TEACHING-LEARNING METHODOLOGY

PROCESS ORIENTED GUIDED INQUIRY LEARNING (POGIL)

Process oriented guided Inquiry learning (POGIL)

- A student-centered approach to Science instruction
- Widely used as a method of Learning in especially in Chemistry
- Chemistry Department has adopted POGIL as a teaching method
- Year of implementation: 2016-2017 onwards
- Year of approval from BoS: 2018-2019

Objectives of POGIL

- A POGIL activity is designed to be used with self-managed teams that employ the instructor as a facilitator of learning rather than as a source of information.
- A POGIL activity guides students through an exploration to construct, deepen, refine, and/or integrate understanding of relevant disciplinary content.
- The application and development of at least one of the targeted process skills is embedded in the structure and/or content of a POGIL activity.

Method

- Students are pre-apprised of prerequisites for a particular POGIL activity.
- Students are divided into groups ranging from 6-10.
- Each group has a Manager, Recorder and Speaker.
- The students have to answer a Questionnaire on a Topic not covered in class by doing group discussion.
- The onus is to arrive at the correct answer based on contributions from Group members
- Learning objectives, Concepts and prerequisites are specified.
- The prerequisites have to be satisfied by the students.
- Usually the concerned topic is introduced briefly to the students and at times additional information is provided in the middle and starting from lower order questions the move is made on to higher order questions.
- The solutions to the questions are discussed at the end of session and also the process and pathways in which the students reached at the solutions are discussed in detail.
- Breakup of a POGIL activity during a 60-minute lecture

  Introduction – 5 minutes

Team formation - 5 minutes

Worksheet solution – 40 minutes

Discussion – 10 minutes

Outcomes

- Student-centered method
- Enhances the group learning ability of students
- Enhances student engagement and interaction
- Students move on from illogical and at times stray thinking to a logical thinking
- Analysis and application ability of students is enhanced
- Students tend to answer higher order questions with comparative ease as compared to a normal class teaching method

Designed by: Dr. Sachin B. Kakodkar

Course: CHE-III.C-5 Comprehensive Chemistry-I

POGIL WORKSHEET

MIGRATION OF IONS

LEARNING OBJECTIVES

- Be able to explain the concept of migration of ions.
- Identify the movement of ions.
- Determine the direction of the movement of ions.
- Design of experiments of similar types.

CONCEPTS

- Ions
- Movement of ions
- Anode and Cathode

PREREQUISITES

- Concept of ions
- Electrodes

Lodge's Moving boundary method and **Movement of colored ions** were two experiments that demonstrated movement of ions towards oppositely charged plates.

1. Lodge's moving boundary experiment

Experiment showing the migration of H^+ ions as indicated by the movement of the red boundary through the agar-agar jelly.

The apparatus used consists of a U-tube which has a long horizontal portion. It is fitted with electrodes in the side limbs. The horizontal portion is filled with a jelly of agar-agar treated with a trace of alkali. This is then made **red** by addition of a few drops of **phenolphthalein**. When the jelly is set, dilute sulphuric acid andsodium sulphate solution are added in the two different limbs of the tube. On passing the current, **gradual discharge of the red colour**is observed.

Q.1 In which limbs sulphuric acid and sodium sulphate solution are added?

_____

_____

Q.2 Identify the migrating ion responsible for discharge of red colour and state its type.

_____

Q.3 State the role of phenolphthalein in above experiment.

_____

_____

Q.4State the reason for the discharge of red colour.

_____

_____

_____

Q.5 Draw arrows in above diagram to indicate the direction of migration of ion.

