STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600086
DEPARTMENT OF CHEMISTRY
SUBJECT CODE: 19CH/MC/GC14
B.Sc. DEGREE EXAMINATION, NOVEMBER 2021
BRANCH IV- CHEMISTRY
FIRST SEMESTER

COURSE: MAJOR CORE
PAPER: GENERAL CHEMISTRY
TIME: 3 HOURS **MAX. MARKS: 100**

SECTION A

ANSWER ALL THE QUESTIONS **(15 x 2 = 30 marks)**

Choose the correct answer.

1. Based on molecular orbital theory, the magnetic characteristics of N_2 and N_2^+ are
   a) N_2 is paramagnetic and N_2^+ is diamagnetic
   b) N_2 is diamagnetic and N_2^+ is paramagnetic
   c) Both are paramagnetic
   d) Both are diamagnetic

2. The hybridization in SF_6 molecule is
   a) sp^3 b) sp^3d c) sp^3d^2 d) sp^3d^3

3. Which of the following is non-linear according to VSEPR theory?
   a) CO_3^{2-} b) $[N_3]^-$ c) ICl_3 d) I_3^-

4. A radioactive detector that uses the property of luminescence is called the _____.
   a) Geiger-Muller counter
   b) Ionisation chamber
   c) Scintillation counter
   d) Neutron detector

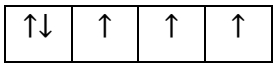
5. Among the following nuclides, the highest binding energy per nucleon is found for
   a) ${}_1^3H$ b) ${}_8^{16}O$ c) ${}_{92}^{235}U$ d) ${}_{26}^{56}Fe$

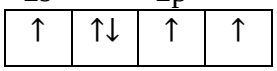
6. Which of the following nuclear reactions is an example of nuclear fusion?
   a) ${}_1^2H + {}_1^3H \rightarrow {}_2^4He + {}_0^1n$
   b) ${}_6^{12}C + {}_1^1H \rightarrow {}_7^{14}N + \gamma$
   c) ${}_7^{14}N + {}_0^1n \rightarrow {}_6^{12}C + {}_1^1H$
   d) ${}_{92}^{235}U + {}_0^1n \rightarrow {}_{56}^{142}Ba + {}_{36}^{91}Kr + 3{}_0^1n$

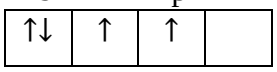
7. The de Broglie hypothesis is associated with
   a) Wave nature of electrons only
   b) Wave nature of protons only
   c) Wave nature of radiation
   d) Wave nature of all microscopic particles

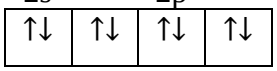
8. Which of the following combination of atomic orbitals is not possible for forming molecular orbitals? (Consider z-axis as molecular axis)
   a) $2p_y$ and $2p_y$ b) 2s and 2s c) 2s and $2p_x$ d) 2s and $2p_z$

9. The orbital diagram in which the Aufbau principle is violated is

a) 

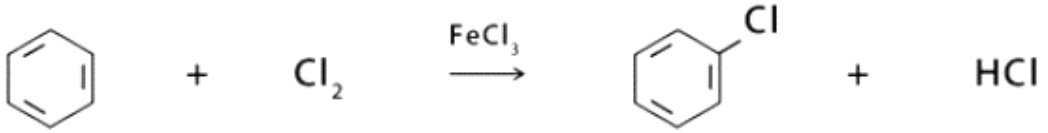
b) 

c) 

d) 

10. Ionic bonds are formed between
    a) Metal and metal
    b) Metal and non-metal
    c) Non-metal and non-metal
    d) All of the above

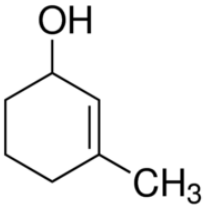
11. The following reaction is an example of _____ reaction.



a) Addition b) Elimination c) Substitution d) Rearrangement

12. The lattice energy is inversely proportional to the sum of the radii of the
    a) Cations only b) anions only c) electrons d) cations and anions

13. The IUPAC name of the following compound is



    a) 2-methyl-3-cyclohexenol
    b) 3-methyl-2-cyclohexene-1-ol
    c) 3-hydroxy-1-methylcyclohexene
    d) 1-hydoxy-3-methylcyclohex-2-ene

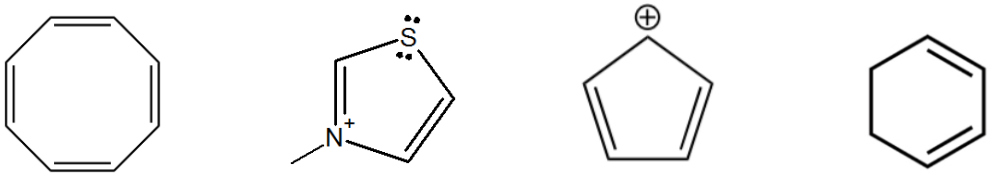
14. Which statement regarding aromaticity of molecules is false?
    a) Must be cyclic
    b) Must be planar
    c) Must be conjugated
    d) Must have either 4n or 4n + 2 pi electrons

15. The order of stability of carbocations is
    a) Benzyl > 3^o > 2^o > 1^o
    b) 3^o > Benzyl >2^o > 1^o
    c) 3^o > 2^o > 1^o > Benzyl
    d) Benzyl > 3^o > 1^o > 2^o

SECTION B

ANSWER ANY FIVE QUESTIONS (5 x 8 = 40 marks)

16. a) Discuss the postulates of Bohr's theory. (6 marks)
    b) Using de Broglie's equation, calculate the wavelength of an electron moving at a velocity of 5.31 x 10^6 m/sec. (2 marks)
17. a) Using molecular orbital theory, explain the paramagnetic nature of the oxygen molecule. (5 marks)
    b) Explain hyperconjugation with an example. (3 marks)
18. a) What is the radioactive series? What are the four types of radioactive series? (6 marks)
    b) Differentiate between a pure covalent bond and a covalent coordinate bond? (2 marks)
19. Define the following – isotopes, isobars, isotones and nuclear isomers.
20. a) Discuss the factors affective lattice energy. (4 marks)
    b) Using VSEPR theory, predict the geometry of ammonia. (4 marks)
21. Determine if the following compounds are aromatic, non-aromatic or anti-aromatic.



22. Discuss the structure and stability of carbocations and carbanions.

SECTION C

ANSWER ANY TWO QUESTIONS (2 x 15 = 30 marks)

23. a) Discuss the postulates of quantum mechanics. (9 marks)
    b) The work function of copper is 7.4501 x 10^{-19} Joules when ultraviolet light of wavelength 220 nm falls on its surface. Calculate the kinetic energy and velocity of the emitted photoelectron. (Planck's constant: 6.626 x 10^{-34} J.s, velocity of light: 2.9979 x 10^8 m and mass of electron: 9.11 x 10^{-31} kg). (6 marks)

24. a) Explain the different modes of decay of radioactive elements. (9 marks)
    b) Discuss the hybridization in BF_3 molecule and predict its geometry. (6 marks)

25. a) Explain the Born-Haber cycle for sodium chloride and give its applications. (8 marks)
    b) What is inductive effect? Discuss bond length of molecules and the strength of acids and bases using inductive effect. (7 marks)

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