

- (ix) In a Mohr's circle, the radius gives the value of _____.
- (a) minimum shear stress (b) maximum normal stress
(c) minimum normal stress (d) maximum shear stress
- (x) For engineering materials, the value of Poisson's ratio is _____
- (a) 0 (b) greater than 0 and less than 0.5
(c) 1 (d) 2.

Fill in the blanks with the correct word

- (xi) The theoretical value of bonding energy of a compound AB is _____ kJ/mol, when bonding energy for A₂ is 430 kJ/mol and for B₂ is 230 kJ/mol.
- (xii) The interstitial site size ratio in BCC for octahedral is _____.
- (xiii) For small angled grain boundaries the angle between two grains will be _____.
- (xiv) Slag is having _____ density compared to iron.
- (xv) The ratio of Young's modulus and Bulk modulus is given by _____.

Group - B

2. (a) Consider a gaseous molecule AB, where the first ionisation energy of A is 502 kJ/mol and electron affinity for B is 335 kJ/mol. Inter-ionic separation is $3A^\circ$. Comment on the stability of the molecule through analysis bond dissociation energy. [[CO1](Apply/IOCQ)]
- (b) "In cases with the graphite, sp² hybridization leads to π - π stacking and this eventually shows good electrical conductivity." – Comment on the correctness of the statement. [[CO1](Evaluate/HOCQ)]
- (c) Calculate the heat of formation of NaCl (s), when the sublimation energy of Na (s) is +107 kJ/mol, ionization energy of Na atom is +502 kJ/mol, dissociation energy of Cl₂ (g) is +242 kJ/mol, electron affinity of Cl atom is -355 kJ/mol and the lattice energy of the crystal NaCl(s) is -786 kJ/mol. [[CO1](Apply/IOCQ)]
4 + 4 + 4 = 12
3. (a) "Deviation in periodicity within crystal lattice is called the defect in crystal" – Justify the appropriateness of the statement citing with an example. [[CO1](Analyse/HOCQ)]
- (b) Mention the classifications of defect. [[CO1](Remember/LOCQ)]
- (c) For a lattice plane if the Miller indices is (326) and the x-axis intercept is $2.1 A^\circ$, compute the y and z-axis intercepts. Lattice parameters are given as $1.5A^\circ$, $2A^\circ$ and $2A^\circ$. [[CO1](Apply/IOCQ)]
3 + 5 + 4 = 12

Group - C

4. (a) What is meant by peritectic reactions for austenite? What is hypoeutectoid steel? [[CO3](Remember/LOCQ)]

- (b) In Fe-C phase diagram, liquid solution with austenite is with the carbon percentage of 2.14% (wt), while with the α -ferrite it is only 0.022% (wt). Elaborate the reason with proper reasons. [[CO3](Analyse/HOCQ)]
- (c) What is meant by lower and upper critical temperature in Fe-C phase diagram? [[CO3](Remember/LOCQ)]
- (2 + 2) + 5 + 3 = 12**
5. (a) What is T-T-T diagram for austenite transformation? Elaborate your answer with a neat sketch. [[CO3](Remember/LOCQ)]
- (b) Why the rapid cooling generates more stress during the austenite transformation? [[CO3](Analyse/HOCQ)]
- (c) Explain the structure of martensite and how it differs from austenite. [[CO3](Remember/LOCQ)]
- 5 + 3 + 4 = 12**

Group - D

6. (a) Elaborate on the classification of furnaces with a neat schematic. [[CO4](Remember/LOCQ)]
- (b) What are the basic steps involved in roasting operation? [[CO4](Remember/LOCQ)]
- 8 + 4 = 12**
7. (a) What is the difference between Bayer's process and Hall-Heroult process? [[CO4](Remember/LOCQ)]
- (b) Blast furnace produces pig iron of composition Fe 94%, Si 2%, Mn 0.5%, and C 3.5% by reduction smelting of iron ore, coke, and limestone. The analysis is as follows: Iron Ore: Fe₂O₃ 78%, SiO₂ 8%, Al₂O₃ 5%, MnO 2%, H₂O 7% Coke: 86% C and 10% S and 4% Al₂O₃. Amount is 600 kg per ton of pig iron. Limestone: Pure CaCO₃ to produce a slag of 45% CaO. Calculate the amount of ore per ton of pig iron, percentage of total silica and of the MnO reduced in the furnace and the amount of slag per ton of pig iron along with its composition. [[CO4](Apply/IOCQ)]
- 3 + (3 + 3 + 3) = 12**

Group - E

8. (a) Explain the terms: normal strain, shear strain, Young's modulus and modulus of rigidity. [[CO5](Remember/LOCQ)]
- (b) An aluminium rod shown in Fig. 1 has a circular cross section and is subjected to an axial load of 10 kN. If a portion of the stress-strain diagram is shown in Fig. 2, determine the approximate elongation of the rod when the load is applied. Take $E_{al} = 70$ GPa.

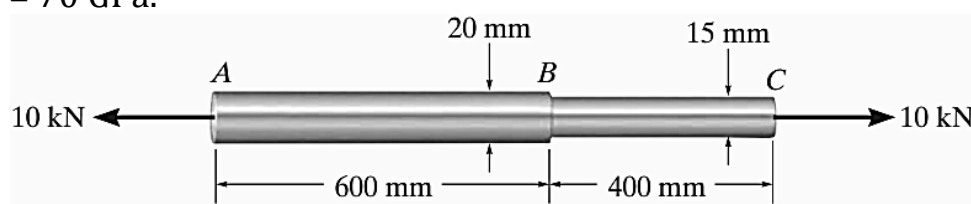


Fig. 1

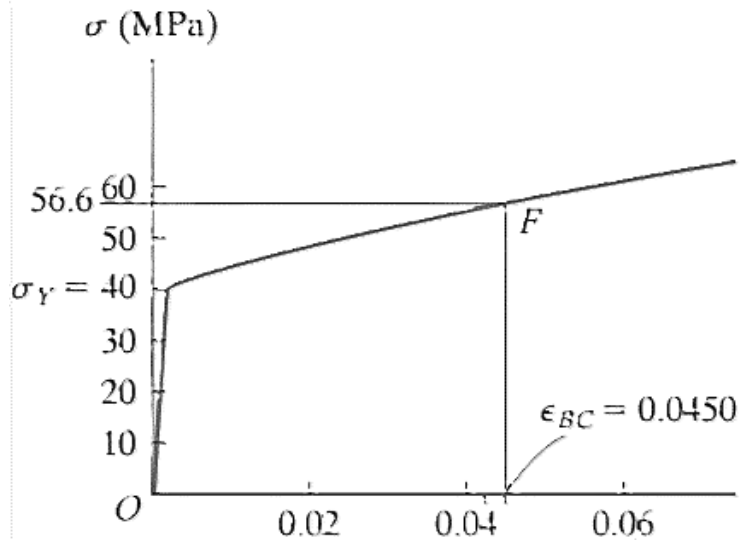


Fig. 2

[[CO5](Apply/IOCQ)]
6 + 6 = 12

9. For the given state of stress (see Fig.3) draw the Mohr Circle using a convenient scale and mark the values of
- (i) Principal stresses
 - (ii) Maximum in-plane shear stress and average normal stress.

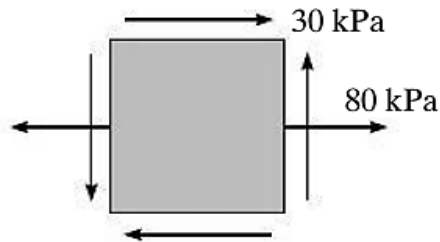


Fig. 3

[[CO5](Analyse/HOCQ)]
(6 + 6) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	43.75	28.12	28.13