TDC (CBCS) Odd Semester Exam., 2020
held in March, 2021

CHEMISTRY

(1st Semester)

Course No. : CHMDSC/CHMGE-101T

(Atomic Structure Bonding, General Organic Chemistry and Hydrocarbons)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer any *fifteen* questions : 1×15=15

1. Which quantum number determines the size of an orbital?

2. How many orbitals are possible in a sub-shell for which $l = 2$?

3. What is meant by degenerate orbitals?

4. Why are Bohr orbits also called stationary states?

5. How many unpaired electrons are present in N?

6. Which orbital has the following quantum number?

$$n = 3,\ l = 1,\ m_l = 0$$

7. What is the type of bond formed between potassium and chlorine?

8. How is bond order related to bond length?

9. Which has shorter bond length—H_2 or $H_2^{\oplus}$?

10. Identify the hybridization state of carbon in *(i)* $CHCl_3$ and *(ii)* CO_2.

11. Give the variation of covalent character of the following molecules in the increasing order :

$$LiCl;\ BeCl_2;\ BCl_3$$

12. Which of the following hybridizations leads to an octahedral shape?

(i) sp^3 *(ii)* sp^2d

(iii) sp^3d *(iv)* sp^3d^2

13. Which of the carbon atoms numbered will have maximum $\delta+$ charge in the given compound?

$$\overset{3}{C}H_3-\overset{2}{C}H_2-\overset{1}{C}H_2-Cl$$

14. Identify the molecule/ion in which the inductive, resonance and hyperconjugative effects are operative.

(i) $(CH_3)_3C^{\oplus}$

(ii) $(CH_3)_3C-\overset{\oplus}{C}H_2$

(iii) $CH_2=CH-CH=O$

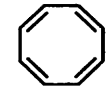
(iv) $CH_3-CH=CH-CH=O$

15. What are the products of *(a)* homolysis and *(b)* heterolysis of a bond in a compound?

16. Give one example each of a neutral electrophile and a neutral nucleophile.

17. What is resonance energy?

18. Examine whether the following compound is aromatic or not :



19. Sodium salt of which acid is needed to prepare *n*-propane?

20. Which alkane cannot be obtained by Kolbe's electrolytic method?

21. If the ozonolysis of an alkene gives only acetone as product, identify the alkene.

22. What is Lindlar's catalyst?

23. Why are alkanes called paraffins?

24. On reaction with water in presence of $HgSO_4$/dil. H_2SO_4, an organic compound gives acetone. Identify the compound and give its structure.

25. Fill in the blank :

The carbon atoms of benzene are ____ hybridized.

26. What is the approximate C—C bond order in benzene?

27. Give an example of Friedel-Crafts acylation reaction of benzene.

28. Why does benzene show substitution reaction?

29. What happens when benzene reacts with chlorine in presence of $FeCl_3$? Write the reaction also.

30. What product is formed when sodium benzoate is heated with soda lime? Give the equation also.

SECTION—B

Answer any *five* questions : 2×5=10

31. Explain why completely filled orbitals are more stable than partially filled orbitals.

32. Write the expression for time-independent Schrödinger wave equation and give the meaning of various terms in it.

33. Which of AlF_3 and $AlCl_3$ is more ionic? Justify your choice.

34. Explain the relation between solubility and lattice energy of a compound.

35. What are electrophiles and nucleophiles? Give two examples of each.

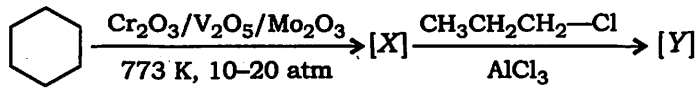
36. Explain resonance energy and its significance.

37. Why is hydrogen of ethyne acidic?

38. Explain how alkane can be prepared by catalytic hydrogenation.

39. Although benzene is highly unsaturated, it does not undergo addition reactions. Give reasons for this observation.

40. Identify (*X*) and (*Y*) in the following reaction sequence :



SECTION—C

Answer *any* **five** questions

41. What is radial distribution function? Explain the concept of most probable distance with reference to 2*s*-orbital. 2+3=5

42. State and explain Heisenberg's uncertainty principle. Explain how Bohr's model of H-atom violates this principle. 2+3=5

43. Discuss Born-Haber cycle to determine the lattice energy of an ionic solid. 5

44. Write the MO electronic configuration of O_2^+, O_2^-, O_2^{2-} ions and arrange them in the decreasing order of their *(a)* bond length and *(b)* stability. 3+2=5

45. Justify the following : 2+2+1=5

(a) Ethanoic acid has less K_a value than chloroethanoic acid.

(b) Aromatic amines are weaker bases than alkyl amines.

(c) Draw the resonance structure for $CH_2=CH-OCH_3$, showing the electron shift using curved arrow notations.

46. What is hyperconjugation? Why is it called no-bond resonance? How is it useful in explaining the shortening in bond length of carbon-carbon single bond adjacent to carbon-carbon double bond? 2+1+2=5

47. *(a)* What happens when (write equation only and name of the product)—

(i) 2-bromobutane is heated with an alcoholic solution of KOH;

(ii) HBr adds to 2-methylpropene? 1½+1½=3

(b) On reaction with an alkene why does the pink colour of Baeyer's reagent get discharged? 2

48. (a) Why does HI not show anti-Markownikoff's addition? 1

(b) How will you chemically distinguish between but-1-yne and but-2-yne? 2

(c) What happens when but-2-yne is treated with ozone and the product is decomposed with zinc and water? 2

49. (a) Convert benzene into bromobenzene and propose a reasonable mechanism for the reaction. 3

(b) Convert ethyl benzene into benzoic acid. 1

(c) What happens when steam is passed over benzene sulphonic acid? 1

50. (a) Write the mechanism of nitration of benzene. 3

(b) What happens when—

(i) phenol is heated with zinc dust;

(ii) benzene is heated with chloro-sulphonic acid? 1+1=2

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