

TESTING OF MATERIALS

OBJECTIVES

- To understand the various destructive and non destructive testing methods of materials and its industrial applications.

UNIT I INTRODUCTION TO MATERIALS TESTING 9

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II MECHANICAL TESTING 9

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III NON DESTRUCTIVE TESTING 9

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test - Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT IV MATERIAL CHARACTERIZATION TESTING 9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT V OTHER TESTING 9

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL : 45 PERIODS

OBJECTIVE TYPE QUESTIONS

1. The ability of a material to undergo plastic deformation without fracture when subjected to uniaxial tensile force is ____
 - a) **Ductility**
 - b) Malleability
 - c) Tensile Strength
 - d) Yield Strength
2. Which metal has the highest ductility?
 - a) Silver
 - b) Gold
 - c) **Platinum**
 - d) Aluminium
3. Ductility of ceramics is ____
 - a) **Less than 1%**
 - b) 2 - 4%
 - c) 4 - 40%
 - d) More than 40%
4. What is the ductility of annealed Cu?
 - a) 25%
 - b) 35%
 - c) 40%
 - d) **45%**
5. What is the ductility of commercial pure Titanium?
 - a) 10%
 - b) 14%
 - c) 16%
 - d) **25%**
6. Which factor increases ductility?
 - a) Cold working
 - b) **Annealing**
 - c) Alloying
 - d) Inclusions
7. Which crystal structure materials possess the best ductility properties?
 - a) **FCC**
 - b) HCP
 - c) BCC
 - d) SC
8. Which factor decreases the ductility of materials?
 - a) Annealing
 - b) Spheroidization

c) Grain refinement

d) Alloying

9. Cast materials show better ductility than wrought materials.

a) True

b) False

10. Neutron irradiation by neutrons can ____ yield stress and ____ ductility.

a) Increase, increase

b) Increase, decrease

c) Decrease, increase

d) Decrease, decrease

11. With the increase in the degree of stress triaxiality, ductility of material decreases.

a) True

b) False

12. As the strain rate increases, the value of ductility ____

a) Increases

b) Decreases

c) Remains constant

d) Changes independent of strain rate.

13. Original gauge length of aluminium cylindrical specimen is 2 inches and fracture length is 2.78 inches. What is the ductility of specimen?

a) 38%

b) 39%

c) 40%

d) 41%

14. A cylindrical specimen having diameter of 12.8 mm is starting and 7.3 mm at the fracture point. What is ductility?

a) 56%

b) 64%

c) 67%

d) 78%

15. The ability of a material to undergo plastic deformation without rupture, when a compressive force is applied, is known as _____

a) Ductility

b) Formability

c) Compressive strength

d) Malleability

16. Which metal has maximum malleability?

a) Platinum

b) Gold

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- c) Silver
- d) Aluminium

17. Which metal shows good malleability but poor ductility?

- a) Silver
- b) Gold
- c) Lead**
- d) Aluminium

18. With an increase in temperature, malleability of material _____

- a) Increases**
- b) Decreases
- c) Remains constant
- d) Varies independent of temperature

19. Malleability is the property of a material to be formed into _____

- a) Wires
- b) Sheets**
- c) Bars
- d) Billets

20. Malleable iron is made by heating white iron between _____ for a long time period.

- a) 200-300°C
- b) 400-500°C
- c) 800-900°C**
- d) 1100-1200°C

21. Malleable cast iron consists of _____

- a) Graphite flakes
- b) Graphite nodules
- c) Graphite clusters**
- d) Spheroidite

22. Crystal structure of a material is an important factor, which affects the malleability.

- a) True**
- b) False

23. Which statement is false regarding malleability?

- a) Presence of interstitials decreases malleability
- b) With an increase in temperature malleability of material decreases**
- c) FCC crystals generally have good malleability
- d) Materials with weak metallic bond tend to have good malleability

24. Materials with stronger metallic bonds exhibit high malleability.

- a) True
- b) False**

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25. What is the inverse of stiffness?

- a) Hardness
- b) Stress
- c) Flexibility**
- d) Toughness

26. A material's resistance to elastic deflection is known as ____

- a) stiffness**
- b) toughness
- c) hardness
- d) elasticity

27. What is the SI unit of stiffness?

- a) N/m**
- b) N/m
- c) Nm^2
- d) N

28. How can stiffness of material be improved?

- a) By increasing the cross-sectional area**
- b) By decreasing the cross-sectional area
- c) By increasing temperature
- d) By increasing the length of spring

29. Plasticizers in polymers ____ toughness and ____ stiffness.

- a) increase, increase
- b) increase, decrease**
- c) decrease, increase
- d) decrease, decrease

30. Stiffness and strength of polymer ____ with an increase in the degree of crystallinity.

- a) increases**
- b) decreases
- c) remains constant
- d) varies showing no relation to the degree of crystallinity

