

**Government of Maharashtra's
Ismail Yusuf College of Arts, Science and Commerce, Mumbai
400060**

NAAC reaccredited A grade

Department of Chemistry

Sample Multiple Choice Questions

1. How many signals does the aldehyde $(\text{CH}_3)_3\text{CCH}_2\text{CHO}$ have in ^1H NMR and ^{13}C NMR spectra?
 - a) five ^1H signals and six ^{13}C signals
 - b) three ^1H signals and four ^{13}C signals
 - c) five ^1H signals and four ^{13}C signals
 - d) three ^1H signals and six ^{13}C signals

2. Which is the correct order of increasing wave number of the stretching vibrations of (1) C-H (alkane), (2) O-H (alcohol), (3) C=O (ketone), and (4) C \equiv C (alkyne)?
 - a) (4) < (3) < (2) < (1)
 - b) (3) < (4) < (2) < (1)
 - c) (3) < (4) < (1) < (2)
 - d) (4) < (3) < (1) < (2)

3. Which of the following statements is wrong?
 - a) UV absorption is attributable to electronic transitions.
 - b) UV spectra provide information about valence electrons.
 - c) IR absorption is attributable to transitions between rotational energy levels of whole molecules.
 - d) NMR spectrometers use radiofrequency electromagnetic radiation

4. Which hydrogen of 1-chloropent-2-ene shows the largest chemical (downfield) shift in its NMR spectrum?
 - a) the H on C1
 - b) the H on either C2 or C3
 - c) the H on C4
 - d) the H on C5

5. Which carbon of (a)-(d) of hex-3-en-2-one shows the largest (most downfield) chemical shift in the NMR spectrum?
 - a) C1
 - b) C2
 - c) C4

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- d) C6
6. Which of the following statements regarding IR spectroscopy is wrong?
- a) Infrared radiation is higher in energy than UV radiation.
 - b) Infrared spectra record the transmission of IR radiation.
 - c) Molecular vibrations are due to periodic motions of atoms in molecules, and include bond stretching, torsional changes, and bond angle changes.
 - d) Infrared spectra give information about bonding features and functional groups in molecules.
7. Which of the following statements regarding NMR spectroscopy is wrong?
- a) NMR signals towards the left of the spectral chart correspond to larger chemical shifts.
 - b) Chemical shifts are larger when the frequencies of the radiation which induces the nuclear transitions are higher.
 - c) Chemical shifts are larger when shielding effects are greater.
 - d) A hydrogen signal splits into $n+1$ peaks by spin-spin coupling when the number of equivalent hydrogen atoms on adjacent atom(s) is n , and no other neighbouring atoms are involved.
8. Which of the following statements regarding mass spectrometry is wrong?
- a) In a normal mass spectrometer, electron impact causes a molecule to lose an electron and become a molecular radical cation which decomposes into fragment cations and radicals.
 - b) Only cations can be detected by a normal mass spectrometer.
 - c) A compound whose molecules contain just one bromine atom shows two molecular ion peaks of similar intensity, one at $+1$ and one at -1 of the average m/z value.
 - d) Molecular ion peaks always have even-numbered values of m/z
9. Which is a useful method for detecting which group are close in space to each other
- a) HETCOR
 - b) NOE
 - c) NOESY
 - d) COSY
10. In the case of NMR spectrum of 13 c the NOE possible is ?

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- a) 1.78
 - b) 2.15
 - c) 1.98
 - d) 3.21
11. In two dimensional NMR there are how many coordinates axis. These axis represents ranges of chemical shifts.
- a) 2
 - b) 1
 - c) 3
 - d) 4
12. Which spectrum of m-dinitrobenzene is presented as a counter plot -
- a) NOE
 - b) COSY
 - c) HETCOR
 - d) NOESY
13. Important peaks in the which spectrum are of diagonal peaks
- a) COSY
 - b) NOE
 - c) HETCOR
 - d) None of the above
14. The spectra that shows spin spin splitting or coupling between the ^{13}C -H directly attached to it are called?
- a) Proton coupled
 - b) Proton decoupled
 - c) EPR
 - d) None of the above
15. In the decoupling technique only _____ observed in the case of heteronuclear
- a) quater
 - b) triplet
 - c) double

