## Entrance Examination for Admission to the P.G. Courses in the Teaching Departments, 2022

CSS
CHEMISTRY/CHEMISTRY (RENEWABLE ENERGY)


## General Instructions

1. The Question Paper is having two Parts - Part ' $A$ ' Objective type (60\%) \& Part ' $B$ ' Descriptive type (40\%).
2. Objective type questions which carry 1 mark each are to be ( $\checkmark$ ) 'tick marked' in the response sheets against the appropriate answers provided.
3. 8 questions are to be answered out of 12 questions carrying 5 marks each in Part ' $B$ '.
4. Negative marking : 0.25 marks will be deducted for each wrong answer in Part 'A'.
Time: 2 Hours
Max. Marks : 100
To be filled in by the Candidate

| Register <br> Number | in Figures |  |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  | in words |  |  |  |  |  |  |  |  |



PART - A
(Objective Type)
Choose appropriate answer from the options in the questions. One mark each.
( $60 \times 1=60$ marks)

1. In which case effective nuclear charge is minimum
a) $\mathrm{Be}^{+}$
b) $\mathrm{Be}^{2+}$
c) $\mathrm{Be}^{3+}$
d) Be

2. The non-metallic cation is in
a) $\mathrm{PCl}_{3}$
b) $\mathrm{NH}_{4} \mathrm{Cl}$
c) VOCl
d) $\mathrm{CrO}_{2} \mathrm{Cl}_{2}$
3. Among $\mathrm{Li}_{2}, \mathrm{Be}_{2}, \mathrm{~B}_{2}$ and $\mathrm{C}_{2}$ molecules, which is paramagnetic?
a) $\mathrm{Li}_{2}$
b) $\mathrm{Be}_{2}$
c) $B_{2}$
d) $\mathrm{C}_{2}$
4. The shape of $I_{3}^{-}$has
a) trigonal bipyramidal
b) tetrahedral
c) linear
d) trigonal planar
5. The bond angle of $\mathrm{SF}_{4}$ molecule is/are
a) $186^{\circ}, 116^{\circ}$
b) $109^{\circ} 28^{\prime}$
c) $90^{\circ}$
d) $180^{\circ}, 90^{\circ}$
6. Which of the following is the weakest base as per Bronsted concept?
a) $[\mathrm{ClO}]^{-}$
b) $\left[\mathrm{ClO}_{2}\right]^{-}$
c) $\left[\mathrm{ClO}_{3}\right]^{-}$
d) $\left[\mathrm{ClO}_{4}\right]^{-}$
7. The reactivity of 2-picoline with $\mathrm{B}\left(\mathrm{CH}_{3}\right)_{3}$ can be explained on the basis of
a) B-strain
b) F-strain
c) E effect
d) I effect
8. The solubility of carbonates decreases down the magnesium group due to a decrease in
a) Inter ionic attraction
b) lattice energies of solids
c) hydration energies of cations
d) entropy of solution formation
9. The chemical formula of red liquor is
a) $\mathrm{Al}(\mathrm{OH})_{3}$
b) $\left(\mathrm{CH}_{3} \mathrm{COO}\right)_{3} \mathrm{~A} 1$
c) $\mathrm{Al}_{2}\left(\mathrm{SO}_{4}\right)_{3}$
d) $\mathrm{Al}_{2}\left(\mathrm{CO}_{3}\right)_{3}$
10. Consider the reaction:

The green precipitate is also known as
a) Scheele's green
b) Pair's green
c) Rinmann's green
d) Verdigris green
11. Clathrates of argon, krypton and xenon in which water forms the cage are known as
a) solid hydrates
b) liquid hydrates
c) gas hydrates
d) coordinate hydrates
12. Which transition metal is present in carbonic anhydrase?
a) Mn
b) Co
c) Ni
d) Zn
13. Jahn-Teller effect affects the geometry of
a) $\left[\mathrm{Cu}\left(\mathrm{NH}_{3}\right)_{4}\right]^{2+}$
b) $\left[\mathrm{MnCl}_{4}\right]^{2-}$
c) $\left[\mathrm{Ni}\left(\mathrm{NH}_{3}\right)_{6}\right]^{2+}$
d) None of these
14. The oxy salt of which of the elements is highly stable?
a) Pm
b) Gd
c) Tm
d) Ho
15. Presence of empty orbitals on the metal centre in order to perform oxidative addition is generally required in
a) nucleophilic substrates
b) electrophilic substrates
c) intact substrates
d) All the above
16. Which of the following solvents has least eluting power?
a) cyclohexane
b) ethyl ether
c) $n$-propanol
d) ethyl acetate
17. Myoglobin is
a) monomer
b) dimer
c) trimer
d) tetramer
18. The number of microstates for d 3 configuration is
a) 45
b) 60
c) 120
d) 240
19. 'Fat man' relates to
a) uranium bomp
b) thorium bomp
c) plutonium bomp
d) literary word from a book
20. The half-life of ${ }^{99} \mathrm{Tc}$ is 6 h . Hence, the average life is
a) 3.0 h
b) 4.17 h
c) 8.0 h
d) 8.66 h
21. The IUPAC name of $\mathrm{C}\left(\mathrm{C}_{6} \mathrm{H}_{11}\right)_{4}$ is
a) tetraphenyl methane
b) 1,1,1,1-tetraphenyl methane
c) 1,1,1,1 -tetracyclohexyl methane
d) All
22. Stereoisomers which rotate the plane polarized light right to the viewer is called
a) laevorotatory
b) dextrorotatory
c) Both (a) and (b) are correct
d) None of these
23. Absence of an $S_{n}$ axis denotes
a) geometrical isomerism
b) optical activity
c) a trans isomer
d) a tetrahedral point group
24. Bucky babies is/are
a) $\mathrm{C}_{32}$
b) $\quad \mathrm{C}_{44}$
c) $\quad \mathrm{C}_{50}$ and $\mathrm{C}_{58}$
d) All of these
25. Which of the following is the strongest base?
a) aniline
b) pyrolle
c) isoquinoline
d) cyclohexyl amine
26. The reactive intermediate in a typical Simmons-Smith reaction is a
a) carbonium ion
b) carbanion
c) carbene
d) free radical
27. A nitrene can be trapped by
a) CO
b) $\mathrm{CO}_{2}$
c) $\mathrm{SO}_{2}$
d) $\mathrm{SO}_{3}$
28. The condensation of aldehydes or ketones with $\alpha$,-haloester takes place in the presence of a base gives $\alpha \beta$-epoxy esters. This reaction is known as
a) Darzen
b) Dieckmann
c) Claisen
d) Knoevenagel
29. The cyclopentanone in the presence of peroxytrifluoro acetic acid into
a) Alcohol
b) Acid
c) Lactone
d) All of these
30. In which of the following reaction amide is reduced to amine which has one carbon less than the starting material?
a) Lossen rearrangement
b) Beckmann rearrangement
c) Dieckmann rearrangement
d) Hoffmann rearrangement
31. Jones reagent is
a) $\mathrm{CrO}_{3}, \mathrm{H}_{2} \mathrm{SO}_{4}$ and $\mathrm{CH}_{3} \mathrm{COCH}_{3}$
b) $\quad \mathrm{CrO}_{3}$, pyridine
c) Both
d) None
32. The number of $\sigma$ and $\pi$ bonds in phosgene is/are
a) 3 and 2
b) 2 and 3
c) 3 and 1
d) 1 and 3
33. Cyclohexyl benzyl ether is converted to cyclohexanol using
a) $5 \%$ aq.KOFI
b) hydrazine hydrate
c) $\mathrm{H}_{2}$-PdIC
d) tetrabutylammonium fluoride
34. Which of the following compounds act as protecting group for alcohols?
a) Ethers
b) Acetals
c) Ketals
d) All of these
35. Enantiomorphs can be separated by
a) Fractional crystallization
b) fractional distillation
c) use of enzymes
d) chromatography over alumina
36. Ene reaction is a
a) $2 m$ electron electrocyclic
b) $4 \pi$ electron electrocyclic
c) $6 \pi$ electron electrocyclic
d) None
37. Which diene and dienophile is employed to synthesize norbornadiene?
a) cyclopentadiene and acetylene
b) cyclopentadiene and ethylene
c) 1,3-butadiene and acetylene
d) None
38. The quantum yield of the following reaction: $2 \mathrm{HBr} \rightarrow \mathrm{H}_{2}+\mathrm{Br}_{2}$
a) 1.0
b) 1.5
c) 2.0
d) 0.01
39. Fischer's indole synthesis involves
a) [2.3] sigmatropic shift
b) $[3,3]$ sigmatropic shift
c) $[3,2]$ sigmatropic shift
d) [2,2] sigmatropic shift
40. Difference in isoelectric points can be used to separate the mixture of amino acids by
a) electrodialysis
b) electrophoresis
c) potentiometry
d) polarography
41. The total number of isotopomers of ethylene diradical are
a) 4
b) 6
c) 8
d) 10
42. What is the degeneracy of H -atom in state $\mathrm{n}=3$ ?
a) 3
b) 6
c) 9
d) 12
43. The radii of second orbit of the hydrogen atom is $\left(a 0.53 A^{\circ}\right)$
a) $2.12 \mathrm{~A}^{\circ}$
B) $0.53 \mathrm{~A}^{\circ}$
c) $\quad 4.77 \mathrm{~A}^{\circ}$
d) $8.48 \mathrm{~A}^{\circ}$
44. Paschen series lies in
a) UV region
b) IR region
c) Visible region
d) Microwave region
45. The delocalization energy of benzene is
a) $2 \beta$
b) $4 \beta$
c) $6 \beta$
d) 0
46. $\mathrm{CO}_{2}$ belongs to the following point group
a) $\mathrm{C}_{2 \mathrm{v}}$
b) $D_{2 h}$
c) $D_{\infty v}$
d) $D_{\infty h}$
47. The normal modes of vibrations of $\mathrm{N}_{2} \mathrm{O}$ is
a) 4
b) 3
c) 1
d) 7
48. Frequency of absorption for transition from $2 \rightarrow 3$ energy level will be
a) $6 B$
b) $5 B$
c) 4 B
d) $3 B$
49. The ratio of two specific heats of a diatomic molecule is
a) 1.33
b) 1.40
c) 1.52
d) 1.66
50. At 0 K , fluids are assumed to have
a) minimum entropy
b) maximum entropy
c) zero entropy
d) fixed value of entropy
51. Which statistics will apply to deuterons and alpha particles?
a) B-E
b) F-D
c) $\quad \mathrm{M}-\mathrm{B}$
d) None
52. The mean activity coefficient of 0.001 molal of $\mathrm{NaSO}_{4}$ solution
a) 0.246
b) 0369
c) 0.571
d) 0.879
53. The signs of $\Delta H$ and $\Delta S$ for fuel cell will be
a) -ye, $\pm \mathrm{ve}$
b) +ve, -ye
c) Both -ye
d) both zero
54. A reaction was found to be second order with respect to the concentration of carbon monoxide. If the concentration of carbon dioxide is doubled with everything else kept the same, the rate of reaction will be
a) remain unchanged
b) triple
c) increase by a factor of 4
d) double
55. The property of lyophilization is
a) scattering of light
b) electrolyte
c) purification of colloids
d) washing of precipitate
56. The tetragonal crystal possesses the following axis of symmetry
a) two fold
b) threefold
c) four fold
d) six fold
57. Accuracy cannot be determined by the method
a) Minimal
b) Absolute
c) Comparative
d) None of these
58. Antifluorite structure is for
a) $\mathrm{ThO}_{2}$
b) $\mathrm{Na}_{2} \mathrm{O}$
c) Both
d) None
59. Piezoelectric crystals with zero dipole are said to have
a) ferroelectricity
b) antiferroelectricity
c) both
d) none
60. The anode and cathode of dry battery is/are
a) $\mathrm{Cu}, \mathrm{Zn}$
b) Zn , graphite
c) $\mathrm{Zn}, \mathrm{ZnO}$
d) graphite, Pt