31. Increasing the stiffness of material diminishes its impact strength.

- a) True**
- b) False

32. A stiff material is always of high strength.

- a) True
- b) False**

33. Which statement is true regarding stiffer?

- a) A longer spring is stiffer
- b) A spring with thin wire is stiffer

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- c) Copper wire spring is stiffer than steel wire spring
d) A spring with a smaller diameter of coils is stiffer

34. With an increase in temperature, elastic modulus of metals _____ and stiffness _____

- a) increases, increases
b) increases, decreases
c) decreases, increases
d) decreases, decreases

35. The property of a material which enables it to absorb energy and deform plastically without fracture is _____

- a) Stiffness
b) Toughness
c) Hardness
d) Resilience

36. What is the SI unit of tensile toughness?

- a) N/m
b) in.lbf.in⁻³
c) Jm⁻³
d) Jm³

37. What is fracture toughness range of ceramics?

- a) 2-8 MN m^{-3/2}
b) 1-10 MN m^{-3/2}
c) 10-30 MN m^{-3/2}
d) 30-40 MN m^{-3/2}

38. What is fracture toughness of magnesia in terms of stress intensity factor?

- a) 1 MPa m^{1/2}
b) 2 MPa m^{1/2}
c) 3 MPa m^{1/2}
d) 5 MPa m^{1/2}

39. Match the following.

Material	K _{Ic} (MPa m ^{1/2})
i) Titanium alloy	p) 3-4
ii) Aluminium	q) 0.2-1.4
iii) Concrete	r) 44-66
iv) Silicon carbide	s) 14-28

- a) i-r, ii-s, iii-p, iv-q
b) i-s, ii-r, iii-q, iv-p
c) i-s, ii-r, iii-p, iv-q
d) i-r, ii-s, iii-q, iv-p

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40. The toughness of material depends on _____ and _____ of material.
- a) Ductility, yield strength
 - b) Ductility, tensile strength**
 - c) Stiffness, tensile strength
 - d) Hardness, yield strength
41. Which factor decreases toughness of material?
- a) Alloying
 - b) Temperature
 - c) Grain refinement
 - d) Strain rate**
42. What is the reason of low toughness of grey cast iron?
- a) Strain rate
 - b) Notch effect**
 - c) Grain size effect
 - d) Crystal structure
43. Which material, would you choose for high toughness property on lower temperatures?
- a) Steel
 - b) Aluminium**
 - c) Zinc
 - d) SiC
44. Stress intensity factor is not a function of _____
- a) Loading
 - b) Crack size
 - c) Volume**
 - d) Structural geometry
45. Material has tensile strength 40 MPa and fracture strain 0.39. What will be approximate value of toughness?
- a) 10.2 MJ/m³
 - b) 15.6 MJ/m³**
 - c) 16.7 MJ/m³
 - d) 18.9 MJ/m³
46. A material has tensile strength 210 MPa, yield strength 117 MPa and fracture strain 0.45. What will be approximate value of toughness?
- a) 54.8 MJ/m³
 - b) 67.4 MJ/m³
 - c) 73.6 MJ/m³**
 - d) 89.2 MJ/m³
47. Cast materials are tougher than wrought materials.
- a) True
 - b) False**

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48. Which statement is false?

- a) A matrix of thermoplastic provides higher toughness than thermoset in the composite.
- b) Microcracking can improve toughness in a composite
- c) Tempering of martensite decreases toughness of steel**
- d) Copolymerization can improve the toughness of polymer

49. The toughness of the composite depends on the toughness of the matrix.

- a) True**
- b) False

50. _____ is the resistance of a material to plastic deformation by indentation.

- a) Toughness
- b) Resilience
- c) Hardness**
- d) Stiffness

51. What is SI unit of hardness?

- a) kg/m^3
- b) kg/m^2**
- c) g/m^2
- d) N/m

52. The hardness of martensite _____ with an increase in carbon content.

- a) Increases**
- b) Decreases
- c) Remains constant
- d) First increases and then decreases

53. _____ is the strongest bond.

- a) Van der Waals bond
- b) Metallic bond
- c) Covalent bond**
- d) Hydrogen bond

54. _____ improve hardness.

