Spect. Deter. Of a Mixture

Introduction:

In this experiment you would determine the amount of chromium and manganese in a given mixture. These are present as dichromate and manganate ions respectively. In fact this determination mimics the determination of the amount of chromium and manganese in alloy steels wherein these are oxidized to dichromate and permanganate ions respectively. The spectra of these ions overlap to certain extent. In the next experiment you would learn about the determination of methylethyl ketone—an important industrial solvent.

## What are:

Types of Substances?

Matter Phases?

Phase Changes?

Permanganate & Dichromate Structural Formula?

ξ and λ_{max} Values calculations?

Types of Substances:

- **Element**
  - Any substance that contains only <u>one kind of atom</u>
  - Cannot be broken down
- **Compound**
  - Consists of atoms of two or more different <u>elements</u>
  - Can be broken down
- **Mixture**
  - Consists of two or more different <u>elements/compounds</u>
  - Can be separated
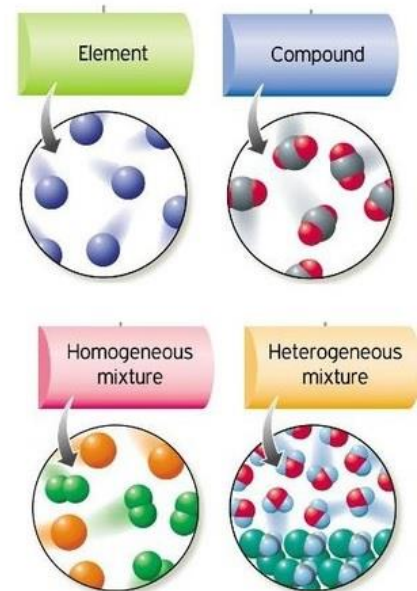
Element

- A pure substance that is listed in the periodic table and only has one type of atom in it.
- There are over 100 elements.
- Most are metals, a few are metalloids (also known as semi-metals), and the rest are non-metals.

Compound

- A pure substance made from more than one type of element chemically bonded together.
- Elements bond in fixed ratios and so can be represented by a chemical formula. For example, sodium chloride has the same number of sodium ions and chloride ions, so its formula is NaCl, whereas water is always made from twice the number of hydrogen atoms as oxygen atoms, so it is H_2O.

Mixture

- An impure substance made from different elements or compounds mixed together that are not chemically joined.
- Mixtures can usually be separated by physical techniques such as filtering and distillation.
- Air is a mixture that contains the elements nitrogen, oxygen and argon, and also the compound carbon dioxide.

Matter Phases:

increasing energy

Solid
The molecules that make up a solid are arranged in regular, repeating patterns. They are held firmly in place but can vibrate within a limited area.
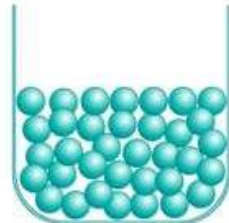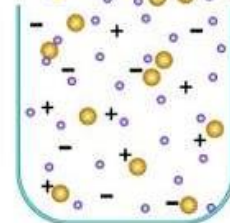
Liquid
The molecules that make up a liquid flow easily around one another. They are kept from flying apart by attractive forces between them. Liquids assume the shape of their containers.

Gas
The molecules that make up a gas fly in all directions at great speeds. They are so far apart that the attractive forces between them are insignificant.

Plasma
At the very high temperatures of stars, atoms lose their electrons. The mixture of electrons and nuclei that results is the plasma state of matter.

Phase Changes:

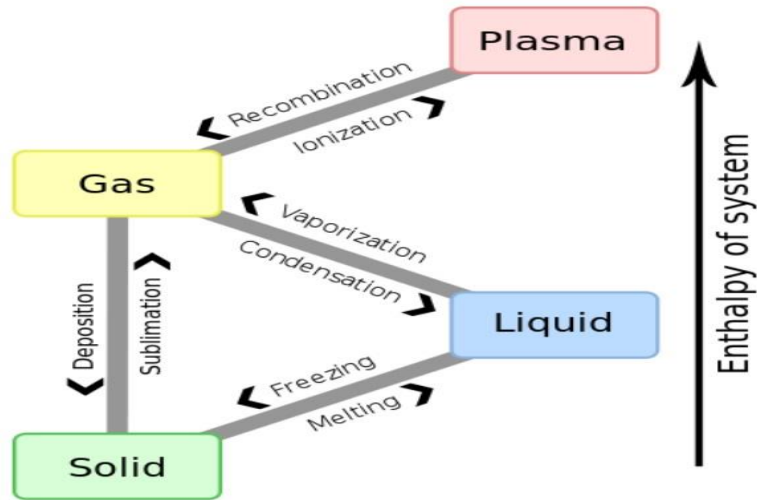# Permanganate & Dichromate Structural Formula:

