

Faculty of Science

WRET-2023

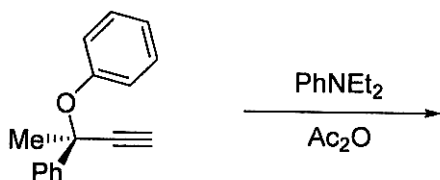
Chemistry

Full Marks: 100

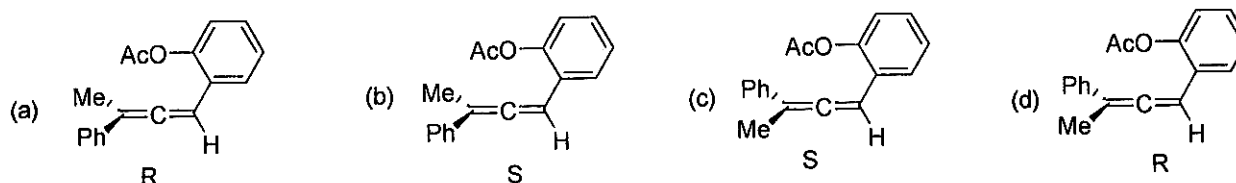
Time: 2 hours

Answer ALL questions. Tick the right choice. Each question carries 2 marks.

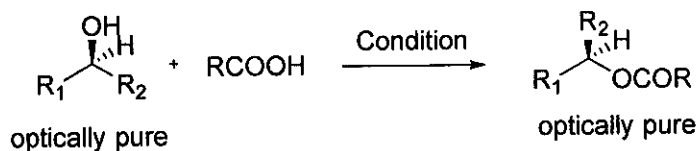
1. The point group of cyclohexene (C_6H_{10}) is
 - a) C_2
 - b) D_{2h}
 - c) C_{2v}
 - d) C_{3v}
2. Enantioselective reduction of unsymmetrical ketone with CBS reagent involves
 - a) activation by Lewis acidic centre only
 - b) activation by Lewis basic centre only
 - c) dual activation by both the Lewis acidic and Lewis basic centres
 - d) no activation of any of the above three kinds.
3. The 1H -NMR signals due to the aromatic protons of an unsymmetrical *p*-disubstituted benzene appear at $\delta 7.39$ and $\delta 7.21$ (measured with 90MHz NMR instrument) with coupling constant 9.0 Hz. The signals will be
 - a) two well-separated doublets
 - b) two well-separated triplets
 - c) AB quartet
 - d) two sets of multiplets.
4. In the following pericyclic reaction, the structure of the allene formed and its configuration are



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5. The appropriate condition for the given esterification reaction is