- a) Strain hardening**
- b) Plasticizers
- c) Over aging
- d) Tempering

55. What is the hardness of silicon carbides?

- a) 5-10 HV
- b) 10-14 HV
- c) 15-20 HV
- d) 20-30 HV**

56. When hardness is measured under dynamic loading conditions, it is known as _____ hardness.

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- a) Brinell
- b) Rebound**
- c) Knoop
- d) Rockwell

57. With an increase in temperature, hardness of material _____ and ductility

- a) Increases, increases
- b) Increases, decreases
- c) Decreases, increases**
- d) Decreases, decreases

58. Which process increases the hardness of the material?

- a) Tempering
- b) Annealing
- c) Quenching**
- d) Over aging

59. Which statement is false?

- a) Alloying increases hardness of the pure metal
- b) Dual phase alloys are harder than single phase alloys
- c) Interstitial solid solutions are harder than substitutional solid solutions
- d) Heat treatment always decreases the hardness of a material**

60. Which scale is not used to measure indentation hardness?

- a) Rockwell
- b) Bennett**
- c) Shore
- d) Brinell

61. Cooling rate _____ with distance from the quenched end, and the hardness

- a) Increases, increases
- b) Increases, decreases
- c) Decreases, increases
- d) Decreases, decreases**

62. Stamping operation increases hardness.

- a) True**
- b) False

63. Which microconstituent of Steel is hardest?

- a) Spheroidite
- b) Pearlite
- c) Bainite
- d) Martensite**

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64. Coarse pearlite is harder than fine perlite for the same composition of Steel.

- a) True
- b) False**

65. What is tensile strength of brass?

- a) 550 MPa**
- b) 220 MPa
- c) 350 MPa
- d) 760 MPa

66. Match the following?

Material	Tensile strength (in MPa)
i) Annealed silver	p) 15
ii) Rubber	q) 33
iii) Brass	r) 170
iv) Glass	s) 550

- a) i-q, ii-p, iii-r, iv-s
- b) i-r, ii-p, iii-s, iv-q**
- c) i-p, ii-r, iii-q, iv-s
- d) i-r, ii-p, iii-q, iv-s

67. Which one of the following, is not a unit of ultimate tensile strength?

- a) MPa
- b) N/m^2
- c) Kg/m^3**
- d) psi

68. The ability of the material to withstand tensile force, without breaking, is known as _____

- a) Yield strength
- b) Tensile strength**
- c) Compressive strength
- d) Creep strength

69. With an increase in the degree of cold working, tensile strength of material _____

- a) Increases**
- b) Decreases
- c) Remains constant
- d) First decreases then increase

70. Which one of the following factor decreases the tensile strength?

- a) Cold working
- b) Alloying**

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c) Temperature rise

d) Grain refinement

71. Which statement is false?

a) With an increase in the degree of cold working, UTS increases.

b) UTS increases with a decrease in temperature.

c) UTS increases with an increase in grain size.

d) Larger the difference between the radius of solute and solvent atoms of alloy, higher is the tensile strength.

72. Tensile strength is used as a design criterion for ductile materials.

a) True

b) False

73. If the Brinell hardness of a steel specimen is measured 149 HBN. What will be the UTS?

a) 431 MPa

b) 514 MPa

c) 608 MPa

d) 637 MPa

74. Brinell hardness of a steel specimen is 151 HBN. Give the value of UTS of Steel in psi.

a) 520 psi

b) 42050 psi

c) 75500 psi

d) 86200 psi

75. Find the minimum tensile strength of spring material ASTM A232 having diameter 3 millimeter, exponent $m = 0.155$ and constant $A = 173$ kpsi.

a) 120 kpsi

b) 146 kpsi

c) 158 kpsi

d) 167 kpsi

76. Tensile strength depends on the molecular structure of the material.

a) True

b) False

77. Tensile strength increases with increasing _____

a) Temperature

b) Molecular weight

c) Purity

d) Grain size

78. What is yield strength of Kevlar?

a) 1650 MPa

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- b) 1737 MPa
- c) 3620 MPa
- d) 3757 MPa

79. What is yield strength of annealed titanium?

- a) 130 MPa
- b) 138 MPa
- c) 450 MPa**
- d) 830 MPa

80. What is SI unit of yield strength?

- a) N
- b) N/m²**
- c) Nm²
- d) g/cm²

81. Strain offset of _____ is commonly used.

- a) 0.002**
- b) 0.004
- c) 0.006
- d) 0.008

82. _____ is the maximum stress that can be applied to the material without causing plastic deformation.

- a) Tensile strength
- b) Fatigue strength
- c) Compressive strength
- d) Yield strength**

83. As the temperature of a material is lowered, the yield stress _____ and the fracture stress _____

- a) Increases, increases
- b) Increases, decreases**
- c) Decreases, increases
- d) Decreases, decreases

84. With decreasing grain size, yield strength of material _____

- a) Increases
- b) Decreases
- c) Remains constant
- d) First increases then decrease**

85. Which material shows the yield point phenomenon?

- a) Copper
- b) Aluminium
- c) Steel**
- d) Silver

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86. Which factor deteriorates yield strength?

