GATE-2021-XE-53-65

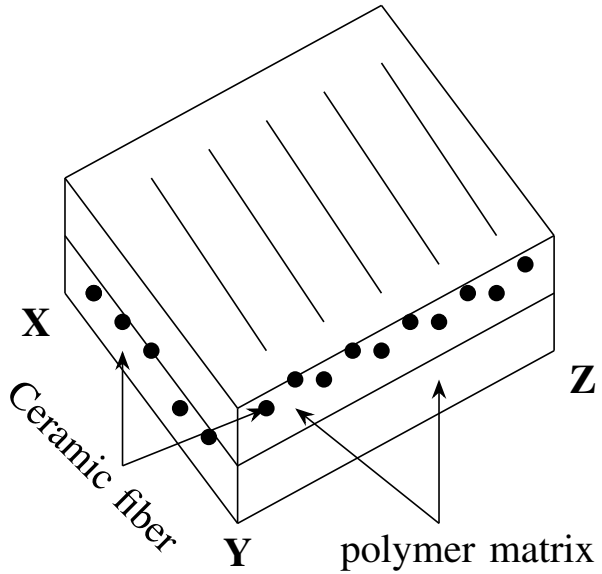
EE24BTECH11047 - Niketh Prakash Achanta

53) Match the heat treatment processes given in Column I with the most suitable outcomes in Column II.

Column I	Column II
(P) Quenching	(1) Hardens the steel
(Q) Annealing	(2) Softens the cold worked steel
(R) Tempering	(3) Softens the steel
(S) Carburizing	(4) Increases the surface hardness of steel

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

54) A co-joined cross-ply laminate composite, as shown in the figure, is distorted upon heating. What are the resultant shapes of layers XY and YZ?



a) X — Y, Y ◡ Z
b) X ◡ Y, Y — Z
c) X ◡ Y, Y ◠ Z

d) X $\frown$ Y, Y $\smile$ Z

55) X-ray diffraction peak broadening enables the estimation of
   a) crystallite size of the material
   b) residual stresses in the material
   c) precise lattice parameter
   d) residual microstrains acting on the material

56) Fe - 10 atom % C austenite (fcc), having no Fe vacancies, has a lattice parameter of 4.2 Å. The density of austenite in g cm^{-3} is **(round off to 2 decimal places)**.
   (Given: atomic weight of Fe = 55.85; atomic weight of C = 12.0; Avogadro's number = 6.023×10^{23})

57) An element transforms from α to β at 773 K and 1 atm pressure with 912 J mol^{-1} as enthalpy of transformation. The molar volumes of α and β phases are 7 and 7.5 cm^3 mol^{-1}, respectively. Determine the difference in their internal energy at 773 K, independent of pressure. The amount of heat required for 10 g of transformation to occur at 723 K is **(round off to nearest integer)**.
   (Given: Atomic mass of α = 110.325 $\times 10^6$ Pa)

58) A binary A-B alloy has α and β phases at equilibrium. The ratio of weight fraction of A in α to β is 4. The wt.% of A in α and β phases is 70 and 20, respectively. The wt.% of B in the alloy is **(round off to nearest integer)**.

59) During heating, Ti undergoes allotropic transformation from bcc to hcp at 882 °C. The percent volume change accompanying this transformation is **(round off to 1 decimal place)**.
   (Given: atomic weight of Ti = 47.9; lattice parameter of bcc Ti = 0.332 nm; density of hcp Ti = 4.51 g cm^{-3}; Avogadro's number = 6.023×10^{23})

60) Vickers hardness test is performed with an indenter of square-base diamond pyramid having an included angle of 136° between the opposite faces of the pyramid. If the diagonal length is 0.5 mm and the average indentation depth is 0.015 mm, the Vickers hardness in kg mm^{-2} is **(round off to nearest integer)**.

61) The drift mobility of electron in an n-type Si crystal doped with 10^{16} cm^{-3} phosphorus atoms is 1350 cm^2 V^{-1} s^{-1}. The electrical conductivity in Ω m^{-1} is **(round off to 2 decimal places)**.

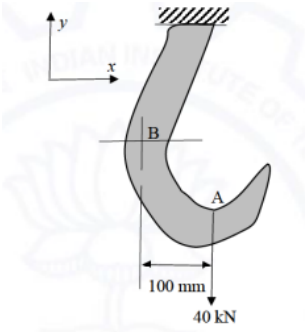
(Given: Intrinsic charge concentration of Si = 1.45×10^{10} cm^{-3}; Charge of an electron, e = 1.6×10^{-19} C)

62) At 1000 K, the linear thermal expansion coefficients of graphite, parallel and perpendicular to the graphite layers, are 0.8 $\times 10^{-6}$ K^{-1} and 29 $\times 10^{-6}$ K^{-1}, respectively. The percentage increase in the volume of graphite when the temperature rises from 100 K to 1100 K is **(round off to 2 decimal places)**.

63) A certain ceramic material has a theoretical density and sintered density of 6.76 g cm^{-3} and 6.69 g cm^{-3}, respectively. The green compact has 18 volume percent porosity. For a sintered cube of side 2 cm, the weight of the cubic green compact in cm is **(round off to 2 decimal places)**.

64) When a metal (M) is immersed in de-aerated acid electrolyte, it polarizes anodically by 0.4 V. The M/M^{2+} couple standard energy is 10^{-4} A cm^{-2} and A = 4 cm^2. Use a tafel slope of 0.12 V decade^{-1} in the anodic reaction. Both anodic and cathodic reactions are under activation control. The rate of metal dissolution in A m^{-2} is **(round off to 1 decimal place)**.

65) A force $F = 40$ kN is applied on the hook as shown. The equivalent force-couple system at B is



a) 40 kN in $+y$ direction and $M = 0$
b) 40 kN in $-y$ direction and $M = 0$
c) 40 kN in $+y$ direction and $M = 4000$ Nm counter clockwise
d) 40 kN in $+y$ direction and $M = 4000$ Nm clockwise