Advanced Materials Science for Young Innovators

Materials Science · Answer Key · 18 Questions

1. Which class of materials exhibits electrical conductivity between that of conductors and insulators, and is crucial for modern electronics like transistors and solar cells?

A) Metals
B) Polymers
C) Semiconductors
D) Ceramics

2. The process of 'tempering' is primarily used to improve the toughness and reduce the brittleness of which common engineering material?

A) Aluminium
B) Steel
C) Copper
D) Glass

3. What unique property of graphene, a single layer of carbon atoms arranged in a hexagonal lattice, makes it a candidate for advanced electronics and strong, lightweight composites?

A) High magnetic permeability
B) Exceptional electrical and thermal conductivity
C) Extreme resistance to chemical corrosion
D) Ability to refract light in a specific pattern

4. Which of the following is a common characteristic of ceramics, making them suitable for applications like ovenware and spark plugs, but also contributing to their tendency to shatter?

A) High ductility
B) Excellent electrical conductivity
C) Brittle nature
D) Low melting point

5. Superconductors are materials that exhibit zero electrical resistance when cooled below a critical temperature. What phenomenon do they famously demonstrate?

A) Ferromagnetism
B) Piezoelectricity
C) Meissner effect
D) Photoelectric effect

6. Polymers are large molecules made up of repeating subunits. Which term describes the process by which smaller monomer units join together to form a long polymer chain?

A) Decomposition
B) Polymerization
C) Crystallization
D) Oxidation

7. Alloys are mixtures of metals or a metal and one or more other elements. Brass, an alloy commonly used for musical instruments and decorative fixtures, is primarily composed of which two metals?

A) Iron and Carbon
B) Copper and Zinc
C) Aluminium and Magnesium
D) Gold and Silver

8. The strength of a material that resists permanent deformation is known as its:

A) Hardness
B) Elasticity
C) Ductility
D) Yield Strength

9. Which of the following is a composite material formed by reinforcing a polymer matrix with strong fibres, often used in aerospace and automotive industries for its high strength-to-weight ratio?

A) Pure Aluminium
B) Carbon Fibre Reinforced Polymer (CFRP)
C) Cast Iron
D) Polyethylene

10. The ability of a material to withstand a sudden impact or shock without fracturing is termed:

A) Tensile Strength
B) Hardness
C) Toughness
D) Compressive Strength

11. Which type of material is characterized by its amorphous (non-crystalline) structure and often exhibits transparency, making it useful for windows and containers?

A) Metals
B) Polymers
C) Ceramics
D) Glasses

12. The phenomenon where certain materials change shape under applied stress and return to their original shape when the stress is removed is called:

A) Plasticity
B) Viscosity
C) Elasticity
D) Brittleness

13. A 'smart material' is one that can respond to external stimuli. Which of the following is an example of a smart material that changes shape when heated and can be used in actuators?

A) Stainless Steel
B) Nitinol (Nickel-Titanium Alloy)
C) Polypropylene
D) Silicon

14. In materials science, 'corrosion' refers to the degradation of a material due to chemical reactions with its environment. Which element is most commonly associated with the rusting of iron?

A) Carbon
B) Oxygen
C) Nitrogen
D) Hydrogen

15. What is the primary difference in the atomic structure between a crystalline material and an amorphous material?

A) Crystalline materials have a fixed molecular weight, while amorphous materials do not.
B) Crystalline materials have atoms arranged in a highly ordered, repeating lattice, while amorphous materials have a disordered arrangement.
C) Crystalline materials are always metals, while amorphous materials are never metals.
D) Crystalline materials are always solids, while amorphous materials can be gases.

16. The ability of a material to be drawn out into a thin wire without breaking is known as:

A) Malleability
B) Brittleness
C) Ductility
D) Hardness

17. Which of the following materials is typically an excellent electrical insulator, commonly used in high-voltage applications and cookware handles due to its low thermal conductivity?

A) Copper
B) Aluminium
C) Ceramic (e.g., Porcelain)
D) Gold

18. The process of heating a material to a high temperature and then rapidly cooling it to change its microstructure and properties is called:

A) Annealing
B) Tempering
C) Quenching
D) Hardening