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**M.Sc. (Third Semester)  
EXAMINATION, Dec. - Jan., 2021-22**

**CHEMISTRY**

**Paper First**

**(Resonance Spectroscopy, Photochemistry and  
Organocatalysis)**

*Time : Three Hours*

*[Maximum Marks:80*

*[Minimum Pass Marks:16*

**Note : Attempt all sections as directed.**

**Section - A**

**(1 Mark each)**

**(Objective/Multiple Choice Questions)**

1. Electron spin resonance is also known as which of following?
- (A) Electron paramagnetic resonance
  - (B) Electron diamagnetic resonance
  - (C) Electron paramagnetic resonance
  - (D) Electron diamagnetic resonance

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2. Which is reference standard in ESR?
- (A) KBr
  - (B) NaCl
  - (C) Cu
  - (D) DPPH
3. Which of the following nuclei has  $I = \frac{3}{2}$ ?
- (A)  ${}_{17}^{36}\text{Cl}$
  - (B)  ${}_{7}^{14}\text{N}$
  - (C)  ${}_{5}^{11}\text{B}$
  - (D)  ${}_{13}^{27}\text{Al}$
4. Which of the following nuclei is expected to exhibit the NQR spectra?
- (A)  ${}_{13}^{27}\text{Al}$
  - (B)  ${}_{17}^{35}\text{Cl}$
  - (C)  ${}_{55}^{133}\text{Cs}$
  - (D) All
5. Klystron produces frequency of?
- (A) 95000 MHz
  - (B) 9500 MHz
  - (C) 900 MHz
  - (D) 500 MHz

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6. ESR sensitivity increases with \_\_\_\_\_ temperatures and with \_\_\_\_\_ magnetic field strength.
- (A) Increasing, increasing
  - (B) Increasing, decreasing
  - (C) Decreasing, increasing
  - (D) Decreasing, decreasing
7. Which of the following element is analyzed by Auger electron spectroscopy?
- (A) C and N
  - (B) H and He
  - (C) Li and B
  - (D) All of the above
8. What are possible X-axis co-ordinates in graphs made from photoelectron spectroscopy data?
- (A) Electron volt (ev)
  - (B) Mega joules per mole (mj/mol)
  - (C) Energy
  - (D) All of the above
9. Fourier Transform-Photoacoustic spectroscopy has application for analysis of-
- (A) High molecular weight polymer
  - (B) Coals
  - (C) Air Pollutants
  - (D) All of the above
10. The most important chemical Actionometry is:
- (A) Thermopile
  - (B) Barrier layer
  - (C) Ferioxalate Actionometer
  - (D) Photomultiplier tube

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11. Which of the following electronic excitations requires highest energy?
- (A)  $n \rightarrow \sigma^*$
  - (B)  $\sigma \rightarrow \sigma^*$
  - (C)  $n \rightarrow \pi^*$
  - (D)  $\pi \rightarrow \pi^*$
12. Which of the following is an example of photochemical reaction?
- (A) Photosynthesis
  - (B) Decomposition of ammonia
  - (C) Formation of NaOH
  - (D) Decomposition of HCl
13. Which of the following is an incorrect statement?
- (A) First step in photochemistry is excited state (photoexcitation)
  - (B) Photochemical reactions are caused by absorption of ultraviolet only
  - (C) When a molecule or atom in the ground state ( $S_0$ ) absorbs light, one electron is excited to a higher orbital level
  - (D) It is possible for the excited state  $S_1$  to undergo spin inversion.

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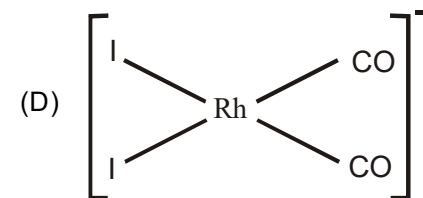
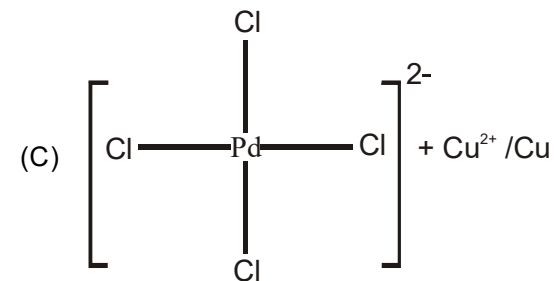
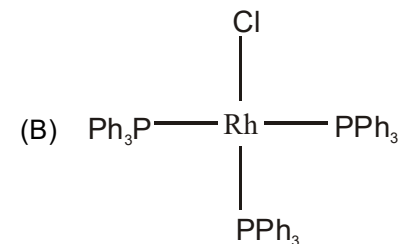
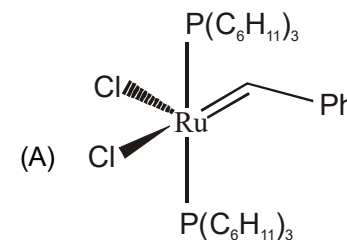
14. The fact that the fluorescence wavelength is often much longer than the irradiation wavelength (Stokes shift) is a consequence of which phenomenon?
- (A) low extinction coefficients (Lambert-Beer law)  
 (B) Vertical transitions (Kasha's rule)  
 (C) High ISC rates (El Sayed rule)  
 (D) The Franck-Condon principle
15. Photochemical smog does not possess?
- (A) Ozone  
 (B)  $\text{CO}_2$   
 (C) Nitrogen dioxide  
 (D) PAN
16. Heterogeneous catalyst involves in:
- (A) Wilkinson catalysis  
 (B) Ziegler-Natta catalysis  
 (C) Oxo-process  
 (D) Wacker oxidation
17. A key feature of the Fischer-Tropsch process?
- (A) Hydrocarbon formation  
 (B) Alkene hydrogenation  
 (C) Alkene polymerization  
 (D) Hydroformylation

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18. Grubbs catalyst is:



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19. Which catalyst is used in the synthesis of acetic acid by Moosanto process?
- (A)  $\text{RhCl}(\text{PPh}_3)$   
(B)  $\text{Al}(\text{C}_2\text{H}_5) + \text{TiCl}_4$   
(C)  $[\text{RhI}_2(\text{CO}_2)]$   
(D) All of the above
20. Which reaction does not involve in organometallic catalysis?
- (A) Reductive elimination  
(B) Decomposition  
(C) Insertion  
(D) Oxidative addition

**Section - B**

**(2 Marks each)**

**(Very Short Answer Type Questions)**

1. Write two limitation of NQR technique?
2. What is coupling constant?
3. Write the principle of photoacoustic spectroscopy.
4. What do you understand by photoelectric effect?
5. How quantum yield can be determined?
6. Write the photo-Fries chemical reaction of anilides.
7. Explain the term "regioselectivity" and "chemoselectivity" of catalysts.
8. What do you mean by alkenes metathesis?

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**Section - C**

**(3 Marks each)**

**(Short Answer Type Questions)**

**Note: Attempt all questions. Write answer in <75 words.**

1. What is the significance of g-tensors?
2. What are different application of NQR spectroscopy?
3. What are Koopman's theorem and it's use?
4. Define photoelectric affect and it's significance.
5. Derive the Stern-Volmer equation and it's use.
6. Discuss the photochemical formation of smog.
7. Write the difference between homogenous and heterogeneous catalysts.
8. What are oxidative, insertion and reductive elimination reactions?

**Section - D**

**(5 Marks each)**

**(Long Answer Type Questions)**

**Note- Attempt all questions. Write answer in <150 words.**

1. Explain the principle and instrumentation of NQR spectroscopy.

OR

Explain the hyperfine structure of hydrogen and methyl radical using ESR spectroscopy.

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2. What is Auger electron spectroscopy (AES) and write the application of AES for chemical characterization of samples.

OR

Write notes on the following-

(A) Surface application of PAS

(B) Instrumentation of PAS.

3. Discuss the interaction of matter with electromagnetic radiation and derive Einstein treatment of absorption and emission phenomenon.

OR

What are adiabatic and diabatic photochemical reactions? Discuss the rate constant and life time of reactive energy states in unimolecular photochemical reaction.

4. Why hydrogenation reaction of alkene does not occur under uncatalyzed conditions? Discuss the mechanism of Wilkinson catalysis for hydrogenation reaction.

OR

Why organometallic compounds are used as a catalyst? Discuss the principles for designing organometallic catalysts.