- a) Cold working
- b) Annealing**
- c) Work hardening
- d) Grain refinement

87. Yield point phenomenon creates problems in deep drawing operations of sheet Steels.

- a) True**
- b) False

88. Which one of the following, gives the relation between work hardening and yield strength of material?

- a) $\Delta\sigma_y = Gbp$
- b) $\Delta\sigma_y = Gb\sqrt{\rho}$**
- c) $\Delta\sigma_y = G\sqrt{\rho b}$
- d) $\Delta\sigma_y = G\rho\sqrt{b}$

89. Work hardening causes a decrease in yield strength of the material.

- a) True
- b) False**

90. _____ is the ability of a material to sustain impact forces without fracture.

- a) Impact strength**
- b) Toughness
- c) Tensile strength
- d) Compressive strength

91. Moisture absorption causes _____ in impact strength and _____ in the strength of polymers.

- a) Increase, Increase
- b) Increase, decrease**
- c) Decrease, Increase
- d) Decrease, decrease

92. What is Izod impact energy of Nylon 6/6?

- a) 10-50 J/m
- b) 12-20 J/m
- c) 50-100 J/m**
- d) 100-210 J/m

93. Which factor increases impact toughness?

- a) Cold working
- b) Precipitation hardening
- c) Water absorption in polymer**
- d) Notches

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94. What is izod impact energy of poly-carbonates?
a) 53 J/m
b) 10-50 J/m
c) 430-850 J/m
d) 12-20 J/m
95. Cleavage in bcc materials take place along ____ plane.
a) {001}
b) {110}
c) {123}
d) {112}
96. Brittle fracture needs more energy than the ductile fracture.
a) True
b) False
97. Ductile-brittle transition temperature increases with strain rate.
a) True
b) False
98. Which statement is false according to impact strength?
a) Notch serves as a stress concentration zone
b) Lowering the temperature reduces the impact strength in BCC materials
c) Generally, strong metals have a lower impact strength
d) In polymers, impact strength keeps on the increase with temperature
99. What is the cross section of izod test specimen?
a) 10×10 mm
b) 10×12 mm
c) 12×12 mm
d) 8×10 mm
100. ____ occurs when metal is subjected to a constant tensile load at an elevated temperature?
a) Fatigue
b) Creep
c) Impact
d) Wear
101. Creep is a ____ dependent phenomenon.
a) Temperature
b) Time
c) Load
d) Stress cycle
102. Creep occurs due to sliding of ____
a) Vacancies

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b) Voids

c) Grain boundaries

d) Dislocations

103. Which one of the following, is a static mechanical property?

a) Impact strength

b) Creep strength

c) Fatigue strength

d) Rebound hardness

104. The _____ the melting point and the _____ the elastic modulus, the higher is creep strength.

a) Lower, lower

b) Lower, higher

c) Higher, lower

d) Higher, higher

105. In _____ creep, atoms diffuse along grain boundaries and grains elongate in stress axis.

a) Dislocation

b) Nabarro-Herring

c) Coble

d) Solute drag

106. With which factor, a magnitude of creep doesn't increase?

a) Temperature

b) Time

c) Grain size

d) Stress

107. Crosslinking in Polymers increases creep strength.

a) True

b) False

108. Which statement is correct regarding creep strength?

a) Wrought materials have higher creep strength than cast materials

b) With an increase in temperature, steady state creep rate decreases

c) Creep strength can be improved by precipitation hardening

d) Aromatic rings in polymer decrease creep strength

109. Creep occurs only at high temperatures.

a) True

b) False

110. Nabarro-Herring creep predicts a strain rate which is a function of _____

a) D

b) D^{-2}

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- c) D^{-3}
- d) D^{-1}

111. Match the following.

Material	Creep temperature
i) Carbon steel	p) $> 50-150^{\circ}\text{C}$
ii) Alloy steel	q) $>$ room temperature
iii) Light metal and alloy	r) $> 450^{\circ}\text{C}$
iv) tin	r) $> 420^{\circ}\text{C}$

- a) i-r, ii-s, iii-p, iv-q
- b) i-s, ii-r, iii-p, iv-q**
- c) i-r, ii-s, iii-q, iv-p
- d) i-s, ii-r, iii-q, iv-p

112. The ability of a metal workpiece to undergo plastic deformation without being damaged is known as _____

- a) Formability**
- b) Stiffness
- c) Resilience
- d) Yield strength

113. Which instrument is used to measure formability?

- a) Universal testing machine
- b) Impact testing machine
- c) Erichsen machine**
- d) Fatigue testing machine

114. What is the reason of orange-peel effect?

- a) Coarse grain structure**
- b) Fine grain structure
- c) Inclusions
- d) Impurities

115. _____ increases the formability of the metal sheet.

- a) Annealing**
- b) Cold working
- c) Inclusions
- d) Grain coarsening

116. Erichsen value of formability _____ with the thickness of the metal sheet.

- a) Increases**
- b) Decreases
- c) Remains constant
- d) First increases and then decreases

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117. Formability of sheet metal _____ with an increase in normal anisotropy.

- a) **Increases**
- b) Decreases
- c) Remains constant
- d) Varies independently

118. In the _____ test, the specimen is bent between two rollers until an angle between 30° to 45° is reached.

- a) **Free bending test**
- b) Olsen cup test
- c) Swift cup test
- d) Fukui conical cup test

119. What is the value of lankford coefficient (r) for good deep drawable material?

- a) ≤ 1
- b) **≤ 2**
- c) ≤ 3
- d) ≤ 4

120. Inclusions don't affect formability of materials.

- a) True
- b) **False**

121. Lack of symmetry in crack shows anisotropy in a material.

- a) **True**
- b) False

122. What is the deformation per unit length?

- a) **Strain**
- b) Stress
- c) Toughness
- d) Resilience

123. Ductility is indicated by _____

- a) **Percentage elongation**
- b) Percentage reduction
- c) Poisson's ratio
- d) Elasticity

124. If a bar is doubled in length, what will be the strain induced?

- a) 0.5
- b) **1.0**
- c) 1.5
- d) 2.0

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125. Ductility is the opposite concept of _____

- a) Toughness
- b) Plasticity
- c) Brittleness**
- d) Resilience

126. What term is used for the ratio of lateral strain to linear strain?

- a) Bulk modulus
- b) Elastic modulus
- c) Shear strain
- d) Poisson's ratio**

127. Material, if show identical properties in all directions, is said to be

- a) Isotropic**
- b) Elastic
- c) Ideal
- d) Homogeneous

128. Which material has higher elasticity?

- a) Rubber
- b) Glass
- c) Steel**
- d) Copper

129. _____ does not show linear stress strain relationship.

- a) Rubber**
- b) Ceramic
- c) Steel
- d) Copper

130. The maximum stress up to which stress is proportional to strain is known as _____

- a) Tensile stress
- b) Compressive stress
- c) Modulus of elasticity
- d) Proportional limit**

131. Yield strength represents resistance against _____

- a) Fracture
- b) Elastic deformation
- c) Bending
- d) Plastic deformation**

132. Strain hardening causes more deformation on less stress application.

- a) True
- b) False**

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133. Necking causes drop in load after an ultimate tensile point.

- a) **True**
- b) False

134. What is an expression of true stress?

- a) P_u / A_i
- b) P_u / A_0
- c) **P / A_i**
- d) P / A_0

135. True strain is _____ than the engineering strain corresponding to a given load.

- a) Larger
- b) **Smaller**
- c) Equal
- d) Either smaller or equal

136. What is a relation between true and engineering strain?

- a) $\epsilon_T = \ln (1 + \epsilon)$
- b) **$\epsilon_T = \ln (L/L_0)$**
- c) $\epsilon_T = \ln (\Delta L/L_0)$
- d) $\epsilon_T = \Delta L/L_0$

137. What is the relation between true and engineering stress?

- a) $\sigma_T = \ln (L/L_0)$
- b) $\sigma_T = \ln (1 + \epsilon)$
- c) **$\sigma_T = \sigma (1 + \epsilon)$**
- d) $\sigma_T = \sigma (1 - \epsilon)$

138. What term defines plastic instability?

- a) $dP = \text{constant}$
- b) **$dP = 0$**
- c) $dP < 0$
- d) $dP > 0$

139. Plastic instability occurs when the slope of the true stress strain curve _____ the true stress at the point.

- a) Exceeds
- b) **Equals**
- c) Is less
- d) Is less or higher

140. True value of stress experience by material _____ than the conventional one for a given load.

- a) **Higher**
- b) Lower
- c) Equal
- d) Higher or lower

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141. What is considered more in mechanical working processes?

- a) Yield stress
- b) Shear stress
- c) True stress**
- d) Engineering stress

142. True stress strain curve _____

- a) Continuously rises**
- b) After yield point comes down
- c) After yield point remains constant
- d) Uncertain after yield point

143. The points on the true stress strain curve _____ the conventional stress strain curves up to the onset of necking.

- a) Lie on the left of**
- b) Lie on the right of
- c) Superimpose
- d) May lie on left or right

144. Materials in general have higher elastic strain of 50% order.

- a) True
- b) False**

145. True stress value is affected by strain hardening.

- a) True**
- b) False

146. With increasing gauge length, % elongation _____

- a) Increases
- b) Decreases**
- c) Remains constant
- d) First increases then decrease

147. What gauge length is commercially used?

- a) 10 mm
- b) 20 mm
- c) 30 mm
- d) 50mm**

148. What is not a variable which affects tensile properties?

- a) Gauge length
- b) Temperature
- c) Load**
- d) Strain rate

149. For L/D ratio greater than _____ the reduction in area is independent of ratio.

- a) 0.2

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b) 2

- c) 5
- d) 10

150. Specimen with $L/D = 0$ gives _____ strength.

- a) Higher**
- b) Lower
- c) Equal
- d) Higher or lower

View Answer

151. With an increase in strain rate, ductility _____ and tensile strength _____

- a) Increases, increases
- b) Increases, decreases
- c) Decreases, increases**
- d) Decreases, decreases