(USE GREEN COLOUR PEN)

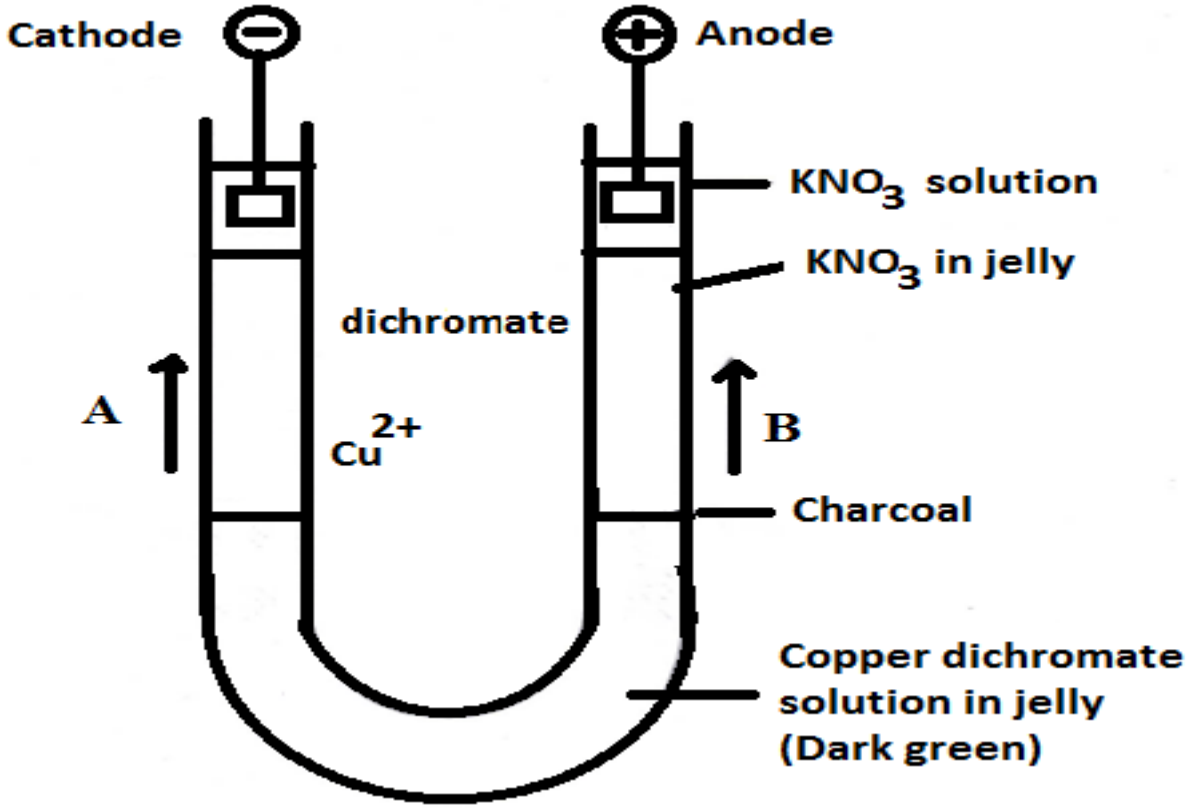
Q.4Identify the limb to which the ion migrates.

_____

_____

Q.6 Demonstrate migration of an oppositely charged ion than one demonstrated in the above diagram with a neat labeled diagram.

2. Movement of coloured ions



The lower part of a U-tube is filled with a 5 percent water-solution of agar-agar with a small amount of **copper dichromate ($CuSO_4$+ $K_2Cr_20_7$).**The dark green colour sets to a jelly. The surface of the green solution in the two limbs of the U-tube is marked by a small amount of charcoal. In both the limbs is then placed a layer of solution of potassium nitrate and agar-agar. This is also allowed to set. Over this second layer is placed some solution of potassium nitrate in pure water and the two electrodes are inserted in it. As the current is turned on, rise of blue colour and reddish yellowcolour is seen in the two different limbs.

Q.1 State the reason for the rise of blue and reddish yellow colour.

