

## NMR SPECTROSCOPY – CONCEPT TEST

### QUESTION 1

Which of the following statements is incorrect?

- A The  $^{12}\text{C}$  nucleus will undergo a measurable change in spin energy levels when exposed to radiation from the radio wave region of the electromagnetic spectrum.
- B There is insufficient energy in the radio wave radiation to cause bending and stretching in covalent bonds.
- C Energies corresponding to the visible spectrum are able to cause excitation of valence electrons in atoms and molecules.
- D Different functional groups in organic molecules absorb radiation of different frequencies from the infra-red region of the electromagnetic spectrum.

### QUESTION 2

When an external magnetic field is applied in NMR spectroscopy

- A all protons align themselves in the opposite direction to the field.
- B all protons align in the same direction as the field.
- C some protons align with the field and some align against it.
- D all protons assume a random orientation.

### QUESTION 3

Which of the following statements is FALSE about NMR spectroscopy?

- A The energy required to flip the spin of a proton is in the infrared region of the electromagnetic spectrum.
- B The energy difference between the two spin states depends on the strength of the magnetic field.
- C When energy absorption occurs, the nuclei are said to be in resonance with the electromagnetic radiation.
- D When a proton is aligned with the magnetic field, its energy is lower than when it is aligned against the magnetic field.

**QUESTION 4**

Which of the following statements about the energy of an applied magnetic field is FALSE?

- A This energy can “flip” a proton from alignment with the field to alignment opposite the field.
- B Nuclei are “in resonance” when they absorb this energy.
- C This energy is proportional to the magnetic field strength.
- D This energy is supplied by radiation in the visible region of the spectrum.

**QUESTION 5**

Which of the following compounds has the MOST deshielded protons?

- A  $\text{CH}_3\text{Cl}$
- B  $\text{CH}_3\text{I}$
- C  $\text{CH}_3\text{Br}$
- D  $\text{CH}_4$

## SOLUTIONS

**QUESTION 1** Answer is A

Overall spin will only be observed in nuclei that have an odd number of nucleons such as  $^{13}\text{C}$ .  $^{12}\text{C}$  has an even number of nucleons hence no overall spin.

**QUESTION 2** Answer is C

**QUESTION 3** Answer is A

**QUESTION 4** Answer is D

**QUESTION 5** Answer is A