

# Mechanical Properties of Materials

Materials Science · Answer Key · 30 Questions

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## 1. What does the text define as the relationship between stress and strain?

- A) Mechanical property
- B) Stress-strain curve**
- C) Elastic modulus
- D) Plastic deformation

## 2. What are the two main types of deformation discussed?

- A) Elastic and plastic**
- B) Tensile and compressive
- C) Shear and torsional
- D) Bending and buckling

## 3. What is Young's modulus a measure of?

- A) Resistance to shear
- B) Stiffness in tension or compression**
- C) Resistance to elastic deformation
- D) Ability to absorb energy

## 4. What does Poisson's ratio describe?

- A) The ratio of stress to strain
- B) The ratio of lateral strain to axial strain**
- C) The ratio of elastic limit to yield strength
- D) The ratio of ultimate tensile strength to yield strength

## 5. What is the elastic limit?

- A) The point where plastic deformation begins
- B) The maximum stress a material can withstand
- C) The point beyond which a material will fracture
- D) The point where the material returns to its original shape after load removal**

## 6. What is yield strength?

- A) The stress at which a material begins to deform plastically**
- B) The maximum stress a material can withstand before fracturing
- C) The stress at which a material returns to its original shape
- D) The stress required to cause a certain amount of elastic deformation

**7. What is ultimate tensile strength?**

**A) The maximum stress a material can withstand during tensile testing**

- B) The stress at which a material begins to deform plastically
- C) The stress at which a material fractures
- D) The stress required to cause a specific amount of elongation

**8. What is the characteristic of brittle materials mentioned?**

A) They undergo significant plastic deformation before fracture

**B) They fracture with little or no plastic deformation**

- C) They have a high yield strength
- D) They have a low elastic modulus

**9. What is the characteristic of ductile materials mentioned?**

A) They fracture with little or no plastic deformation

**B) They undergo significant plastic deformation before fracture**

- C) They have a low ultimate tensile strength
- D) They have a high elastic limit

**10. What is the stress-strain curve used to determine?**

A) The material's density and hardness

**B) The material's mechanical properties**

- C) The material's melting point
- D) The material's electrical conductivity

**11. What does the slope of the elastic portion of the stress-strain curve represent?**

A) Poisson's ratio

**B) Young's modulus**

- C) Shear modulus
- D) Bulk modulus

**12. What is the phenomenon where a material's properties change over time under constant stress called?**

**A) Creep**

- B) Fatigue
- C) Tension
- D) Compression

**13. What is fatigue in materials science?**

A) The process of hardening a material

**B) The weakening of a material caused by repeatedly applied loads**

- C) The ability of a material to deform without fracturing
- D) The tendency of a material to return to its original shape

**14. What is the main difference between elastic and plastic deformation?**

- A) Elastic deformation is permanent, while plastic deformation is not
- B) Elastic deformation is temporary, while plastic deformation is permanent**
- C) Elastic deformation occurs at high temperatures, while plastic deformation occurs at low temperatures
- D) Elastic deformation involves changes in atomic structure, while plastic deformation does not

**15. What is the purpose of stress-strain diagrams?**

- A) To measure the material's hardness
- B) To illustrate the mechanical behavior of a material under load**
- C) To determine the material's density
- D) To calculate the material's thermal conductivity

**16. In the context of stress-strain curves, what does the area under the curve represent?**

- A) The yield strength of the material
- B) The energy absorbed per unit volume up to fracture**
- C) The elastic modulus of the material
- D) The ultimate tensile strength of the material

**17. What type of deformation is characterized by a permanent change in shape?**

- A) Elastic deformation
- B) Plastic deformation**
- C) Creep
- D) Fatigue

**18. What is the relationship between stress and strain in the elastic region?**

- A) Non-linear and permanent**
- B) Linear and temporary
- C) Linear and permanent
- D) Non-linear and temporary

**19. What is the term for the maximum stress a material can withstand before it starts to break?**

- A) Yield strength
- B) Elastic limit
- C) Ultimate tensile strength**
- D) Compressive strength

**20. What is the effect of temperature on the mechanical properties of materials?**

- A) It generally increases strength and stiffness
- B) It generally decreases strength and stiffness**
- C) It has no significant effect
- D) It only affects brittle materials

**21. What is the purpose of hardness testing?**

- A) To measure the tensile strength of a material
- B) To measure a material's resistance to scratching or indentation**
- C) To determine the material's ductility
- D) To measure the material's electrical conductivity

**22. What is the difference between strain hardening and work hardening?**

- A) They are the same process**
- B) Strain hardening refers to metals, while work hardening is a broader term
- C) Work hardening refers to metals, while strain hardening is a broader term
- D) There is no significant difference

**23. What is the role of dislocations in plastic deformation?**

- A) They prevent deformation
- B) They facilitate slip and movement of atomic planes**
- C) They increase the elastic limit
- D) They cause immediate fracture

**24. What is the phenomenon of creep?**

- A) Sudden fracture under impact load
- B) Permanent deformation under sustained stress at elevated temperatures
- C) Rapid deformation during elastic loading**
- D) Sudden loss of strength at low temperatures

**25. What is the effect of grain size on the mechanical properties of metals?**

- A) Smaller grains generally lead to higher strength and hardness**
- B) Larger grains generally lead to higher strength and hardness
- C) Grain size has no effect on mechanical properties
- D) Smaller grains lead to increased ductility and reduced strength

**26. What is the purpose of annealing a metal?**

- A) To increase its hardness and strength
- B) To reduce its hardness and increase its ductility**
- C) To make it more brittle
- D) To increase its electrical conductivity

**27. What is the relationship between the shear modulus (G) and Young's modulus (E) for an isotropic material?**

- A)  $G = E / (1 + ?)$
- B)  $G = E * (1 + ?)$
- C)  $G = E / (2 * (1 + ?))$**
- D)  $G = E * (2 * (1 + ?))$

**28. What does the term 'anisotropy' refer to in material properties?**

- A) Properties being the same in all directions
- B) Properties varying depending on the direction of measurement**
- C) Properties changing with temperature
- D) Properties being consistent over time

**29. What is the main application of understanding stress-strain behavior?**

- A) Predicting material failure and designing safe structures**
- B) Determining material cost
- C) Estimating material weight
- D) Calculating material's heat capacity

**30. What is the main difference between a hard material and a tough material?**

- A) Hardness refers to resistance to scratching, while toughness refers to resistance to fracture**
- B) Hardness refers to resistance to fracture, while toughness refers to resistance to scratching
- C) Hard materials are always brittle, while tough materials are always ductile
- D) Tough materials have high elastic limits, while hard materials do not