MCH20

DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH

M.Sc. Chemistry Admission Test 2020 – 2021

Time: 2 hours M.M. : 200

Question Booklet **SERIES – B**

Name of the Candidate : .....

Roll No. of the Candidate : .....

Examination Centre : .....

Room Number : .....

Date & Time of Examination : .....

Signature of the Candidate

Signature of Invigilator
Name of Invigilator ....

Instructions to Candidate:

1. This booklet contains two sections. **Section A** contains 70 objective type questions each of **2 marks** and **Section B** contains 10 short answer type questions each of **6 marks**.
2. Candidate should choose the most appropriate answer out of four options given with each question in **Section A** and mark it on OMR sheet using Blue/Black ball point pen.
3. **Negative Marking:** Incorrect answers shall result in a negative score of 25 percent of the marks allotted to the question.
4. Candidate should write the answer of each question in **Section B** using ball point pen in the answer sheet provided to them. Answer of each question should be on **separate page mentioning clearly Question Number.**
5. Any rough work if required can be done in the blank space available in the question booklet.
6. Symbols have their usual meaning
7. Candidate will have to return the **Hall Ticket, OMR Sheet** and **Answer Sheet** to the invigilator before leaving his/her seat. They can take carbon less copy of OMR sheets with them.

SECTION A

1. Ag^+ and Cu^+, respectively, are
   (a) Hard acid and Hard acid
   (b) Hard acid and Soft acid
   (c) Soft acid and Soft acid
   (d) Soft acid and Hard acid

2. Which of the following lanthanide ions will be eluted out first in ion exchange chromatography?
   Pr^{3+}, Sm^{3+}, Dy^{3+}, Yb^{3+}
   (a) Pr^{3+}
   (b) Sm^{3+}
   (c) Dy^{3+}
   (d) Yb^{3+}

3. Which of the following interhalogen compound is known as wiz's reagent used for the estimation of no. of double bonds in alkenes or unsaturated compounds?
   (a) ClF_3
   (b) ClF
   (c) ICl
   (d) BrF

4. The correct statement regarding Zeise's salt
   (a) The mode of bonding in this compound is ionic and covalent
   (b) The bonding between metal and Alkene is synergic
   (c) Alkene acts as bidentate ligand
   (d) Alkene acts as four electron donor.

5. For $[PNCl_2]_n$ the value of n ranges between
   (a) 2 to 7
   (b) 3 to 7
   (c) 1 to 7
   (d) 1 to 5

6. Which configuration for octahedral complex will have totally quenched orbital contribution
   (a) $t_{2g}^3 eg^1$
   (b) $t_{2g}^3 eg^0$
   (c) $t_{2g}^1 eg^0$
   (d) $t_{2g}^4 eg^2$

7. The ground state term symbol for V^{3+} ion is
   (a) $^3F_2$
   (b) $^3F_3$
   (c) $^2F_3$
   (d) $^3F_4$

8. Which complex will show maximum crystal field splitting.
   (a) $[Co(H_2O)_6]^{+2}$
   (b) $[CoCl_4]^{-2}$
   (c) $[Fe(H_2O)_6]^{+2}$
   (d) $[Rh(H_2O)_6]^{+3}$

9. True about Cytochrome C is
   (a) Non heme protein
   (b) Acts as electron carrier
   (c) Heme is ionically bonded
   (d) A kind of Iron sulphur protein

10. Which of the following ligands can form $d\pi$- $d\pi$ bonds with metal ions?
    (a) RO^-
    (b) RS^-
    (c) R_3P
    (d) R_2N

11. The correct shape of 'Be' atom in dimeric $(BeCl_2)_2$ is
    (a) Tetrahedral
    (b) Trigonal planar
    (c) Trigonal pyramidal
    (d) Square planar

12. The correct relationship between magnetic susceptibility (χ) and Temperature (T) for a diamagnetic substance is
    (a) χ increases with increases in T
    (b) χ decreases with increases in T
    (c) χ first increases then decreases with increase in T
    (d) χ is independent of T

13. The deficiency of Co causes deadly disease
    (a) wilson's disease
    (b) Pernacious anaemia
    (c) Osteoporosis
    (d) Gout

14. In a typical square planar $[Ni(CN)_4]^{2-}$ complex ion, the highest unoccupied orbital in dsp^2 hybridisation is
    (a) d_{xy}
    (b) d_{x^2}
    (c) $d_{x^2-y^2}$
    (d) d_{xz}