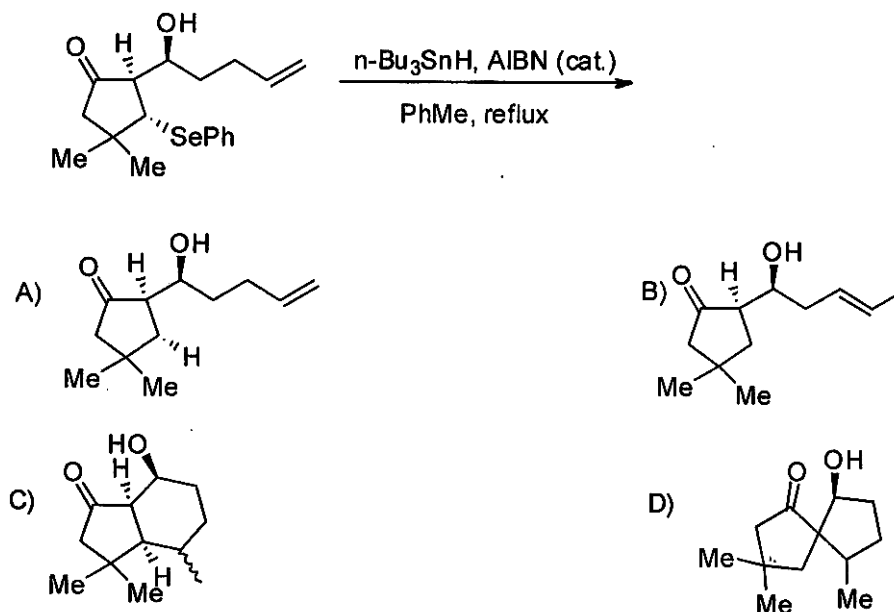


- (a) 2,4,6-trichlorobenzoyl chloride, Et₃N
 (b) DCC, DMAP
 (c) 2-Chloro-1-methylpyridinium iodide, Et₃N
 (d) Ph₃P, DEAD
6. Which one of the following techniques is most appropriate for determining number average molecular weight of a polymer?
- (a) MALDI-TOF (b) ESI-MS (c) EI-MS (d) CI-MS
7. Thermodynamically most stable molecule among the following is
- (a) *trans*-1,2-dimethylcyclohexane
 (b) *cis*-1,2-dimethylcyclohexane
 (c) *trans*-1,4-dimethylcyclohexane
 (d) *cis*-1,4-dimethylcyclohexane
8. Bibliography given in a research report mostly
- (a) helps those interested in further research and studying the problem from another angle
 (b) shows the vast knowledge of the researcher
 (c) makes the report authentic
 (d) increase the length of report.

9. Which one of the following compounds will have two doublets, $J = 16$ Hz in its ^1H NMR spectrum?

- (a). 1,1-dibromoethene
- (b). 1-bromo-1-chloroethene
- (c). (*E*)-1-bromo-2-chloroethene
- (d). (*Z*)-1-bromo-2-chloroethene

10. Predict the major product in the following reaction:



11. In order to pursue the research, which of the following is primarily required?

- a. Developing a research design
- b. Formulating a research question
- c. Deciding about the data analysis procedure
- d. Formulating a research hypothesis

12. Thermolysis of allyl phenyl ether generates:

- a. *o*-Allylphenol only
- b. *o*-, *m*- and *p*-Allylphenols

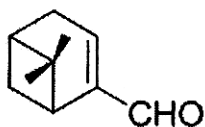
- c. m-Allylphenol only
- d. o- and p-Allylphenols

13. A molecule will be chiral if it

- a) Does not have any plane of symmetry.
- b) Does not have any improper/alternating axis of rotation.
- c) Does not have any center of symmetry.
- d) Does not have any rotational axis of symmetry.

14. In the ^1H NMR spectrum of myrtenal, the two methyl groups are expected to display chemical shift values (δ) in ppm at

Myrtenal

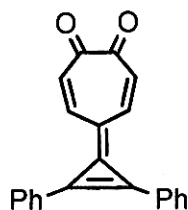


- (a) 1.33 (s, 6H) (b) 0.74 (s, 6H) (c) 1.35 (s, 3H) and 5.0 (s, 3H)
- (d) 0.74 (s, 3H) and 1.33 (s, 3H)

15. How many signals with intensity ratios would you expect in the proton decoupled ^{13}C NMR spectrum of CDCl_3 .

- (a) 3 (1:2:1) (b) 5 (1:2:3:2:1) (c) 3 (1:1:1) (d) 2 (1:1)

16. The following molecule is-



- (a) Aromatic (b) Nonaromatic (c) Antiaromatic (d) Homoaromatic

17. Which of the following statement about $[\text{Re}_2\text{Cl}_8]^{2-}$ and $\text{Re}_2(\text{CO})_{10}$ is correct?

- a) Both have quadrapole bonding

- b) Both have Re-Re bond and carbonyl has D_{4d}
 c) Both have Re-Re bond and D_{4h} structure
 d) None of the above
18. Decreasing trend of CO stretching frequency in the isoelectronic series $V(CO)_6^-$, $Cr(CO)_6$ and $Mn(CO)_6^+$ is
 (a) $V(CO)_6^- > Mn(CO)_6^+ > Cr(CO)_6$
 (b) $V(CO)_6^- > Cr(CO)_6 > Mn(CO)_6^+$
 (c) $Mn(CO)_6^+ > Cr(CO)_6 > V(CO)_6^-$
 (d) $Cr(CO)_6 > V(CO)_6^- > Mn(CO)_6^+$
19. In Ziegler-Natta catalysis the catalysts used:
 (a) $(PPh_3)_3RhCl$
 (b) $[Rh(CO)_2I_2]^-$
 (c) $[PdCl_4]^{2-}$
 (d) $Et_3Al/TiCl_4$
20. Which of the techniques below is neither an application of gamma radiation nor uses gamma rays?
 a) Mössbauer spectroscopy
 b) Neutron activation analysis
 c) Industrial radiography
 d) Magnetic resonance imaging
21. Who is credited for detailing the evidence for nuclear shell model that accounts for many properties of the atomic nuclei and leads to the discovery of magic numbers?
 a) Enrico Fermi and Albert Einstein
 b) Pierre Curie and Marie Curie
 c) Maria Goeppert Mayer and Hans Jensen
 d) Ernest Rutherford and Niels Bohr
22. The incorrect order of adjacent bond angles is:
 a) $CO_2 > BF_3 > CH_4$
 b) $NO_2^+ > NO_3^- > NO_2^-$
 c) $XeF_2 > XeF_4 > XeO_4^-$
 d) $PH_3 > AsH_3 > SbH_3$
23. Which of the following is a naturally occurring organometallic compound
 a) haemoglobin
 b) chlorophyll
 c) haemocyanin
 d) vitamin B₁₂

24. Calculate the M-M- bond present in $[(\text{Fe}_3(\text{CO})_{12}]$

- a) 3
- b) 0
- c) 2
- d) 1

25. All research processes start with

- a) hypothesis
- b) observation
- c) experiments
- d) conclusions

26. $\text{HM}(\text{CO})_5$ and $[\eta^5\text{-C}_5\text{H}_5\text{M}'(\text{CO})_3]_2$ obey 18 electron rule. Find out the metal and the value of $^1\text{H NMR}$ (in ppm).

- a) Mn, 10.22 and Fe, 2.80
- b) Cr, 4.10 and Mn, -7.5
- c) V, -7.5 and Cr, 4.10
- d) Mn, -7.5 and Cr, 4.10

27. Complete the sentence:

The main purpose of research in education is to.....

- a) increase social status of an individual.
- b) increase job prospects of an individual.
- c) help the candidate to become an eminent educationist.
- d) help in the personal growth of an individual.

28. Calculate the absolute standard deviation of the following

$$y = 0.50 (\pm 0.02) + 4.10 (\pm 0.03) - 1.97 (\pm 0.05)$$

$$= 2.63 (\pm ?)$$

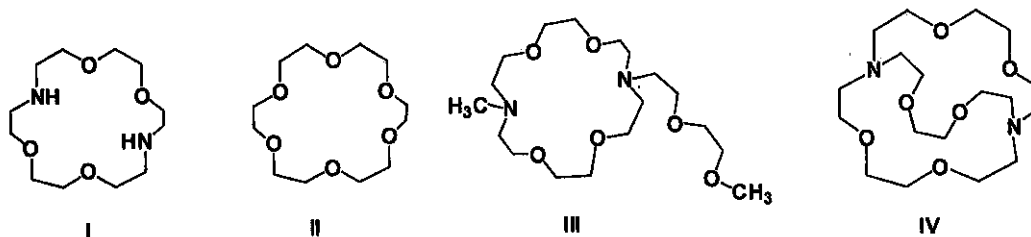
- (a) 0.03
- (b) 0.06
- (c) 0.00

(d) 0.10

29. The pH of water at 100°C is 6.14 (K_w of water at 100°C = 49×10^{-14}). It indicates that water is

- (a) acidic
- (b) neutral
- (c) basic
- (d) contaminated

30. Order of K^+ binding constant of the hosts depicted below follows



- a) I>II>III>IV
- b) IV>III>II>I
- c) IV>II>III>I
- d) IV>III>I>II

31. In the following pairs, which one has Perovskite and Ilmenite structure?

- a) CaTiO_3 & FeTiO_3
- b) TiO_2 & FeTiO_3
- c) FeTiO_3 & Zn_2TiO_4
- d) MgAl_2O_4 & CaTiO_3

32. Predict the spin only magnetic moments (μ_B) at 25 °C of $[\text{Ru}(\text{NH}_3)_6]^{3+}$ and $[\text{EuCl}_6]^{4-}$ complex ions

- (a) 1.73, 6.87
- (b) 7.94, 2.83

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(c) 1.73, 7.94

(d) 2.83, 6.87

33. A blueprint of research work is called

a) research problem

b) research design

c) research tools

d) research method

34. Fluorescence emission appears generally:

a) at the same wavelength as that of the exciting light

b) at shorter wavelength than that of exciting light

c) at longer wavelength than that of the exciting light

d) none of the above

35. What is the best-suited name for a process that doesn't necessitate experimental research?

a) Manipulation

b) Controlling

c) Content analysis

e) Observation

36. A particle is constrained in a one dimensional box of length $2a$ with potential $V(x)=\infty$;

$x < -a$, $x > a$ and $V(x)=0$; $-a \leq x \leq a$. Energy difference between levels $n=3$ and $n=2$ is

a) $\frac{5h^2}{8ma^2}$

b) $\frac{9h^2}{8ma^2}$

c) $\frac{9h^2}{32ma^2}$

d) $\frac{5h^2}{32ma^2}$

37. In fluorometers radiation source, sample and detector are arranged at right angle configuration
- because emission originates only at right angle to the direction of excitation
 - to increase the convenience of measurement
 - to minimize the contribution of the excitation radiation
 - to optimize fluorescence anisotropy
38. The bond distance of nitrogen molecule can be experimentally determined from
- fluorescence spectroscopy
 - microwave spectroscopy
 - IR spectroscopy
 - Raman spectroscopy
39. In a double beam spectrophotometer the 3 mirrors are of following categories
- all 3 are totally reflecting
 - all 3 are partially reflecting
 - 1 is totally reflecting and 2 are partially reflecting
 - 1 is partially reflecting and 2 are totally reflecting
40. As we increase the solvent polarity the absorption maximum of n- π^* transition
- moves to higher energy
 - moves to lower energy
 - does not show any shift
 - moves to higher or lower energy depending on the fluorophore
41. With an extension of π -conjugation the absorption spectrum of a molecular system shows a red shift. This observation
- is not a general one

- b) can only be explained through detailed molecular orbital calculations
- c) can not be rationalized
- d) can be explained simply by quantum mechanical idea of particle in a box

42. Among $n-\pi^*$ and $\pi-\pi^*$ transitions of a molecular system

- a) the former is weaker
- b) the latter is weaker
- c) depends on the nature of the absorbing molecule
- d) depends on the polarity of the solvent

43. Discretised Fourier Grid Hamiltonian Method is used for solving

- a) Rotational Eigenvalues and Eigenfunctions
- b) Bound state vibrational Eigenvalues and Eigenfunctions
- c) Continuous vibrational Eigenvalues and Eigenfunctions
- d) All of the above

44. Which of the following (for the same values of externally controlled conditions) is not a requirement for the occurrence of a chemical oscillation?

- a) The system must be far from equilibrium
- b) The rate law of the reaction must be linear
- c) There must be at least two autocatalytic steps in the reaction mechanism
- d) The system must be able to exist in two stable steady states

45. Which of the following technique is suitable for bulk phase (crystallinity and structure) analysis of a material?

- a) X-ray fluorescence spectroscopy
- b) X-ray photoelectron spectroscopy
- c) X-ray diffraction

d) Energy dispersive X-ray analysis

46. If the wall of an one dimensional box be suddenly removed

- a) the particle in the box does not obey the wave function
- b) the particle vanishes into the air
- c) the particle has infinite kinetic energy
- d) the particle has continuous energy function

47. When placed in magnetic field, all the random spins of nuclei

- a) stop
- b) reverse direction
- c) align with the magnetic field
- d) rotate to 90° away from the induced field

48. r_{\max} and K_m for an enzyme catalyzed reaction are $2 \times 10^{-3} \text{Ms}^{-1}$ and $1.0 \mu\text{M}$ respectively. The rate of reaction when substrate concentration is $1 \mu\text{M}$ is

- a) $3 \times 10^{-3} \text{s}^{-1}$
- b) $2 \times 10^{-3} \text{s}^{-1}$
- c) $2 \times 10^{-3} \text{s}^{-1}$
- d) 0.50s^{-1}

49. In a spherically symmetric potential, the potential energy depends on

- a) r
- b) r, θ, φ
- c) θ, φ
- d) R, φ

50. MB statistics is applicable for

- a) photon
- b) ideal gas
- c) electron
- d) proton