_____

_____

_____

Q. 2 Match arrows A and B in the figure with blue and reddish yellow colour.

_____

_____

Q. 3 In which limb will blue colour rise?

_____

Q. 4 In which limb will reddish yellow colour rise?

_____

Q. 5 Indicate arrows in the above figure to designate Cu^{2+} and dichromate presence in the limbs.

(USE GREEN COLOUR PEN)

Q. 6 What is the role of jelly in the above experiment?

_____

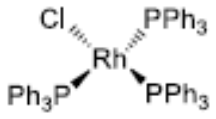
_____

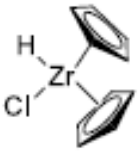
_____

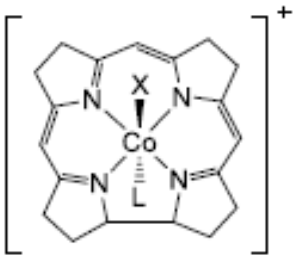
PRACTICAL PROBLEMS

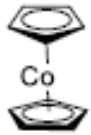
Problems Session – Electron Counting in Transition Metal Complexes and Clusters

I. For each of the following complexes, calculate:
   a. The oxidation state of the metal
   b. The electronic configuration of the metal (d^n)
   c. The total number of electrons of the metal





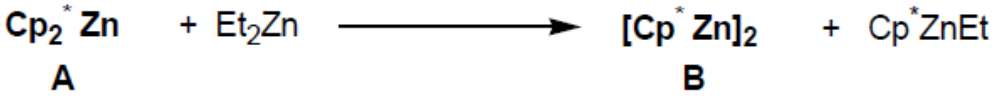




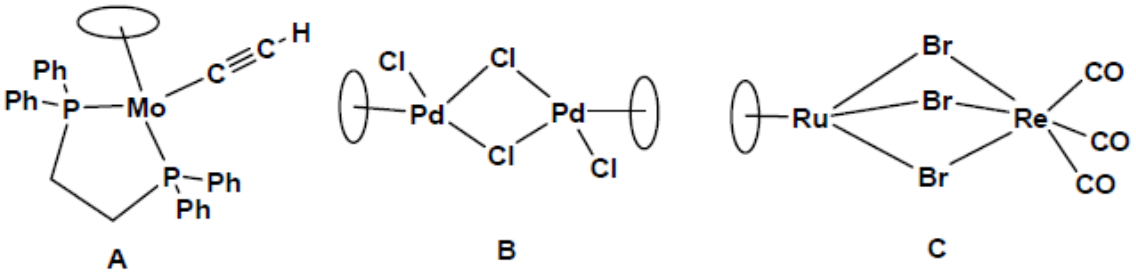
2. Determine the number of metal-metal bonds in the following clusters;

$[Mn_2(CO)_{10}]$ $[Re_3Cl_9(\mu_2\text{-}Cl)_3]^{3-}$ $[Ru(CO)_4]_3$ $[[ReCl_4]_2]^{2-}$

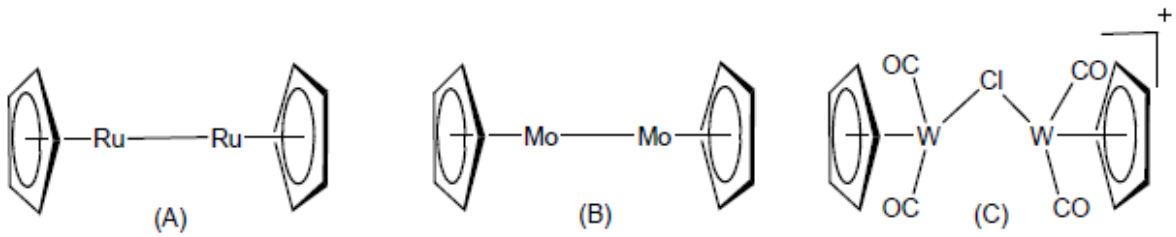
3. Compounds A and B in the given equation obey the 18 electron rule. Draw structures of compounds A and B clearly indicating hapticity of Cp^*. Also indicate oxidation state of Zn in both A and B.



4. Given that it shows the highest hapticity possible, find out the missing planar, unsaturated and conjugated carbocyclic hapto ligands in the following compounds, all of which obey the 18 electron rule.



5. Four chlorine ligands are missing in each of the given skeletons of dimeric compounds A, B and C. Given that all of them obey the 18 electron rule and no additional metal-metal bonds are present, attach the missing Cl ligands on the complexes in the most appropriate manner.



6. Count the electrons in the following compounds and indicate the electron count per metal unit.

Designed by: Dr. Sachin B. Kakodkar

Course: CHE-III.E-6 Polymer and Colloid Science

POGIL WORKSHEET

PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE
(AUTONOMOUS), MARGAO-GOA

POGIL WORKSHEET

THERMODYNAMICS OF FREE RADICAL POLYMERISATION

Class: S. Y. B. Sc. **Semester:** IV

Subject: Chemistry **Paper:** CHE-IV. E-6 Polymer and Colloid Science

---

Free radical polymerization proceeds through three steps.
Gibbs free energy change is used to predict the feasibility of a process.
Prerequisites: Chemical Thermodynamics, Chemical equilibrium, Chemical kinetics, Polymerisation

---

1. **State the three steps involved in free radical polymerization.**

2. **State the symbols for Enthalpy, Entropy and Gibbs free energy?**

3. **Are the above functions State functions? Justify your answer.**

4. **Identify the relation between Gibbs free energy and enthalpy?**

5. **Comment on the heat involved in initiation and propagation steps.**

6. Predict Gibbs free energy change (ΔG_p) for polymerization process if ΔH_p is heat of polymerization and ΔS_p is entropy of polymerization.

7. If E_p is energy of activation of polymerization and E_{dp} is energy of activation of depolymerization, predict value of heat of polymerization.

8. Is heat of polymerization positive or negative? Justify your answer.

9. Is entropy of polymerization positive or negative? Justify your answer.

10. Will Gibbs free energy change (ΔG_p) be positive or negative? Justify your answer.

POGIL ACTIVITY

1. Which of the following relationships between absorbance and %Transmittance is **incorrect** ?
   a) $A = \log_{10} 100 / \%T$
   b) $A = 2 - \log_{10} \%T$
   c) $A = \log_{10} 1 / \%T$

2. In the equation, $A = \varepsilon bc$, what quantity is represented by "ε" ?

   a) Absorbtivity
   b) Molar absorbtivity
   c) Path length

3. Why is it generally preferable to use absorbance as a measure of absorption rather than % Transmittance?

   a) Because %T cannot be measured as accurately as absorbance
   b) Because %T is dependant on the power of the incident radiation
   c) Because absorbance is proportional to the concentration of the analyte, whereas %T is not.

4. Does a compound with high molar absorbtivity have a higher or lower limit of detection than a compound with low molar absorbtivity?

5. How does the percent transmittance of a solution vary with (a) increasing concentration and (b) increasing path length?

Numerical Problems:

1) A solution of Tryptophan has an absorbance at 280 nm of 0.54 in a 0.5 cm length cuvette. Given the absorbance coefficient of tryptophan is 6.4×10^3 LMol-1 cm-1 . What is the concentration of solution?

2) A solution shows a transmittance of 20%, when taken in a cell of 2.5 cm thickness. Calculate its concentration, if the molar absorption coefficient is 12000 dm^3/mol/cm.

3) Calculate the molar absorptivity of a 1 x 10 -4 M solution, which has an absorbance of 0.20, when the path length is 2.5 cm.

4) The concentration of yeast t-RNA in an aqueous solution is 10 M. The absorbance is found to be 0.209 when this Solution is placed in a 1.00 cm cuvette and 258 nm radiations are passed through it. a) Calculate the molar absorptivity b) What will be the absorbance if the solution is 5 M? c) What will be the absorbance if the path length of the original solution is increased to 5.00 cm?

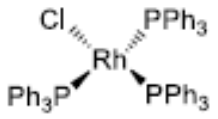
5) A $CaCO_3$ solution shows a transmittance of 90%, when taken in a cell of 1.9 cm thickness. Calculate its concentration, if the molar absorption coefficient is 9000 dm^3/mol/cm.

