Week 1 Assignment 1

Due on 2020-09-30, 23:59 IST

1. If $^12$C is an NMR nucleus, which of the following statements is correct?
   - It has odd number of protons and odd number of neutrons
   - It has even number of protons and even number of neutrons
   - It has even number of protons and odd number of neutrons
   - It has even number of protons and even number of neutrons (Correct)
   - It has even number of electrons
   - No, the answer is incorrect
     Score: 6
     Accepted Answers:
     - It has even number of protons and even number of neutrons

2. The $\gamma$ transition is spin $\frac{3}{2}$. Its magnetic quantum numbers are
   - $m = -\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}, \frac{3}{2}$
   - $m = -1, 0, 1$
   - $m = 0, 1, 2$
   - $m = 1, 0, -1$
   - No, the answer is incorrect
   - No, the answer is incorrect
     Score: 5
     Accepted Answers:
     - $m = -\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}, \frac{3}{2}$

3. For spin $\frac{1}{2}$ nuclei, the direction of orientations of Spin Angular momentum with respect to magnetic field are
   - $+\frac{1}{2}$, $-\frac{1}{2}$
   - $+\frac{3}{2}$, $-\frac{3}{2}$
   - $+\frac{1}{2}$, $-\frac{1}{2}$, $+\frac{3}{2}$, $-\frac{3}{2}$
   - $+\frac{1}{2}$, $-\frac{1}{2}$, $+\frac{3}{2}$, $-\frac{3}{2}$ (Correct)
   - No, the answer is incorrect
   - No, the answer is incorrect
     Score: 5
     Accepted Answers:
     - $+\frac{1}{2}$, $-\frac{1}{2}$, $+\frac{3}{2}$, $-\frac{3}{2}$

4. The value of gyromagnetic ratio
   - Increases linearly with the magnetic field
   - Is constant for a given nucleus
   - Depends on the number of atomic mass
   - All of the above (Correct)
   - No, the answer is incorrect
     Score: 5
     Accepted Answers:
     - All of the above

5. The spin quantum number and the magnetic quantum numbers of $^1$H and $^1$C are identical. If $m = -\frac{1}{2}$ and $m = -\frac{3}{2}$ and $m = -\frac{1}{2}$, what makes them different as far as NMR spectroscopy is concerned?
   - They have different number of electrons
   - Their gyromagnetic ratios are same
   - They have different gyromagnetic ratios
   - Because of all of the above reasons (Correct)
   - No, the answer is incorrect
     Score: 5
     Accepted Answers:
     - Because of all of the above reasons

6. $^1$H has spin $\frac{1}{2}$. The removal of degeneracy in the magnetic field leads to how many number of energy states?
   - Four
   - Seven
   - Six
   - None of the above (Correct)
   - No, the answer is incorrect
     Score: 5
     Accepted Answers:
     - None of the above

7. When magnetic moment (µ) interacts with the magnetic field (B), their interaction energy is given by [Note, both of them are vectors]
   - $\mu \times B$
   - $\mu \cdot B$
   - $\mu \cdot B_0$ (Correct)
   - $\mu \times B_0$
   - No, the answer is incorrect
     Score: 5
     Accepted Answers:
     - $\mu \cdot B_0$

8. The resonance frequency of the nuclear spin
   - Is independent of the External magnetic field strength
   - Has linear dependence with the external magnetic field strength
   - Does not change with the magnetic field
   - Depends on $B_0^2$ (Correct)
   - No, the answer is incorrect
     Score: 5
     Accepted Answers:
     - $B_0^2$

9. According to Boltzmann equation of population ratio of different energy states, relative to other spectroscopic techniques
   - NMR spectroscopy is the highly sensitive technique
   - NMR is the most sensitive technique
   - Population ratio has no relevance to sensitivity
   - The population ratio and the sensitivity are inverse of each other (Correct)
   - No, the answer is incorrect
     Score: 5
     Accepted Answers:
     - The population ratio and the sensitivity are inverse of each other

10. The Larmor precession frequency of $^{13}$C in a magnetic field of 9.4 T is 100 MHz. If the magnetic field is increased to 10.0 T, what is the new precession frequency?
    - 95 MHz
    - 100 MHz
    - 105 MHz
    - 120 MHz (Correct)
    - No, the answer is incorrect
      Score: 5
      Accepted Answers:
      - 120 MHz