

**Molecular magnetic materials. Questionnaire**

Choose one answer to each of the following questions from the three possibilities offered in each of them.

1. Which of these materials is a prominent single-molecule magnet

- A. MnO
- B. Fe<sub>2</sub>O<sub>3</sub>
- C. Mn<sub>12</sub> acetate

Answer:

2. The rate of tunnelling in a Landau-Zener process for a spin with a tunnel splitting  $\Delta$  subject to a magnetic bias field swept at a rate  $w$

- A. Increases with  $\Delta$  and  $w$
- B. Increases with decreasing  $w$  and increasing  $\Delta$
- C. Only depends on  $\Delta$

Answer:

3. In the case of an anisotropic spin, the Curie law corresponds to the linear response to

- A. A weak magnetic field along the anisotropy axis
- B. A weak magnetic field perpendicular to the anisotropy axis
- C. Both A. and B. are correct.

Answer:

4. The superparamagnetic blocking temperature determines the minimum temperature for which a spin system relaxing via thermally activated processes remains in equilibrium. It depends on the magnetic anisotropy constant and on the experimental time as follows:

- A. It depends exponentially on both
- B. It is proportional to the anisotropy constant and decreases logarithmically with increasing experimental time.
- C. It depends logarithmically on both

Answer:

5. The tunnelling probability of a spin with orthorhombic magnetic anisotropy can show quantum interference for a magnetic field applied

- A. Along the hard magnetic axis
- B. Along the medium magnetic axis
- C. Along the easy magnetic axis

Answer:

6. T quantum phase transition in the Ising quantum spin model takes place

- A. With decreasing magnetic entropy
- B. With increasing magnetic entropy
- C. At constant magnetic entropy.

Answer:

7. A 4f magnetic orbital with a prolate electronic structure, thus with L and S being parallel to its rotational axis, decreases its energy for

- A. A coordination leading to an axial distribution of electronic charges
- B. A coordination leading to an equatorial distribution of electronic charges
- C. Both

Answer:

8. The power of quantum computation arises from the fact that

- A. Each qubit can store more than two states
- B. Each qubit can process two information states “in parallel” exploiting the superposition principle of Quantum Mechanics
- C. Both

9. The following are sufficient requisites for universal operation of a quantum computer

- A. Arbitrary quantum operations on each individual qubit and conditional two-qubit operations on any two of them
- B. Arbitrary quantum operations on each individual qubit plus Hadamard gates leading to quantum superpositions of individual qubits
- C. Arbitrary quantum operations on each individual qubit plus the ability to swap the states of any two qubits.

Answer:

10. The maximum magnetic entropy change, which determines the performance of a magnetic cooler, is achieved for:

- A. Four uncoupled  $S = \frac{1}{2}$  spins
- B. Two uncoupled  $S = \frac{7}{2}$  spins
- C. Four  $S = \frac{7}{2}$  strongly coupled to a total  $S = 14$

Answer: