

6. Direction of easy-axis in a single domain particle is decided by its _____ & _____ anisotropy (1)

7. When nanomagnetic particles are considered at higher temperatures, $k_B T$ becomes \gg _____ energy, given by _____. This phenomena is known as _____. (1^{1/2})

8. The most striking feature observed in 2D magnetic semiconductors is the _____ near band-edge. (1/2)

9. When compared, the thinner magnetic sample will have _____ domains (less / more). The reason for this is _____. (1)

10. In multilayers of Fe/Cr, Fe layers were $\sim 30 \text{ \AA}$ and Cr layer thickness were varied between 9 \AA to 60 \AA . The R / R_H was found to be _____ (largest / smallest) for Cr 9 \AA . In this configuration, the strength of AF coupling would be _____ (maximum / minimum) (1)

11. What are the requirements placed on magnetism by Maxwell's equations? What is the physical meaning conveyed by them? (2)

12. The magnetic tunnel junction resistivity devices are preferred over GMR devices because of the following 3 reasons (3)

13. Plot qualitatively the M Vs H plots for the following:

(5)

(i) paramagnet

(ii) ferromagnet

(iii) diamagnet

(iv) ferromagnet coated with a thin antiferromagnetic layer

(v) nanomagnetic film of Ni with domains oriented along easy-axis and field applied parallel to easy axis

(vi) case above (v) with field applied perpendicular to easy-axis direction

(5)

(ii) Using Hund's rules, the value of S is _____

(iii) 63591275332763327591328272313172113253177232333599 L is _____

(iv) "J is

(v) If spin-only moment is to be considered, the Fe^{2+} has maximum moment _____ μ_B .

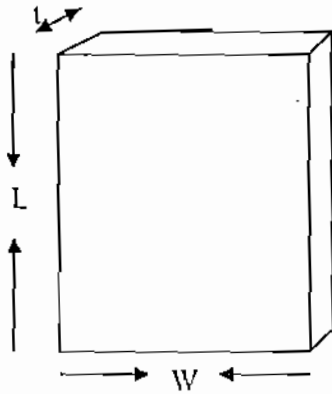
(vii) If an unit cell volume of Fe_2O_3 is $(3.34 \times 10^{-10})^3 \text{ m}^3$, saturation magnetization of Fe_2O_3 will be

A/m.

15. The direct band-gaps of (Ga,Mn)As and (Al,Ga)As are 1.5 eV and 2.2 eV respectively. Multilayers of above compositions are prepared using MBE technique. The growth is in z direction. (a) Draw the equivalent confining potential diagram with appropriate parameters marked. (b) Assuming that this can be considered as infinite confining potential, write the expression for allowed energy states. (c) Estimate the maximum width for the (Ga,Mn)As quantum well if it is desired that the first two confined states are separated by 40 meV; the effective mass in first and second confined levels are $0.35 m_e$ and $0.082 m_e$ respectively. (5)

16. (a) Name the different types of energy densities that are relevant in magnetic materials. How do they contribute towards the domain formation in magnetic materials? (2)

(b) A magnetic sample has length, width and thickness given as L , W , t , as shown in figure. If domain wall energy density is σ_{DW} , show that the total domain wall-energy / unit volume, $f_W = \sigma_{DW} / d$, where d is the domain size. (4)



(c) If free energy of this magnetic system is given as (f_W + magnetostatic energy f_{MS}) and f_{MS} is given as $(1.7 d t \mu_0 M_S^2) / L^2$, show that for minimum energy configuration, the domain size d is given as $d_0 = L(\sigma_{DW} / t \mu_0 M_S^2)^{1/2}$. (2)

(17) What are the factors responsible for noise in GMR / TMR devices?

(2)

$$I_{\mu B} = 9.27 \times 10^{-24} \text{ A}\cdot\text{m}^2, \hbar^2/m_e = 7.62 \text{ eV}\cdot\text{\AA}^2, m_e = 9.1 \times 10^{-31} \text{ Kg}, \text{ Atomic number for Fe} = 26$$

A·m²

34 .

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