## ANSWER SHEET - PART - A

| 1 | A | B | C | D | E | 21 | A | B | C | D | E |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | A | B | C | D | E | 22 | A | B | C | D | E |
| 3 | A | B | C | D | E | 23 | A | B | C | D | E |
| 4 | A | B | C | D | E | 24 | A | B | C | D | E |
| 5 | A | B | C | D | E | 25 | A | B | C | D | E |
| 6 | A | B | C | D | E | 26 | A | B | C | D | E |
| 7 | A | B | C | D | E | 27 | A | B | C | D | E |
| 8 | A | B | C | D | E | 28 | A | B | C | D | E |
| 9 | A | B | C | D | E | 29 | A | B | C | D | E |
| 10 | A | B | C | D | E | 30 | A | B | C | D | E |
| 11 | A | B | C | D | E | 31 | A | B | C | D | E |
| 12 | A | B | C | D | E | 32 | A | B | C | D | E |
| 13 | A | B | C | D | E | 33 | A | B | C | D | E |
| 14 | A | B | C | D | E | 34 | A | B | C | D | E |
| 15 | A | B | C | D | E | 35 | A | B | C | D | E |
| 16 | A | B | C | D | E | 36 | A | B | C | D | E |
| 17 | A | B | C | D | E | 37 | A | B | C | D | E |
| 18 | A | B | C | D | E | 38 | A | B | C | D | E |
| 19 | A | B | C | D | E | 39 | A | B | C | D | E |
| 20 | A | B | C | D | E | 40 | A | B | C | D | E |

## CHEMISTRY/ CHEMISTRY (RENEWABLE ENERGY)

PART - B
(Descriptive Type)

Answer any eight questions.
( $8 \times 5=40$ Marks)

1. What is hybridization? Explain the hybridization involved in SO3 and PCI5 molecules.
2. Sketch the structure of Dithionic acid and Peroxodisulphuric acid. Give number of $\sigma$ and $\pi$ bonds in it.
3. When do expect square planar geometry? Give suitable example in CFT.
4. Define EAN rule. Calculate EAN of $\left[\mathrm{Mn}(\mathrm{CN})_{6}\right]^{[--}$complex.
5. Discuss the chemistry of azulene.
6. Explain briefly about Birch reduction and given its mechanism.
7. Draw the structure of crown ethers and its applications.:
8. Explain the structure, synthesis and uses of citral.
9. Discuss the operators in quantum mechanics.
10. Give the sets of four quantum numbers for the valence electrons of rubidium and calculate orbital angular quantum number for rubidium with the help of suitable formula.
11. Compare the similarity and differences of $B-E, F-D$ and $M-B$ statistics.
12. Derive the Gibbs-Helmholtz equation from Gibbs free energy function $G=H-T S$.
