

Q. 10 - Q. 22 carry two marks each

10) Match the properties in Column I with the appropriate units in Column II

<u>Column I</u>	<u>Column II</u>
P. Thermal diffusivity	1. $Hm^{-1}$
Q. Fracture toughness	2. $m^2s^{-1}$
R. Surface energy	3. $Fm^{-1}$
S. Magnetic permeability	4. $Nm^{-\frac{3}{2}}$
	5. $Jm^{-2}$

a) P-2,Q-5,R-4,S-1

c) P-3,Q-4,R-5,S-3

b) P-2,Q-4,R-5,S-1

d) P-5,Q-4,R-2,S-3

11) Match the characterization techniques in Column I with Column II

<u>Column I</u>	<u>Column II</u>
P. Scanning tunneling microscopy	1. No vacuum required
Q. Scanning electron microscopy	2. Backscattered electrons
R. Transmission electro microscopy	3. Photoelectrons
S. Atomic force microscopy	4. Atomically sharp tip
	5. Sub-Angstrom resolution

a) P-4, Q-2, R-5, S-1

c) P-2, Q-4, R-1, S-5

b) P-1, Q-3, R-4, S-5

d) P-5, Q-1, R-2, S-4

12) Match the materials in Column I with the applications in Column II

<u>Column I</u>	<u>Column II</u>
P. Titanium diboride	1. Photocatalyst
Q. Molybdenum disilicide	2. Furnace heating element
R. Hydroxyapatite	3. Ultra high temperature material
S. Nanocrystalline titanium oxide	4. Tough ceramic
	5. Artificial bone implant

a) P-3,Q-4,R-5,S-1

c) P-4,Q-3,R-1,S-5

b) P-5,Q-3,R-2,S-1

d) P-3,Q-2,R-5,S-1

13) Match the properties in column I with the options in Column II

<u>Column I</u>	<u>Column II</u>
P. Toughness	1. Resistance to plastic deformation
Q. Resilience	2. Time dependent permanent deformation under constant load
R. Creep	3. Total elongation at failure
S. Hardness	4. Area under Stress-strain graph
	5. Area under the elastic part of the stress-strain curve

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

14) Determine the mole fraction of vinyl chloride in a copolymer of vinyl chloride ( $CH_2CHCl$ ) and vinyl acetate ( $CH_2 - CH - OCOCH_3$ ) having molecular weight of  $10520g/mol$  and degree of polymerization of 160.

- a) 0.14                      b) 0.30                      c) 0.70                      d) 0.86

15) The electron concentration in an n-type semiconductor is  $5 \times 10^{18}/m^3$ . If the drift velocity of electrons is  $100m/s$  in an electric field of  $500V/m$ , calculate the conductivity of the semiconductor.

- a)  $0.16 \times 10^{-1} S/m$    b)  $1.6 \times 10^{-1} S/m$    c)  $2.50 \times 10^{-1} S/m$    d)  $30.05 \times 10^{-1} S/m$

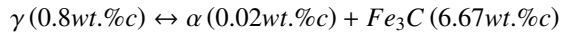
16) Calculate the saturation magnetization ( $M_{sat}$ ) for bcc iron of lattice parameter  $2.866\text{\AA}$ .

- a)  $0.76 \times 10^6 A/m$    b)  $1.5 \times 10^6 A/m$    c)  $3.15 \times 10^6 A/m$    d)  $4.73 \times 10^6 A/m$

### COMMON DATA QUESTIONS

Common data questions for 17 and 18 :

A plain  $0.45wt.\%$  carbon steel is cooled slowly from  $900^\circ C$  to just below the eutectoid temperature ( $723^\circ C$ ) so that the following reaction occurs:



17) During cooling from  $900^\circ C$  to  $700^\circ C$ , the proeutectoid  $\alpha$  forms from  $\gamma$ . Find the volume % of proeutectoid  $\alpha$  just below  $723^\circ C$  for the steel.

- a) 44.9%                      b) 66.1%                      c) 55.1%                      d) 34.9%

18) Find the volume % of pearlite for the steel just below  $723^\circ C$  for  $0.45\%$  carbon steel.

- a) 44.9%                      b) 55.1%                      c) 40.9%                      d) 59.1%

Common data questions for 19 and 20 :

A  $20kN$  tensile load is applied axially to a steel bar of cross-section area  $8cm^2$  and  $1m$  length. The Young's modulus of steel ( $E_{steel}$ ) is  $200GPa$ , and of aluminium ( $E_{Al}$ ) is  $70GPa$ . The Poisson's ratio ( $\nu$ ) can be taken as 0.3.

19) When the same load is applied to an aluminium bar, it is found to give same elastic strain as the steel. Calculate the cross-section area of the aluminium bar.

- a)  $11.43cm^2$                       b)  $14.93cm^2$                       c)  $18.26cm^2$                       d)  $22.86cm^2$

20) Calculate the final area of the steel bar after the deformation under the applied load of  $20kN$ .

- a)  $7.9\text{cm}^2$                       b)  $9.7\text{cm}^2$                       c)  $7.0\text{cm}^2$                       d)  $8.1\text{cm}^2$

Linked Answer Questions

Statement for Linked answer questions 21 and 22 :

Chromium has the bcc structure with atomic diameter of  $2.494\text{\AA}$

21) Calculate the lattice parameter of chromium assuming tight atomic bonding.

- a)  $1.442\text{\AA}$                       b)  $2.880\text{\AA}$                       c)  $4.323\text{\AA}$                       d)  $5.764\text{\AA}$

22) Find the first diffraction peak position ( $2\theta$ ) for Cu  $K\alpha$  radiation with a wavelength of  $1.54\text{\AA}$

- a)  $21.76^\circ$                       b)  $33.05^\circ$                       c)  $44.43^\circ$                       d)  $66.10^\circ$