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d) Singlet

16. Which technique is used to determine the multiplicity of each carbon atom and also verify the order of carbon atoms

a) NMR

b) ESR

c) DPT

d) MRI

17. What is the ^{13}C resonance frequency on a 600 MHz NMR spectrometer?

a) 600 MHz

b) 92 MHz

c) 60 MHz

d) 150 MHz

18. The pulse angle is dependent on

a. transmitter power (pulse power)

b. pulse length

c. receiver gain

d. both (a) and (b)

19. If number of time domain points equals 4k and dwell time equals 100 μsec , then acquisition time equals

a. $100 \mu\text{sec} \times 4000$

b. $100 \mu\text{sec} \times 4096$

c. $100 \mu\text{sec} \times 4000 \times 2$

d. $100 \mu\text{sec} \times 4096 \times 2$

20. The signal-to-noise ratio (S/N) of an NMR spectrum can be increased by the accumulation of acquisitions. Compared to one recorded with 2 scans, a spectrum with 32 scans has an S/N ratio

a. 16 times higher

b. 4 times higher

c. 8 times higher

d. 32 times higher

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21. The wider frequency range covered by an RF pulse (pulse bandwidth) is achieved by the pulse with
- lower power and longer pulse length
 - Higher power and longer pulse length
 - higher power and shorter pulse length
 - none of the above
22. Integration of ^1H signal intensities (or peak area) gives information about
- the absolute number of protons corresponding to the resonance frequencies
 - the ratio of the number of protons corresponding to the resonance frequencies
 - the types of protons corresponding to the resonance frequencies
 - intensities of protons relative to the solvent peak
23. ^{13}C spectra without decoupling show multiplicity of ^{13}C peaks due to the coupling of ^1H to ^{13}C . In a 1D ^1H spectrum of an unlabeled sample (natural abundance ^{13}C), the coupling of ^{13}C to ^1H is neglected because
- the NMR spectrometer decouples ^{13}C from ^1H automatically
 - a large portion of protons are bound to ^{12}C , which is NMR inactive
 - the J_{CH} coupling constant is small compared to the line widths of ^1H peaks
 - both (b) and (c)
24. Improper shimming
- can be eliminated by spinning the sample
 - can broaden the line shape of the NMR signal
 - can shorten T_1 relaxation
 - does not have any effect on NMR spectra
25. ESR is remarkably sensitive when compared with NMR.
- True
 - False

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26. Reflex klystron is used in which of the following frequency ranges?
- 1000 to 2000 MHz
 - 1000 to 10000 MHz
 - 1000 to 15000 MHz
 - 1000 to 20000 MHz
27. Under ideal conditions, a commercial X-band spectrometer can detect of the order of which of the following number of spins at room temperature?
- 101
 - 105
 - 1010
 - 1012
28. A silyl radical bearing an Si-H· fragment has a g value of 2.0033 and a pair of lines separated by 15.5 MHz. Express the splitting in units of mT, Gauss and cm^{-1} .
- $15.5 \text{ MHz} = 11.104 \text{ mT} = 27.201 \text{ Gauss} = 0.862 \times 10^{-4} \text{ cm}^{-1}$
 - $15.5 \text{ MHz} = 7.352 \text{ mT} = 10.104 \text{ Gauss} = 18.39 \times 10^{-4} \text{ cm}^{-1}$
 - $15.5 \text{ MHz} = 1.55 \text{ mT} = 0.562 \text{ Gauss} = 31.0 \times 10^{-4} \text{ cm}^{-1}$
 - $15.5 \text{ MHz} = 0.553 \text{ mT} = 5.530 \text{ Gauss} = 5.17 \times 10^{-4} \text{ cm}^{-1}$
29. A Cu(II) metal ion ($g_{iso} = 2.12$) produces four lines with a separation of 500 MHz between each line. Express the hyperfine splitting in field units of mT and the hyperfine coupling in units of wavenumbers.
- $500 \text{ MHz} = 0.185 \text{ mT} = 0.29842 \text{ cm}^{-1}$
 - $500 \text{ MHz} = 16.850 \text{ mT} = 0.01667 \text{ cm}^{-1}$
 - $500 \text{ MHz} = 32.953 \text{ mT} = 0.76298 \text{ cm}^{-1}$
 - $500 \text{ MHz} = 45.672 \text{ mT} = 2.86329 \text{ cm}^{-1}$
30. The magnetic moment (μ_I) of an unknown nuclide is $2.884 \times 10^{-27} \text{ J T}^{-1}$. Given the nuclear spin is known to be 1, identify the unknown nuclide.
- ^{14}N
 - ^2H
 - ^{19}F
 - ^6Li