JADAVPUR UNIVERSITY

M. Sc. Entrance Test – 2019

Subject: CHEMISTRY

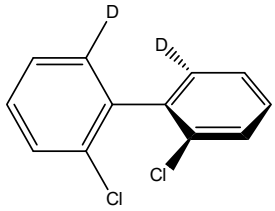
Time: Two hours **Full Marks: 100**

Answer all the questions

(Each wrong answer will deduct 0.5 marks)

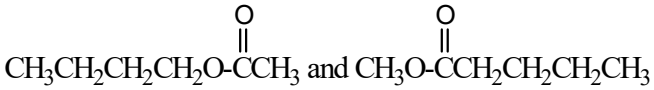
---

1. The number of C_2 axis present in the following molecule is



a) 1 b) 2 c) 3 d) 0 (zero)

2. The following compounds can be distinguished best by



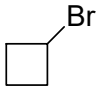
a) ^{1}H NMR spectroscopy

b) IR spectroscopy

c) Mass spectroscopy

d) Absorption spectroscopy

3. 1-Bromo-3-chlorocyclobutane, on treatment with two equivalents of Na in the presence of diethyl ether, produces

a) 

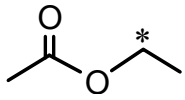
b) 

c) 
d) 

4. The species obtained through the elimination of both atoms/groups from the same carbon is

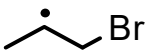
a) carbocation b) carbanion c) carbene d) ketene

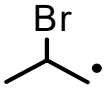
5. The multiplicity expected in the ^{1}H NMR spectrum for the hydrogen atoms marked by "*" in the following compound is

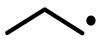


a) singlet b) doublet c) triplet d) quartet

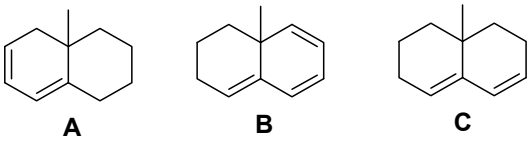
6. The reaction of propene with HBr in the presence of benzoyl peroxide proceeds through the intermediate

a)  b) 

c) 

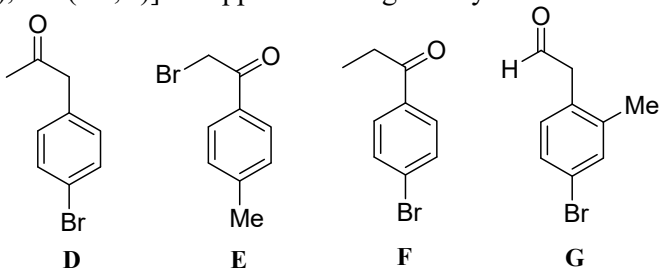
d) 

7. The order of λ_{max} in the UV-VIS spectra of the following compounds (A-C) is



a) A>B>C b) B>A>C c) B>C>A d) C>B>A

8. Out of the compounds (D-G), the ^{1}H-NMR signals [δ 7.8 (2H, d), 6.7 (2H, d), 4.5 (2H, s), 2.3 (3H, s)] is supposed to be given by



a) D b) E c) F d) G

9 . Benzaldehyde can be reduced to benzyl alcohol using

a) acetaldehyde and conc. aq. potassium hydroxide
b) hydrazine hydrate and conc. aq. potassium hydroxide
c) aqueous potassium cyanide
d) formaldehyde and conc. aq. potassium hydroxide

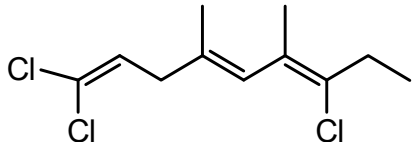
10. Total number of stereoisomers of 1,2-dimethylcyclobutane is

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

11. The structural feature of a hydrocarbon indicated by a strong absorption at 3297
cm^{-1} in the IR spectrum is

a) C≡C b) sp^3 C−H c) sp^2 C−H d) sp C−H

12. The correct configurational descriptor for the following compound is



a) 4*E*, 6*E* b) 4*Z*, 6*E* c) 4*E*, 6*Z* d) 4*Z*, 6*Z*

13. Mechanism of the formation of Grignard reagent is an example of a

a) chain radical reaction

b) non-chain radical reaction

c) salt elimination reaction

d) insertion reaction

14. If during the $LiAlH_4$ reduction of (*R*)-3-methyl-pentan-2-one hydride delivery takes place from the *reR*-face, the configuration of the product will be

a) 2 (*R*), 3 (*R*) b) 2 (*S*), 3 (*S*) c) 2 (*S*), 3 (*R*) d) 2 (*R*), 3 (*S*)