15. The bonding in trimeric phosphazene $P_3N_3Cl_6$ complexes involves
    (a) $p\pi - p\pi$
    (b) $d\pi - \pi^*$
    (c) $d\pi - p\pi$
    (d) $d\pi - \sigma^*$

16. Which of the following are example of Aprotic solvents.
    (a) Carbon tetrachloride
    (b) Ammonia
    (c) Acetic acid
    (d) Water

17. Which of the following lanthanide elements is used as a volumetric standard in redox titrations.
    (a) Pr^{3+}
    (b) La^{3+}
    (c) Ce^{4+}
    (d) Gd^{3+}

18. The spin only magnetic moment value for d^9 octahedral weak or strong field complexes will be
    (a) 1.73
    (b) 0.00
    (c) 5.92
    (d) 2.83

19. Which of the following has largest paramagnetism?
    (a) $[Cr(H_2O)_6]^{3+}$
    (b) $[Fe(H_2O)_6]^{2+}$
    (c) $[Cu(H_2O)_6]^{2+}$
    (d) $[Zn(H_2O)_6]^{2+}$

20. The C.F.S.E for strong field Octahedral d^7 system is
    (a) $-1.8\ \Delta_o$
    (b) $-0.8\ \Delta_o$
    (c) $-2.83\ \Delta_o$
    (d) $-0.00\ \Delta_o$

21. Which of the following statistical test is performed to reject any suspicious analytical data?
    (a) t test
    (b) Q test
    (c) F test
    (d) None of the above

22. Normality of 0.1% solution of NaOH is [Given: Gram Mol. Wt. of NaOH =40]
    (a) 0.025 N
    (b) 0.075 N
    (c) 0.150 N
    (d) 0.125 N

23. A given change in distribution ratio (D) causes greater change in percent extraction when D is near
    (a) 100
    (b) 10
    (c) 1
    (d) 0.1

24. Mohr titration is used for chloride with silver ion in which chromate is used as the indicator. The first color appearance at the end point of the titration is:-
    (a) Reddish-brown
    (b) Pink
    (c) White
    (d) Blue

25. Non-equilibrium mass transfer term in van Deemter equation can be minimized by
    (a) Decreasing both particle size and thickness of stationary phase
    (b) Decreasing D_S, diffusion coefficient of the stationary phase
    (c) Decreasing D_M, diffusion coefficient of the mobile phase
    (d) All of the above

26. F-test, in actual, determines the significant difference of _____ ___ between two methods.
    (a) Precision
    (b) Accuracy
    (c) Standard deviation
    (d) Coefficient of variation

27. Function of monochromator in the UV-spectrophotometer is to
    (a) Provide a stable and readily detectable output of radiant energy
    (b) Isolate a beam of radiation of desired wavelength from a continuous source of radiation
    (c) Convert radiant energy to usable signal
    (d) Display the transduced signal on a meter scale

28. Which of the following is not an example of determinate error
    (a) Methodic
    (b) Constant
    (c) Operative
    (d) Random

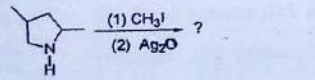
29 A simple complexing agent such as ammonia cannot be used for the complexometric titration of the Cu^{2+} because

(a) Stepwise formation constants are frequently close together and are not very large, and a single stoichiometric complex can not be observed.
(b) Overall formation constant of the complex is less than 10^8 which is required for a reaction to be completed at the equivalence point for a feasible titration.
(c) Both a and b
(d) Ammonia always form 1:1 complex with Cu^{2+}

30 What is generally done for the EDTA titration of calcium to avoid error

(a) Magnesium blank is added
(b) Back titration
(c) Buffered to pH of 10
(d) Both a and b can be done.

31 What is major product formed in the given reaction:



(a) 
(b) 
(c) 
(d) 

32 Bischler-Napieralski synthesis is used for the synthesis of

(a) Quinoline
(b) Indole
(c) Isoquinoline
(d) Pyridine

33 How many ^1H-NMR signals will be obtained for "1-propanol" ?

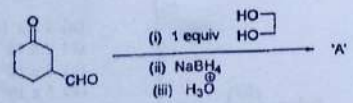
(a) 2
(b) 3
(c) 4
(d) 5

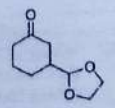
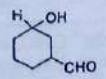
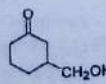
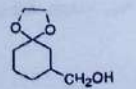
34 The given reaction

is known as

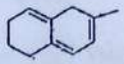
(a) Fries rearrangement
(b) Claisen rearrangement
(c) Kolbe-Schmidt reaction
(d) Leibermann reaction

35 In the given reaction product 'A' is:



(a) 
(b) 
(c) 
(d) 

36 Calculate λ_{max} for the following molecule.



(a) 279 nm
(b) 318 nm
(c) 274 nm
(d) 313 nm

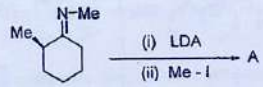
37 Which among the following nuclei would not show NMR spectrum

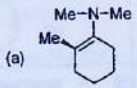
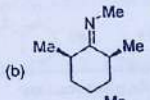
(a) ^1H
(b) ^{12}C
(c) ^{13}C
(d) ^{19}F

38 Which one of the following region in IR is known as functional group region?

(a) 1300 – 4000 cm^{-1}
(b) 900 – 1300 cm^{-1}
(c) 650 – 900 cm^{-1}
(d) None of these

39 What is 'A' (product) in the given reaction?



(a) 
(b) 
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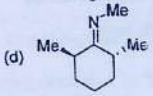
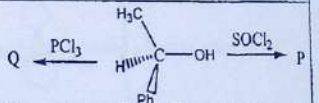
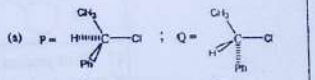
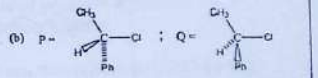
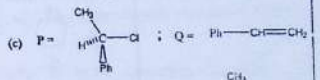
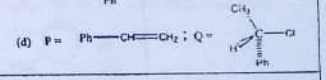
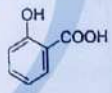
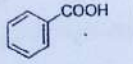
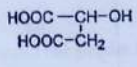
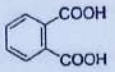
(d) 

40 

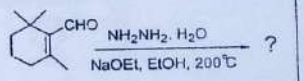
The major products 'P' and 'Q' in the above reaction:

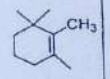
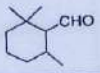
(a) 
(b) 
(c) 
(d) 

41 Which one of the following acid on heating decarboxylate to phenol ?

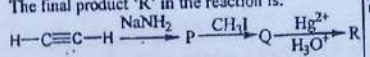
(a) 
(b) 
(c) 
(d) 

42 In the given reaction, the major product is:



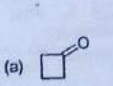
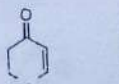
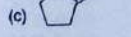
(a) 
(b) 
(c) 
(d) 

43 The final product 'R' in the reaction is:

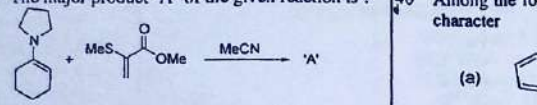


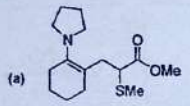
(a) CH_3CHO
(b) CH_3CH_2CHO
(c) CH_3CH_2COOH
(d) $CH_3\overset{O}{\overset{\|}{C}}-CH_3$

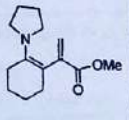
44 Which among the followings has maximum absorption frequency for carbonyl group in the IR spectrum

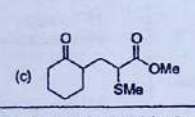
(a) 
(b) 
(c) 
(d) 

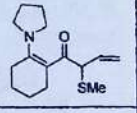
45 The major product 'A' of the given reaction is ?



(a) 

(b) 

(c) 

(d) 

46 Among the following which have aromatic character

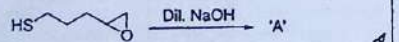
(a) 

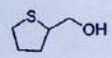
(b) 

(c) 

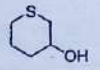
(d) 

47 Write product 'A' in the given reaction:



(a) 

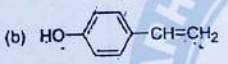
(b) 

(c) 

(d) 

48 A compound C_8H_8O gives a strong absorption band at 1680 cm^{-1}. Which one of the following structure will fit to above value?