Oxidised state

MnO_4^-

Purple (aq)

Permanganate

$O=Mn-O^-$ K^+

Oxidised state

$Cr_2O_7^{2-}$

Orange (aq)

Dichromate
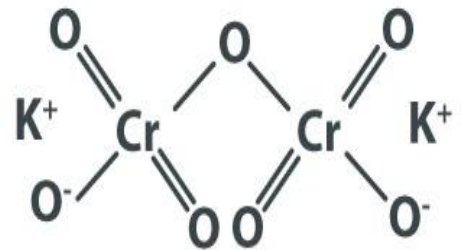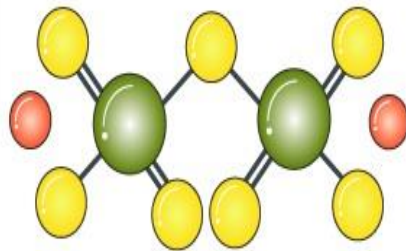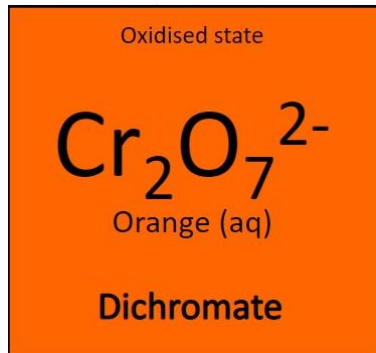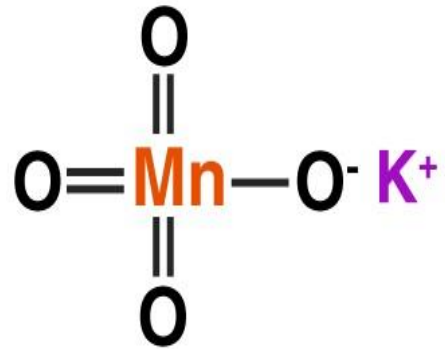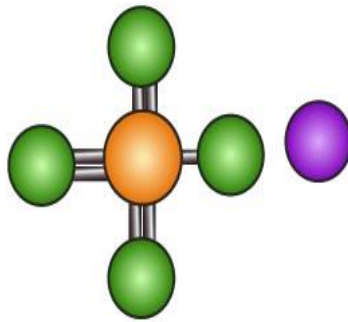
ξ and λ_max Values calculations:

$$A_{\lambda_1} = C_1(\varepsilon_1)_{\lambda_1} + C_2(\varepsilon_2)_{\lambda_1}$$

$$A_{\lambda_2} = C_1(\varepsilon_1)_{\lambda_2} + C_2(\varepsilon_2)_{\lambda_2}$$
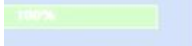
$$A_{440} = \varepsilon_{Cr,440}[Cr_2O_7^{2-}] + \varepsilon_{Mn,440}[MnO_4^-]$$

$$A_{545} = \varepsilon_{Cr,545}[Cr_2O_7^{2-}] + \varepsilon_{Mn,545}[MnO_4^-]$$

$$[Cr_2O_7^{2-}] = \frac{A_{440}(\varepsilon_{MnO_4^-})_{545} - A_{545}(\varepsilon_{MnO_4^-})_{440}}{(\varepsilon_{Cr_2O_7^{2-}})_{440}\ (\varepsilon_{MnO_4^-})_{545} - (\varepsilon_{MnO_4^-})_{440}(\varepsilon_{Cr_2O_7^{2-}})_{545}}$$

$$[MnO_4^-] = \frac{A_{545} - (\varepsilon_{Cr_2O_7^{2-}})_{545}[Cr_2O_7^{2-}]}{(\varepsilon_{MnO_4^-})_{545}}$$

Expermental:

1- Prepare **50ml** Of [0.005M] ($KMnO_4$) in water and <u>including</u> **1m** of [2M] H_2SO_4.

2- Prepare **50ml** Of [0.02M] ($K_2Cr_2O_7$) in water and <u>including</u> **1m** of [2M] H_2SO_4.

3- Prepare Blank.

4- Take **10ml** of the given Uknown in 50ml V.F and fill with water.

NO	$K_2Cr_2O_7$			$KMnO_4$			Blank	Unknown
ml	1	2	3	1	2	3	NIL	NIL

5- Move to the next Laboratory and find the concentration of [Cr^{6+}] & [Mn^{7+}] in the

Unknown Sample.

Results:

No	$K_2Cr_2O_7$			$KMnO_4$		
	C	λ_{440}	λ_{545}	C	λ_{545}	λ_{440}
1	C_1	A_1	-	C_1	A_1	-
2	C_2	A_2	-	C_2	A_2	-
3	C_3	A_3	A	C_3	A_3	A
Unknown	?	$A_{Unknown}$		?	$A_{Unknown}$	

Calibration Graphs: