

**CAT ENTRANCE EXAMINATION 2023 - M. Sc. MATERIAL SCIENCE
(SPECIALIZATION IN ENERGY SCIENCE)**

MULTIPLE CHOICE QUESTIONS (MCQs)

1. Find out the wrong number in the given sequence of numbers (odd man out).
396, 462, 572, 427, 671, 264
(A) 396
(B) 427
(C) 264
(D) None of the Above

2. The limit

$$\lim_{x \rightarrow \pi} \frac{\sin x}{x^2 - \pi^2}$$

is equal to

- (a) ∞ (b) $1/2\pi$ (c) 0 (d) $-1/2\pi$
3. Among the following which method increases both the strength as well as ductility in materials:
(A) precipitation hardening
(B) annealing
(C) solute addition
(D) grain refinement
4. As compared to the engineering stress-strain curve the true stress strain curve is
(A) above and to the left (B) below and to the right
(C) crosses the engineering curve (D) none of the above
5. If a three-component non-reactive system exists in three-phase equilibrium and if pressure is not allowed to vary, how many independent variables are still available to change the state of the system without disturbing the equilibrium?
a. 0
b. 1
c. 2
d. 3
6. A well annealed metal block of 100 mm thickness has to be rolled down to 20mm thickness by rolling and annealing cycles. The metal can be reduced maximum by 20% at a time and annealing fully recovers the ductility of the metal. What is the minimum number of annealing cycles the metal block has to pass through?
a. 2
b. 3

- c. 7
 - d. 4
7. Fractography is usually carried out in a Scanning Electron Microscope because of its
- a. large depth of focus
 - b. large depth of field
 - c. high resolution
 - d. low optical aberration
8. Which one of the following surfaces is expected to have the least surface energy in an FCC crystal?
- a. {110}
 - b. {111}
 - c. {100}
 - d. {112}
9. Number of tetrahedral voids in a unit cell of a FCC pure metal is:
- a. 2
 - b. 4
 - c. 6
 - d. 8
10. A Carnot engine operates between two thermal reservoirs having temperatures of 20°C and 400°C. What's the maximum possible thermal efficiency of the engine?
- a. 56.5%
 - b. 95%
 - c. 46.3%
 - d. 100%
11. Which one of the following statements is correct about Entropy?
- a. Entropy of a closed system can never decrease
 - b. Entropy of an isolated system can never decrease
 - c. Entropy of an isolated system can never increase
 - d. Entropy of a closed system can never increase
12. The equilibrium partial pressure of oxygen for the oxidation of one mole of solid iron to solid Fe₃O₄ is 10⁻²² atm at 800°C. What is the standard Gibbs free energy change of the reaction?
- a. 301.3kJ
 - b. -45kJ
 - c. -301.3kJ
 - d. 45Kj

13. A very commonly used etchant for plain carbon steel is:
- Kroll's reagent
 - Nital
 - Aqua Regia
 - HF
14. When placed in an external magnetic field the magnetic dipoles in a diamagnetic material are aligned as
- Parallel to the direction of external magnetic field lines.
 - Anti-parallel to the direction of external magnetic field lines.
 - 50% of all the dipoles are parallel to, and remaining are antiparallel to the external field.
 - None of the above.
15. For a semiconductor having n electrons and p holes per unit volume, which of the following relations is correct, provided that the symbol n_i represents the intrinsic charge carrier concentration in all of the following expressions.
- (a) $n.p = n_i^2$ (b) $n.p = n_i(1/2)$ (c) $n/p = n_i^2$ (d) $n.p = n_i^3$
16. The transmitted intensity of a monochromatic radiation from a material of thickness 1 cm is 50% of the incident intensity. What is the absorption coefficient of this material?
- (a.) 1 cm^{-1} (b) 0.5 cm^{-1} (c) 0.7 cm^{-1} (d) 0.25 cm^{-1}
17. Which of these are characteristics of screw dislocation
- \vec{b} is parallel to dislocation line
 - \vec{b} is perpendicular to the dislocation line
 - Dislocation line is parallel to direction of dislocation line movement
 - \vec{b} is parallel to direction of dislocation line movement
 - It is a planar defect
18. Find the statement that must be true according to the given information:
 Rahul is twelve years old. For three years, he has been asking his parents for a dog. His parents have told him that they believe a dog would not be happy in an apartment, but they have given him permission to have a bird. Rahul has not yet decided what kind of bird he would like to have.
- Rahul's parents like birds more than they like dogs.
 - Rahul does not like birds.
 - Rahul and his parents live in an apartment.
 - Rahul and his parents would like to move

19. One alloy contains silver and copper in the ratio 5:1 and the other contains silver and copper in the ratio 7:2. What weights of the two alloys must be mixed together to get 5 kg alloy containing 80% silver?

- (a) 0.5 kg and 4.5 kg
- (b) 1.0 kg and 4.0 kg
- (c) 2.0 kg and 3.0 kg
- (d) 3.5 kg and 1.5 kg

20. Phonon is

- (a) a positive charge carrier
- (b) an exciton
- (c) a lattice wave
- (d) an antimatter particle