation and hence contained an **oxidising agent**.

Note: *The above colour changes would be observed (and would lead to the corresponding conclusions), assuming the absence of other coloured substances (reactants or products) in the reaction.*

Practice Questions

1 A sample of polluted air, containing a reducing agent, was passed through two reagents, acidified potassium dichromate(VI) and aqueous potassium iodide.

Which colour change will be seen?

	acidified potassium dichromate(VI)	*potassium iodide*
A	green to orange	brown to colourless
B	green to orange	no change
C	orange to green	colourless to brown
D	orange to green	no change

(C)

2 What does an oxidizing agent do?

A It turns acidified potassium dichromate(VI) green.
B It turns acidified potassium manganate(VII) colourless.
C It turns Universal Indicator red.
D It turns aqueous potassium iodide brown.

(D)

3 When iron(II) sulfate solution is added to acidified potassium manganate(VII) the purple colour is decolourised.
Which of the following best represents this colour change?

A $Fe^{2+} \rightarrow Fe^{3+}$
B $K \rightarrow K^{+}$
C $MnO_4^{-} \rightarrow Mn^{2+}$
D $SO_4^{2-} \rightarrow SO_3^{2-}$

(C)

4 Acidified potassium dichromate(VI) can be used to detect the presence of ethanol vapour in the breath of a person who has consumed alcohol.
A colour change from orange to green is observed if ethanol is present.
What does this show about the nature of ethanol?

A It is a catalyst.
B It is an alkali.
C It is an oxidizing agent.
D It is a reducing agent.

(D)

5 Which of the following correctly matches the colour to each ion?

	MnO_4^{-}	Cr^{3+}	$Cr_2O_7^{2-}$
A	colourless	orange	purple
B	purple	green	orange
C	colourless	green	orange
D	purple	colourless	orange

(B)