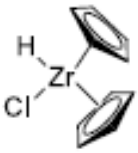
6) The absorbance of a Cu sulphate solution containing 0.500 mg Cu/mL was reported as 0.3500 at 440 nm. a) Calculate the molar absorptivity, on the assumption that a 1.00 cm cuvette was used. b) What will be the absorbance if the solution is diluted to twice its original volume.

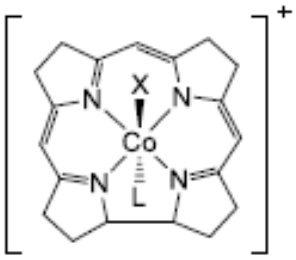
PRACTICAL PROBLEMS

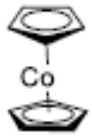
Problems Session – Electron Counting in Transition Metal Complexes and Clusters

I. For each of the following complexes, calculate:
   a. The oxidation state of the metal
   b. The electronic configuration of the metal (d^n)
   c. The total number of electrons of the metal







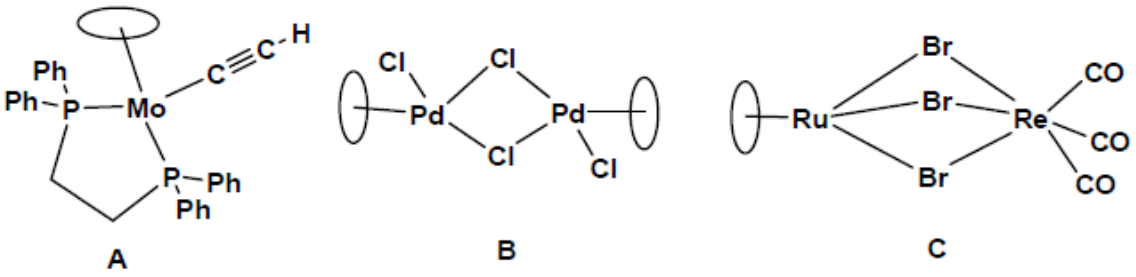


2. Determine the number of metal-metal bonds in the following clusters;

$[Mn_2(CO)_{10}]$ $[Re_3Cl_9(\mu_2\text{-}Cl)_3]^{3-}$ $[Ru(CO)_4]_3$ $[[ReCl_4]_2]^{2-}$

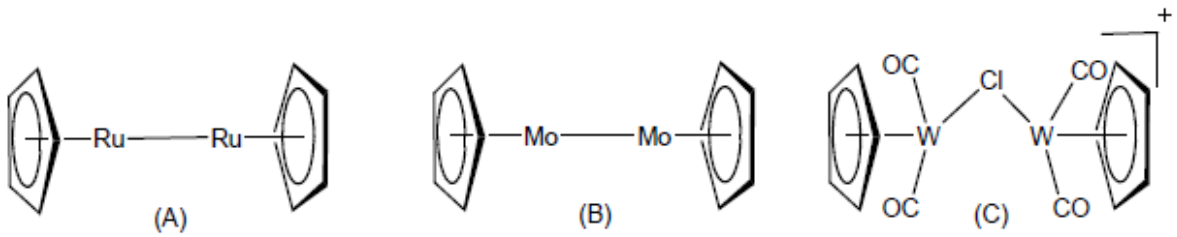
3. Compounds A and B in the given equation obey the 18 electron rule. Draw structures of compounds A and B clearly indicating hapticity of Cp^*. Also indicate oxidation state of Zn in both A and B.

4. Given that it shows the highest hapticity possible, find out the missing planar, unsaturated and conjugated carbocyclic hapto ligands in the following compounds, all of which obey the 18 electron rule.



A B C

5. Four chlorine ligands are missing in each of the given skeletons of dimeric compounds A, B and C. Given that all of them obey the 18 electron rule and no additional metal-metal bonds are present, attach the missing Cl ligands on the complexes in the most appropriate manner.



6. Count the electrons in the following compounds and indicate the electron count per metal unit.