152. Yield and flow strength at lower plastic strain is more dependent on _____ than _____

- a) Strain rate, tensile strength**
- b) Tensile strength, strain rate
- c) Strain rate, temperature
- d) Temperature, tensile strength

153. At strain rates _____ behaviour of the material is characterized by creep.

- a) Low, 10^4 per second
- b) Low, 10^{-4} per second**
- c) High, 10^4 per second
- d) High, 10^{-4} per second

154. Elastic modulus and strength _____ and ductility _____ as the temperature of material increases.

- a) Increases, increases
- b) Increases, decreases
- c) Decreases, increases**
- d) Decreases, decreases

155. Tensile curve gets lower down with an increase in temperature.

- a) True**
- b) False

156. In FCC metals, yield stress increases rapidly with decreasing temperature.

- a) True
- b) False**

157. Which metal is capable of maintaining its mechanical strength on working temperature?

- a) Pb

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- b) Zn
- c) Fe**
- d) Sn

158. With an increase in temperature, the modulus of elasticity _____

- a) Increases
- b) Decreases**
- c) Remains constant
- d) First Increases, then decreases

159. With increases in temperature, yield strength _____ and tensile strength _____

- a) Increases, increases
- b) Increases, decreases
- c) Decreases, increases
- d) Decreases, decreases**

160. Softening process dominates over hardening process in _____ stage of creep.

- a) Primary
- b) Secondary
- c) Tertiary**
- d) Quaternary

161. Stress rupture curves show the variation in stress as a function of _____

- a) Temperature
- b) Time**
- c) Cycles
- d) Notch depth

162. The first stage of creep is also known as _____ creep.

- a) Transient**
- b) Viscous
- c) Flow
- d) Tertiary

163. Second stage of creep is also known as _____ creep.

- a) Primary
- b) Secondary
- c) Transient
- d) Viscous**

164. Viscous creep is represented by _____ constant in Andrade empirical equation.

- a) β
- b) k**

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- c) ϵ
- d) t

165. Transient creep is also known as _____ flow.

- a) k
- b) β**
- c) ϵ
- d) t

166. k represents elongation per unit length at a constant rate.

- a) True**
- b) False

167. The most common creep rate corresponds to which the creep strength is specified is _____

- a) 1% in 100 hrs
- b) 1% in 1000 hrs
- c) 1% in 10,000 hrs**
- d) 1% in 100,000 hrs

168. In what terms, fatigue life is measured?

- a) Time of failures
- b) Number of cycles of failure**
- c) Stress of failure
- d) Appearance of fracture

169. Fatigue curves are popularly known as _____ curves.

- a) S
- b) R
- c) N
- d) S-N**

170. What term is used for the maximum stress at which material fail on a specified number of cycle?

- a) Fatigue strength**
- b) Fatigue life
- c) Ultimate tensile strength
- d) Endurance limit

