

Advanced Materials Science Fundamentals

Materials Science · Answer Key · 25 Questions

1. Which process involves heating a metal to a specific temperature and cooling it slowly to reduce internal stresses and increase ductility?

- A) Quenching
- B) Annealing**
- C) Tempering
- D) Case hardening

2. In crystallography, which term describes the ability of a material to exist in more than one crystal structure depending on temperature and pressure?

- A) Isotropy
- B) Allotropy**
- C) Amorphism
- D) Isomerism

3. Which mechanical property defines a material's resistance to permanent deformation under a tensile load?

- A) Yield strength**
- B) Hardness
- C) Elastic modulus
- D) Toughness

4. What is the primary function of a dopant when added to an intrinsic semiconductor like silicon?

- A) To increase the melting point
- B) To improve thermal conductivity
- C) To increase the number of charge carriers**
- D) To prevent oxidation

5. Which ceramic material is known for its extreme hardness and is commonly used as an abrasive in industrial cutting tools?

- A) Silicon carbide**
- B) Sodium chloride
- C) Magnesium oxide
- D) Calcium carbonate

6. What type of bonding involves the sharing of valence electrons between atoms, typical in organic polymers?

- A) Ionic bonding
- B) Metallic bonding
- C) Covalent bonding**
- D) Van der Waals forces

7. Which material is classified as a 'shape memory alloy' capable of returning to a pre-set shape when heated?

- A) Brass
- B) Nitinol**
- C) Stainless steel
- D) Bronze

8. What is the unit of measure for Young's Modulus, representing the stiffness of a solid material?

- A) Pascals**
- B) Joules
- C) Newtons
- D) Watts

9. In polymers, what process describes the linking of polymer chains with covalent bonds to improve mechanical properties?

- A) Polymerization
- B) Vulcanization**
- C) Oxidation
- D) Distillation

10. Which material property describes the ratio of lateral strain to axial strain during uniaxial loading?

- A) Poisson's ratio**
- B) Shear modulus
- C) Bulk modulus
- D) Hardness coefficient

11. What crystal defect occurs when an atom is missing from its normal lattice site?

- A) Interstitial defect
- B) Vacancy**
- C) Dislocation
- D) Grain boundary

12. Which noble metal is most commonly used as a catalyst in automotive catalytic converters to reduce emissions?

- A) Gold
- B) Platinum**
- C) Silver
- D) Copper

13. What is the defining characteristic of a thermoplastic polymer?

- A) It decomposes upon heating
- B) It can be melted and reshaped multiple times**
- C) It remains rigid at high temperatures
- D) It is chemically inert to all solvents

14. Which substance is an example of an amorphous solid rather than a crystalline one?

- A) Diamond
- B) Table salt
- C) Window glass**
- D) Graphite

15. What is the primary constituent element in ferrous alloys?

- A) Aluminum
- B) Carbon
- C) Iron**
- D) Nickel

16. The 'Mohs scale' is used to measure which physical property of minerals?

- A) Density
- B) Hardness**
- C) Refractive index
- D) Elasticity

17. Which element is added to iron to produce stainless steel, providing corrosion resistance?

- A) Chromium**
- B) Lead
- C) Tin
- D) Mercury

18. What term describes the energy required to fracture a material, representing its ability to absorb energy before failure?

- A) Ductility
- B) Toughness**
- C) Brittleness
- D) Malleability

19. In the context of metals, what is the 'grain boundary'?

- A) The center of a crystal lattice
- B) The interface between two grains of different orientation**
- C) A point where atoms are missing
- D) The exterior surface of a metal

20. Which type of material is synthesized from two or more constituent materials with significantly different physical properties?

- A) Alloy
- B) Composite**
- C) Polymer
- D) Ceramic

21. What phenomenon causes a material to fail under repeated cyclic loading at stresses lower than the ultimate tensile strength?

- A) Creep
- B) Fatigue**
- C) Stress corrosion
- D) Ductile fracture

22. Which of the following is a naturally occurring polymer?

- A) Nylon
- B) Cellulose**
- C) Polystyrene
- D) Polyethylene

23. What is the process of removing impurities from a metal using an electric current?

- A) Electrowinning
- B) Electroplating
- C) Electrolysis**
- D) Electroforming

24. Which property allows metals to be hammered or rolled into thin sheets?

- A) Ductility
- B) Malleability**
- C) Elasticity
- D) Plasticity

25. What is the term for the temperature at which a polymer transitions from a hard, glassy state to a rubbery state?

- A) Melting point
- B) Boiling point
- C) Glass transition temperature**
- D) Flash point