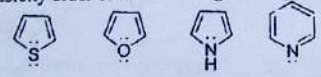
(a) $C_6H_5CH_2CH=O$

(b) 

(c) $C_6H_5OCH=CH_2$

(d) $C_6H_5COCH_3$

49 Basicity order of the following heterocycles are

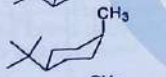


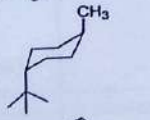
1 2 3 4

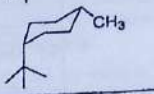
(a) 1 > 2 > 3 > 4
(b) 1 > 4 > 2 > 3
(c) 3 > 2 > 1 > 4
(d) 4 > 1 > 3 > 2

50 The most stable conformation is

(a) 

(b) 

(c) 

(d) 

51 A zinc rod is placed in 0.1 M $ZnSO_4$ solution at 298 K. What will be the potential of the electrode?

(Given $E^0_{Zn^{2+}/Zn} = -0.76\ V$)

(a) 0.79 V
(b) -0.79 V
(c) 0.73 V
(d) -0.73 V

52 According to principle of equipartition of energy, the energy of Acetylene will be –

(a) $\frac{19}{2}\ RT$ per mole

(b) $\frac{15}{2}\ RT$ per mole

(c) $\frac{13}{2}\ RT$ per mole

(d) $\frac{7}{2}\ RT$ per mole

53 The normalization constant of wave function of a particle in a one dimensional box is (where L represents length)

(a) $\frac{L}{2}$ (b) $\frac{2}{L}$

(c) $\sqrt{\frac{L}{2}}$ (d) $\sqrt{\frac{2}{L}}$

54 The parameter of ortho rhombic unit cell are a = 60 pm, b = 120 pm and c=180 pm. The spacing between (123) planes will be

(a) 100 pm
(b) 35 pm
(c) 70 pm
(d) 180 pm

55 Which of the following statement related to compression factor 'Z' is true for most gases.

(a) At high pressure, Z>1, repulsive forces are dominant
(b) At high pressure, Z<1, attractive forces are dominant
(c) At intermediate pressure, Z<1, repulsive forces dominate
(d) At intermediate pressure, Z>1, repulsive forces dominate

56 The expectation value <x> of the position operator for a wave function $\Psi(x)$ is

(a) The position of the particle
(b) The least likely place to find the particle
(c) The value where the Hamiltonian must be evaluated to get the energy
(d) The average value of the position you would get if you measured it multiple times.

57 Polarizability ellipsoid is difined as 3-d surface whose distance from the electrical centre of the molecule is propotional to

(a) $\frac{1}{a_i}$ (b) $\frac{1}{\sqrt{a_i}}$

(c) $\frac{1}{I_i}$ (d) $\frac{1}{\sqrt{I_i}}$

58 Addition of catalyst to a reaction, do(es) not change

(a) Activation energy
(b) Gibbs free energy
(c) Equilibrium constant
(d) Both b and c

59 For an ideal gas

(a) $\left(\frac{\delta H}{\delta P}\right)_T = -C_p \mu_{JT}$ (Where $\mu_{JT} \neq 0$)

(b) $\left(\frac{\delta H}{\delta P}\right)_T = -C_p$

(c) $\left(\frac{\delta H}{\delta P}\right)_T = 0$

(d) $\left(\frac{\delta H}{\delta P}\right)_T = -C_p \left(\frac{\delta T}{\delta P}\right)_H$ (where $\left(\frac{\delta T}{\delta P}\right)_H \neq 0$)

60 The stability constant of the complex $[Zn(NH_3)_4]^{2+}$ formed in the reaction will be $\left(E^0_{cell} = 0.3\ V\right)$

$Zn^{2+} + 4NH_3 \rightleftharpoons [Zn(NH_3)_4]^{2+}$

(a) 1.4×10^{10}
(b) 7×10^{9}
(c) 5×10^{5}
(d) 5×10^{15}

61 A solution of 0.001 mol dm^{-3} $CuSO_4$ is placed in an optical cell of path length 1cm, to record, the absorption spectrum. The absorption have characteristic λ_{max} and ε_{max} values. What are the correct unit of ε_{max} ?

(a) mol dm^{-3} cm^{-1}
(b) cm dm^3 mol^{-1}
(c) dm^3 mol^{-1} cm^{-1}
(d) cm mol dm^{-3}

62 Which of the following relations does not give the equation of an adiabatic process, (where terms have their usual meaning)

(a) $pT^{1-\gamma} = Constant$
(b) $p^{1-\gamma}T^{\gamma} = Constant$
(c) $PV^{\gamma} = Constant$
(d) $TV^{\gamma-1} = Constant$

63 The electrical energy of galvanic cell will be equal to enthalpy of cell reaction when temperature coefficient of E_{cell} $\left(\frac{\delta E}{\delta T}\right)_p$ will be

