

Sardar Patel University

M.Sc. (Materials Science) Ist Semester Examination

Thursday, Date: 29/11/2012

Time: 10:30 am to 1:30 pm

Subject: PS01CMTS01 Basic Concepts in Materials Science

Total Marks: 70

Note: Figures on the right indicate marks for the question.

Q-1 Multiple Choice Questions.

[8]

- (1) The C_v value of most of solids at high temperature approaches a constant value of $25 \times 10^3 \text{ J kMol}^{-1} \text{ K}^{-1}$, which is known as _____ value.
 (a) Boltzmann constant (b) Dulong-Petit (c) Medugal-petit (d) None
- (2) Tensile strength of steel is closely related with _____ BHN Brinell hardness number.
 (a) 100 (b) 350 (c) 500 (d) None
- (3) _____ is the formula for three point bend strength?
 (a) $\sigma = E \epsilon$ (b) $\sigma = 3FL/2wh^2$ (c) $\sigma = F/A$ (d) $\sigma = 2FL/3wh^2$
- (4) Which of the following tests can help to know the brittle to ductile transition temperature (DBTT)?
 (a) Creep test (b) Fatigue Test (c) Impact test (d) Tensile Test
- (5) Which of the following is extensive property?
 (a) Magnetic Intensity (b) Density (c) Surface Tension (d) None
- (6) _____ step of the typical creep curve is creep rate determining step?
 (a) Second (b) First (c) Third (d) None of these
- (7) Thermal conductivity of metals is _____ than ceramics?
 (a) greater (b) equal (c) less (d) none of these
- (8) What is the relationship between thermal conductivity and electrical conductivity?
 (a) $k/\sigma T = L$ (b) $Q/A = k \cdot \Delta T/\Delta X$ (c) $\alpha = k/\rho c_p$ (d) None of these

Q-2 Answer any Seven of the following.

[14]

- (1) A thermal engineer develops an engine, working between 427°C and 37°C and claims to have an efficiency of 52%. Does he claim correctly?
- (2) Explain the heat of transformation or enthalpy and justify the statement, "the heat of sublimation at triple point is equal to the heat of vaporization and heat of fusion".
- (3) Explain the terms for thermodynamic system: i) Energy states ii) Energy levels iii) Macrostates iv) Microstates
- (4) Explain the basic thermodynamic processes by P-V curve.

- (5) Give the schematic illustration of four types of deformations occur in engineering materials.
- (6) Differentiate between engineering stress-strain and true stress-strain.
- (7) Define the terms: i) Tensile Toughness, ii) Stiffness iii) Ductility iv) Poisson's Ratio
- (8) Calculate the work done under external magnetic field and work due to surface tension.
- (9) Discuss various types of strain response to applied stress in different types of materials.

Q-3 [a] Explain the Carnot cycle for an ideal gas and cyclic heat engine. [6]

Q-3 [b] Derive the general form of the first law of thermodynamics for variable kinetic and potential energy of any given system. [6]

(OR)

Q-3 [b] A Carnot's engine whose low temperature reservoir is at 17°C has efficiency of 45%. It is desired to increase the efficiency to 75%. By how many degrees should temperature of the high temperature reservoir be increased? [6]

Q-4 [a] Derive the expression for Bose-Einstein distribution function in which particles are assumed to be indistinguishable. [6]

Q-4 [b] Derive an expression of Maxwell-Boltzmann distribution function in which the particles are assumed to be distinguishable. [6]

(OR)

Q-4 [b] Derive an expression for Fermi-Dirac distribution function in which the particles are indistinguishable and obey the Pauli's exclusion principle. [6]

Q-5 [a] Describe the types of Impact Testing with their sample preparation. [6]

Q-5 [b] What is hardness? Mention various hardness scales. Describe the indentors and loads for bulk hardness and microhardness measurement. [6]

(OR)

Q-5 [b] What is fatigue? How it can be measured? Which information can be obtained from fatigue testing? [6]

Q-6 [a] What is Coefficient of thermal expansion? Which precautions are to be taken when calculating the dimensional changes? [6]

Q-6 [b] What is thermal conductivity? Discuss the effect of temperature on the thermal conductivity of ceramics and metals. [6]

(OR)

Q-6 [b] The flexural strength of glass fiber-epoxy composite is 250MPa , the specimen is 150mm long, 8mm thick and width is 12mm . The specimen is supported between two points 100mm . Find out the force require to fracture the material. [6]
