GATE - XE - 2009 - 49 - 60

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1) Correlate the material properties given in Column I with the units given in Column II. (GATE XE 2009)

Column I	**Column II**
P. Magnetic moment	1. MN $m^{3/2}$
Q. Thermal conductivity	2. H m^{-1}
R. Fracture toughness	3. A m^2
S. Electron mobility	4. m^2 V^{-1} s^{-1}
	5. J s^{-1} m^{-1} K^{-1}

a) P-2, Q-5, R-1, S-4
b) P-4, Q-5, R-1, S-3
c) P-3, Q-5, R-1, S-4
d) P-3, Q-2, R-4, S-1

2) If the spacing between two consecutive (110) planes in a BCC material is 0.203 nm, the lattice parameter and radius of the atom of the said material will be (GATE XE 2009)

a) 0.242 nm and 0.110 nm
b) 0.242 nm and 0.120 nm
c) 0.287 nm and 0.134 nm
d) 0.287 nm and 0.124 nm

3) A continuous and aligned carbon fibre reinforced composite is made up of 30 vol% carbon fibre having a modulus of elasticity of 300 GPa dispersed in a polymer matrix which on hardening has a modulus of elasticity of 4 GPa. What will be the modulus of elasticity of the composite in longitudinal and transverse directions of the carbon fibres respectively? (GATE XE 2009)

a) 92.8 GPa and 5.7 GPa
b) 211.0 GPa and 9.3 GPa
c) 304.0 GPa and 7.5 GPa
d) 92.8 GPa and 6.7 GPa

4) A potential of 10 volts is applied across a parallel plate capacitor which has a plate area of 10^{-4} m^2 and a plate separation of 2×10^{-3} m. If dielectric constant of the material placed between parallel plates is 10, the capacitance and the magnitude of the charge stored between the plates will be (GATE XE 2009)

a) 4.425×10^{-13}F and 4.425×10^{-12}C
b) 8.850×10^{-13} F and 8.850×10^{-12} C
c) 4.425×10^{-12} F and 4.425×10^{-11} C
d) 8.850×10^{-12} F and 8.850×10^{-11} C

5) Conductivity of Silicon at 300 K is 3.16×10^{-4} ohm^{-1} m^{-1} and that of Germanium is 2.12×10^{-2} ohm^{-1} m^{-1} at 300 K. At what temperature would the conductivity of intrinsic Silicon be the same as the conductivity of intrinsic Germanium at 300 K? (Given: E_g of Silicon at 300 K = 1.12 eV, E_g of Germanium at 300 K = 0.72 eV) (GATE XE 2009)

a) ~ 506 K b) ~ 606 K c) ~ 726 K d) ~ 816 K

6) Molecular weight distribution of a polystyrene polymer and the number fraction of polymer chains in the molecular weight range are given below.

Range of Molecular weight (kg/mol)	Number fraction of polymer chain
5 - 10	0.05
10 - 15	0.15
15 - 20	0.20
20 - 25	0.30
25 - 30	0.20
30 - 35	0.08
35 - 40	0.02

The number average molecular weight and the number average degree of polymerization will be (GATE XE 2009)

a) 15.750 kg/mol and 151
b) 21.350 kg/mol and 203
c) 15.750 kg/mol and 302
d) 21.350 kg/mol and 205

Common Data Questions

Common Data for Questions 19 and 20:
Nickel has FCC structure and its lattice parameter is 0.353 nm. Weight of one mole of Nickel is 0.05871 kg.

7) The Ni-Ni nearest neighbour distance (in nm) is (GATE XE 2009)

a) 0.173 b) 0.223 c) 0.250 d) 0.273

8) Theoretical density of Nickel (in kg m^{-3}) is closer to (GATE XE 2009)

a) 8700 b) 8900 c) 9100 d) 9300

Common Data for Questions 21 and 22:
The diffusivity of lithium in Silicon is 10^{-9} m^2 s^{-1} at 1400 K and 10^{-10} m^2 s^{-1} at 1000 K.

9) The value of activation energy (J mol^{-1}) of lithium diffusion in silicon is (GATE XE 2009)

a) 66086 b) 66986 c) 67086 d) 67986

10) The value of jump frequency factor of lithium in silicon in $m^2\ s^{-1}$ is (GATE XE 2009)

a) 2.15×10^{-7} b) 3.15×10^{7} c) 3.15×10^{-8} d) 2.15×10^{-8}

Linked Answer Questions

Statement for Linked Answer Questions 23 and 24:
Aluminum has a density of 2710 kg m^{-3} and weight of one mole of aluminum is 0.02698 kg. The collision time, τ, for electron scattering in Aluminum is 2×10^{-14} s at 300 K.

11) The number of free electrons per m^3 of Aluminum at 300 K is (GATE XE 2009)

a) 6.05×10^{28} b) 7.05×10^{28} c) 6.05×10^{27} d) 7.05×10^{27}

12) The conductivity of aluminum ($ohm^{-1}\ m^{-1}$) at 300 K is (GATE XE 2009)

a) 3.40×10^{6} b) 4.40×10^{6} c) 3.40×10^{7} d) 4.40×10^{7}