(a) Negative
(b) Positive
(c) Zero
(d) All of above

64 Which out of the following plots will be linear? (a-x) is the concentration of reactant remaining after time, t.

(a) (a-x) vs t for a zero order reaction
(b) (a-x) vs t for a 1st order reaction
(c) (a-x) vs t for a 2nd order reaction
(d) $\frac{1}{(a-x)}$ vs t for a 1st order reaction

65 The temperature of source and sink of a heat engine are 127 °C and 27 °C respectively. An inventor claims its efficiency to be 26%

(a) It is impossible
(b) It is possible with high probability
(c) It is possible with low probability
(d) Data are insufficient

66 The ratio of work done in reversible isothermal expansion (w_1) to reversible adiabatic expansion (w_2) is

(a) $\frac{w_1}{w_2} > 1$ (b) $\frac{w_1}{w_2} < 1$
(c) $\frac{w_1}{w_2} = 1$ (d) $\frac{w_1}{w_2} = 0$

67 Consider the reaction $3A \rightarrow$ Product $r = K[A]^0$ and initial conc.=$[A]_0$. What will be the concentration of the reactant after time 't' and half-life of A?

(a) $[A] = [A]_0 - Kt$ and $\frac{[A]_0}{2K}$
(b) $[A] = [A]_0 - 2Kt$ and $\frac{[A]_0}{K}$
(c) $[A] = [A]_0 - Kt$ and $\frac{[A]_0}{3K}$
(d) $[A] = [A]_0 - 3Kt$ and $\frac{[A]_0}{6K}$

68 The correct order of enthalpy of neutratization is

(a) $CH_3COOH > HCOOH > HCN > H_2S$
(b) $H_2S > HCN > HCOOH > CH_3COOH$
(c) $H_2S > HCN > CH_3COOH > HCOOH$
(d) $HCOOH > CH_3COOH > HCN > H_2S$

69 In a cyclic process

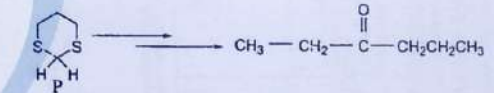
(a) Work done is zero
(b) Work done by the system is equal to the quantity of heat given to the system
(c) Work done does not depend on the quantity of heat given to the system
(d) The internal energy of the system increases

70 When one mole of a mono atomic ideal gas initially at a temperature of T 'K undergoes adiabatic expansion under a constant external pressure of 1 atm the volume changes from 1 liter to 2 liter. Which one of the following option would be a correct expression for the final temperature of the gas when R = 0.0821 atm liter K^{-1} mol^{-1}

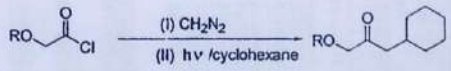
(a) $\frac{T}{2^{273}}$
(b) T
(c) $T - \frac{2}{3X0.0821}$
(d) $T + \frac{2}{3X0.0821}$

Section B

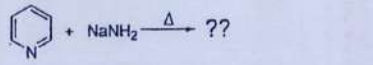
1. Components A & B have retention time(s) 16.40 and 17.63 minutes, respectively, on a 30 cm column length. An un-retained species passes through the column in 1.30 minute. The peak width at the base for A & B is 1.11 and 1.21 minutes, respectively. Calculate
   (a) Column resolution
   (b) Average number of plates in the column
   (c) Plate height
2. Discuss the correlation in the electronic spectra and Jahn-Teller effect in case of $[Ti(H_2O)_6]^{3+}$
3. Explain the temperature dependence of magnetic susceptibility values (χ) in ferro- and antiferromagnetic substances? How is curie-weiss law applicable to such systems.
4. Describe the mechanism of Na^+/K^+ ATPase ion pump.
5. Increase in volume of a gas from a given decrease of pressure is more in an Isothermal expansion than in an adiabatic expansion. Explain
6. Calculate liquid junction potential at 25 °C between two solutions of HCl having mean ionic activities of 0.05 and 0.005, respectively. The transference number of H^+ ion (t_+) in HCl may be taken as 0.83.
7. Write the physical significance of the term 'A' and $e^{-\frac{E_a}{RT}}$ in the Arrhenius equation $k = Ae^{-\frac{E_a}{RT}}$
8. Write the steps to prepare 'Q' from 'P'

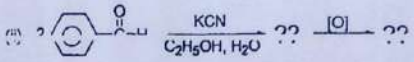


9. Outline steps involved in the given reaction:



10. Predict the product, name the reaction and given the plausible mechanism of the following

(i) 

(ii) 

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