15. If *m*-bromoanisole reacts with $NaNH_2$ / liq. NH_3 the major product will be

a) *o*-methoxyaniline b) *m*-methoxyaniline

c) *p*-methoxyaniline d) *m*-phenylenediamine

16. The B-form of DNA and D-form of DNA differ in

a) helix handedness

b) base pair per turn

c) pitch per turn of the helix

d) all of the above-mentioned properties

17. The compound, which gives brisk effervescence on treatment with aqueous solution of sodium nitrite followed by dilute hydrochloric acid, is

a) aniline b) phenylhydrazine c) benzoic acid d) urea

18. $[Co(NH_3)_6]Cl_3$ shows distinct orange colour in aqueous solution. The complex is Oh symmetry and Co(III) is d^6 (low spin, t_{2g}^6). The reason for colour is

a) pσ (NH_3) →dπ* (Co(III)) transition

b) pπ(Cl) →dπ*(Co(III)) transition

c) dπ(Co(III))→dπ*(Co(III)) transition

d) dπ(Co(III))→excited state originated from the mixture of dπ*(Co(III))+Co-NH_3 bond pulsations.

19. IR inactive molecule is
a) CO_2
b) CS_2
c) OCS
d) N_2

20. Total number of stereoisomers of $[PtF_2Cl_2(NH_3)_2]$ is

a) 2
b) 3
c) 4
d) 6

21. Which of the following ones is the strongest Brønsted acid?

a) HPF_6
b) H^+
c) a mixture of SbF_5& HSO_3F
d) CH_5^+

22. Colour of red lead arises due to following transition

a) MLCT b) LMCT c) IVCT d) Ligand field

23. O_2 binding protein is

a) Haemoglobin

b) Myoglobin

c) Hemerythrin

d) All of these

24. How many M — M bonds are present in [Cp $Mo(CO_3)]_2$?

a)1
b)2
c)0
d) 4

25. Column chromatography is based on the principle of

(a) adsorption
(b) solubility
(c) thermal stability
(d) molecular size

26. Which of the following is a pseudohalide

(a) Cl^-

(b) N_3^-

(c) $HCOO^-$

(d) NO_3^-

27. Which species will be generated upon two sequential electron capture by $_{56}Ba^{131}$

a) $_{54}Xe^{131}$ (b) $_{54}Xe^{130}$ c) $_{56}Ce^{131}$ d) $_{56}Ce^{130}$

28. According to VSEPR theory what is the correct shape of $[TeF_5]^-$ ion

a) Trigonal bipyramidal
b) Pentagonal planar
c) Square pyramidal
d) See-saw

29. Which of the following complex shows orbital contributionto the magnetic moment

a) $[Cu(H_2O)_6]^{2+}$
b) $[Ni(H_2O)_6]^{2+}$
c) $[Cr(H_2O)_6]^{2+}$
d) $[Co(H_2O)_6]^{2+}$

30. In the following pairs of complexes, in which pair Jahn-Teller distortion is expected for both the complexes

a) $K_4Cr(CN)_6$ and $K_3Co(CN)_6$
b) $K_4Fe(CN)_6$ and $K_4Mn(CN)_6$
c) $K_4Cr(CN)_6$and $K_4Mn(CN)_6$
d) $K_4Mn(CN)_6$and$K_3Co(CN)_6$

31. Acid addition to aqueous solution of copper(II) sulfate and potassium iodide causes

a) Immediate iodine liberation

b) Copper Sulfate is reduced to cuprous sulfide

c) Solution colour turned to blue

d) No reaction takes place.

32. Identify the correct order of O-O-O bond angle

a) $O_3 > O_3^+ > O_3^-$

b) $O_3^- > O_3 > O_3^+$

c) $O_3^+ > O_3 > O_3^-$

d) $O_3 > O_3^- > O_3^+$

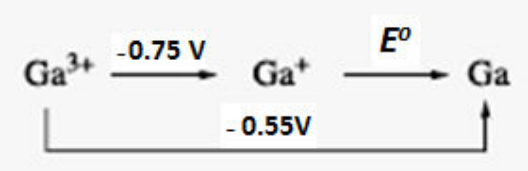
33. Choose the incorrect statement:

a) Emission of alpha particles from the nucleus is explained by quantum mechanical tunneling effect
b) Moessbauer spectroscopy is not an application of gamma rays.
c) Liberation of antineutrino is an integral part of the emission of beta particles
d) All radioactive processes are accompanied by emission of gamma rays.