171. Word "endurance limit" is used for _____

- a) Plastics
- b) Ferrous materials
- c) Nonferrous materials**
- d) Alloys

172. Which ferrous material doesn't show fatigue limit?

- a) Cast iron
- b) Wrought iron

c) Austenitic stainless steel

d) Low carbon steel

173. Which of the following show a fatigue limit?

a) Titanium

b) Cast iron

c) Magnesium

d) Al-Mg alloys

174. What is the reason for fatigue failure?

a) Movement of Dislocations

b) Submicroscopic cracks

c) Dynamic recovery

d) Vacancy coalescence

175. What cycles range is chosen for endurance limit?

a) $10^2 - 10^3$

b) $10^5 - 10^6$

c) $10^7 - 10^8$

d) $10^{11} - 10^{12}$

176. What is the relation between stress at the tension side and diameter of the fatigue test specimen?

a) $\sigma_t \propto d$

b) $\sigma_t \propto d^2$

c) $\sigma_t \propto 1/d^2$

d) $\sigma_t \propto 1/d^3$

177. Which of the following is not a reason for crack initiation?

a) Inclusions

b) Gas pores

c) Local soft spots

d) Vacancy

178. Crack mostly starts at _____

a) Surface

b) Inclusion

c) Pore

d) Soft spots

179. Orowan's theory is related to _____

a) Grain boundaries

b) Weak crystal

c) Slip band

d) Gas pores

180. Wood's theory is described by _____

a) Microscopic voids

b) Microscopic slip bands

- c) Weak crystal
- d) Grain boundaries

181. Slip band are notch root of _____ dimensions.

- a) Micro
- b) Macro
- c) Nano

d) Atomic

182. Which theory defines fatigue failure using microscopic slip bands?

- a) Orowan's theory

b) Wood's theory

- c) Cottrell's theory
- d) Dislocation theory

183. What term is used for initial crack formation during fatigue?

- a) Cracking

b) Stage I fatigue

- c) Stage II fatigue
- d) Micro cracking

184. Stage of crack growth is called _____

- a) I stage

b) II stage

- c) III stage
- d) IV stage

185. Material with a high surface to volume ratio have _____ fatigue life.

- a) Very low fatigue life
- b) Very high fatigue life
- c) Lower fatigue life

d) Improved fatigue life

186. Which of the following material fails by both hysteric heating and crack propagation?

- a) Nylon
- b) Polyethylene
- c) Propylene

d) PMMA

187. Paris-Erdogan relationship is applicable to some ceramics and plastics along with metals.

a) True

- b) False

188. Indentation hardness gives a rough idea of _____

- a) Yield strength

b) Toughness

c) Tensile strength

d) Compressive strength

189. Which one is a micro-indentation test?

a) Brinell

b) Rockwell

c) Shore

d) Knoop

190. _____ is used for measuring the hardness of brittle materials.

a) Brinell hardness test

b) Rockwell hardness test

c) Shore hardness test

d) Vickers hardness test

191. For hardness test, where test load is larger than 1 kgf, is categorized as _____

a) Micro-hardness test

b) Macro-hardness test

c) Scratch hardness test

d) Rebound hardness test

192. Which one of the following is not an indentation hardness test?

a) Rockwell

b) Shore

c) Vickers

d) Brinell

193. _____ measures the resistance of a sample to material deformation due to a constant compression load from a sharp object.

a) Scratch hardness

b) Rebound hardness

c) Indentation hardness

d) Leeb test

194. For higher _____ indentation hardness is also higher.

a) Ductility

b) Plasticity

c) Stiffness

d) Ductility

195. Indentation hardness is measured by _____

a) Size of indentation

b) Penetration

c) Height of rebound

d) Area under stress-strain curve

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196. Hardness steel ball is used in _____ test.
- a) Knoop
 - b) Vickers
 - c) Brinell**
 - d) Rockwell
197. Vickers hardness test gives accurate readings.
- a) True**
 - b) False
198. Leeb is an indentation hardness test.
- a) True
 - b) False**
199. What indenter is used for Brinell test?
- a) Hardened steel ball**
 - b) Diamond ball
 - c) Diamond prism
 - d) Steel prism
200. What test force is applied for nonferrous materials in Brinell test?
- a) 50 kgf
 - b) 500 kgf**
 - c) 1000 kgf
 - d) 3000 kgf
201. What test force is applied for steels and cast irons in Brinell test?
- a) 500 kgf
 - b) 1000 kgf
 - c) 2000 kgf
 - d) 3000 kgf**
202. What is the most important source of error in the Brinell test?
- a) Surface roughness
 - b) Indentation measurement**
 - c) Coarse structure
 - d) Indenter error
203. What is the ball diameter taken for indenter of 500 kgf load in Brinell test?
- a) 50 mm
 - b) 1 mm
 - c) 5 mm
 - d) 10 mm**
204. What is the ball diameter taken for 1 kgf test load in Brinell test?
- a) 1 mm**
 - b) 5 mm

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- c) 10 mm
- d) 50 mm

205. Brinell hardness number is not a function of _____

- a) Ball diameter
- b) Impression diameter
- c) Surface roughness**
- d) Load

206. Brinell test method is defined in _____

- a) ASTM B10
- b) ASTM E20
- c) ASTM E10**
- d) ASTM B20

207. For Brinell hardness test _____ is kept constant.

- a) P
- b) P/D
- c) P*D
- d) P/D²**

208. For very hard metals _____ ball is used in Brinell test.

- a) Hardened steel
- b) Alloyed steel
- c) Tungsten carbide**
- d) Diamond

209. A ball Indenter of _____ mm and _____ kgf load is used in case of gray cast iron.

- a) 10, 3000**
- b) 5, 750
- c) 10, 1000
- d) 10, 500

210. Brinell test is sensitive to surface roughness.

- a) True
- b) False**

211. The load is applied for a standard time in Brinell test.

- a) True**
- b) False

212. _____ Indenter is used in Vickers hardness test.