34. The number of isomers possible for $[CrCl_2(H_2O)_4]^+$ and $[CoCl_2(en)_2]^+$ are respectively:

a) Two and Two b) Three and three c) Two and Three d) Three and two

35. The potential diagram for gallium (at pH = 0) is given below. E^0 (Ga^+/Ga) is



a) 0.15 V b) -0.20 V c) 0.20 V d) -0.15 V

36. For hydrogen-like atom with a nuclear charge *Z*, the energy of orbital with principal quantum number '*n*' follows the relation

a) $E_n \propto n^2Z^2$

b) $E_n \propto -Z^2/n$

c) $E_n \propto -Z/n$

d) $E_n \propto -Z^2/n^2$

37. For an isothermal free expansion of an ideal gas into vacuum, which one of the following set of values is correct?

a) $\Delta U = 0,\ q>0,\ w<0$
b) $\Delta U > 0,\ q>0,\ w=0$
c) $\Delta U = 0,\ q=0,\ w=0$
d) $\Delta U < 0,\ q=0,\ w<0$

38. For a Zero order reaction, the half life depends on the initial concentration (C_0) of the reactant as

a) $[C_0]$
b) $[C_0]^0$
c) $[C_0]^{-1}$
d) $[C_0]^{0.5}$

39. Mechanism of action of an inhibitor in a chemical reaction is as follows:

(a) it increases the activation energy of reaction

(b) it decreases the activation energy of reaction

(c) it changes the order of reaction

(d) it makes some sort of complex with the reactant and restricts it from the reaction

40. For radius ratio calculations the determination of lattice does not assume

a) Ions must be univalent.
b) Ions are considered as hard spheres
c) All ions touch each other
d) Ions tend to arrange themselves in a manner that they increase their coordination number

41. The ratio of osmotic pressure of 10^{-6} M NaCl (aq) solution to 10^{-6} M glucose (aq) solution is 1.98. What is the percentage of ionization of NaCl in its 10^{-6} M aq solution at experimental temperature?

a) 0.02
b) 0.98
c) 98.0
d) 2.00

42. Evidence for the de Broglie hypothesis is

a) Stern-Gerlach experiment on application of inhomogenous magnetic field
b) Moseley's law on emission of X-rays.
c) Davisson – Germer's experiment on diffraction of an electron beam.
d) Heisenberg's gamma-ray microscope experiment.

43. The heat of neutralization of HCN (aq) is -3000 cal at 25°C by a strong alkali. The heat of dissociation reaction, HCN (aq) $\Leftrightarrow$ $H^+(aq) + CN^-(aq)$ is very near to

a) 10.9 kcal b) 12.7 kcal c) 10.7 kcal d) 11.5 kcal

44. The ionic strength (M) of a solution made by mixing 30 ml 0.008 M Na_2SO_4, 40 ml 0.005 M KCl and 30 ml 0.05 M H_2O (assume salts are completely dissociated) is near to

a) 0.0083 b) 0.0075 c) 0.0088 d) 0.0092

45. The density of silver which crystallizes in a f.c.c. lattice with edge length of 4.086 Å is nearly

a) 12.6 g/cc b) 10.5 g/cc c) 15.1 g/cc d) 11.2 g/cc

46. On raising the temperature from 27^0C to 37^0C, the rate of reaction is doubled. The activation energy (kJ) of the reaction is nearly

a) 30 b) 50 c) 80 d) 100

(Given ln2 = 0.693)

47. The standard potentials of Cu^{2+}/Cu and Cu^+/Cu electrodes are 0.34V and).52V respectively. The standard potential(V) for reduction of Cu^{2+} to Cu^+ is nearly

a) -0.18 b) 0.70 c) 0.16 d) 0.18

48. If the door of a refrigerator is kept open, then which of the following is true?

a) Room is cooled
b) Room is either cooled or heated
c) Room is neither cooled nor heated
d) Room is heated.

49. For a process, ΔG will be equal to ΔA

a) when system is closed.
b) for isothermal change.
c) for perfect gas.
d) for fixed amount of perfect gas under isothermal condition.

50. At constant pressure, for partially miscible liquids (phenol and water) at critical point

a) number of phases is one (P = 1) & number of degrees of freedom is one (F = 2).
b) number of phases is two (P = 2) & number of degrees of freedom is one (F = 1).
c) number of phases is two (P = 2) & number of degrees of freedom is zero (F = 0).
d) number of phases is two (P = 1) & number of degrees of freedom is zero (F = 1).