- a) Hardened steel ball
- b) Diamond ball
- c) Diamond pyramid**
- d) Tungsten carbide

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213. Vickers indenter has _____ angle between opposite faces of a diamond.
- a) 90°
 - b) 120°
 - c) 136°**
 - d) 180°
214. Which standards define Vickers hardness test?
- a) ASTM E92-72**
 - b) ASTM E10
 - c) ASTM E19-74
 - d) ASTM E334-69
215. Up to a Vickers hardness of _____ the VHN agrees with the BHN.
- a) 30
 - b) 100
 - c) 350**
 - d) 1000
216. What is the disadvantage of the Vickers test?
- a) Accurate readings
 - b) One type indenter for all type materials
 - c) Hardness above 450 BHN can be measured
 - d) Large floor-standing machines**
217. Why Brinell and Vickers hardness test results show similarities?
- a) Same material indenter
 - b) Geometrically similar indentations**
 - c) Applied load is same
 - d) Same size indenter
218. One division of the main scale equals _____ in Vickers test.
- a) 0.1 mm**
 - b) 0.01 mm
 - c) 1.0 mm
 - d) 0.001 mm
219. Which of the following is an advantage of the Vickers test?
- a) Rough surface preparation
 - b) Cheaper
 - c) Accurate readings**
 - d) Large floor-standing machine
220. What is Vickers hardness of martensite?
- a) 140 VHN
 - b) 180 VHN
 - c) 1000 VHN**
 - d) 1200 VHN

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221. What is the hardness of the diamond in VHN?

- a) 1000 HV
- b) 1200 HV
- c) 9000 HV
- d) 10000 HV**

222. Yield strength is given as $HV/0.3$.

- a) True**
- b) False

223. Thickness of sample doesn't affect the Vickers test.

- a) True
- b) False**

224. Which hardness test is most widely used in the US?

- a) Brinell
- b) Vickers
- c) Shore
- d) Rockwell**

225. Rockwell test utilizes _____ a measure of hardness.

- a) Load
- b) Depth of indentation**
- c) Diameter of indentation
- d) Time of loading

226. A minor load of _____ is applied to seat the specimen in the Rockwell test.

- a) 1 kg
- b) 5 kg
- c) 10 kg**
- d) 150 kg

227. What is a limitation of the Rockwell test?

- a) Slow speed
- b) Personal error
- c) Bigger size of indentation
- d) Different indenters**

228. What minimizes the amount of surface preparation in Rockwell test?

- a) Minor load**
- b) Indenter surface
- c) Indenter geometry
- d) Heat-treatment

229. How much penetration is indicated by each division in dial in Rockwell test?

- a) 0.2 mm

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- b) 0.02 mm
- c) 0.002 mm**
- d) 0.0002 mm

230. Hardened steel is tested on the C scale with _____ indenter and a _____ kg major load.

- a) Diamond, 100
- b) Diamond, 150**
- c) 1.6 mm steel ball, 100
- d) 3.2 mm steel ball, 150

231. Which scale is used to test softer materials?

- a) A
- b) B**
- c) C
- d) D

232. What is the hardness of low brass?

- a) HRB 40
- b) HRB 55**
- c) HRC 55
- d) HRC 60

233. What is the hardness of martensite?

- a) 40 HRB
- b) 64 HRB
- c) 40 HRC
- d) 64 HRC**

234. In A scale, steel ball indenter is used.

- a) True
- b) False**

235. Diamond indenter is known as 'Brale indenter'.

- a) True**
- b) False

236. What is test load used in Micro hardness test?

- a) 2-200 gmf
- b) 5-1000 gmf**
- c) 60 gmf
- d) 100 gmf

237. Which of the following is a Microhardness test?

- a) Brinell
- b) Knoop**
- c) Rockwell
- d) Shore

238. What is the shape of indentation by knoop indenter?

- a) Semi spherical
- b) Square
- c) Cone
- d) Rhombohedral**

239. What is the diagonals' ratio of Knoop indenter?

- a) 1:1
- b) 1:2
- c) 7:1**
- d) 10:1

240. Which test is more preferred for testing hardness of electroplated surface?

- a) Dynamic hardness test
- b) Scratch hardness test
- c) Macrohardness test
- d) Microhardness test**

241. Which of the following is an angle between opposite faces in Knoop indenter?

- a) 130°**
- b) 120°
- c) 136°
- d) 122°

242. What is the disadvantage of the Knoop hardness test?

- a) Elastic recovery**
- b) Soft indenter
- c) High load required
- d) Cannot use thin specimen

243. What is Knoop hardness of diamond?

- a) 100 HK
- b) 1000 HK
- c) 7000 HK**
- d) 9000 HK

244. What is Knoop hardness of gold foil?

- a) 68 HK
- b) 69 HK**
- c) 343 HK
- d) 820 HK

245. In microhardness test, Vickers test uses load less than 1 kgf.

- a) True**
- b) False

246. Microhardness test gives average hardness.

- a) True

b) False

247. What is the formula for Knoop hardness number?

- a) $KHN = h - 500t$
- b) $KHN = 1.854P/L^2$
- c) $KHN = P/ D^2$
- d) $KHN = P/L^2C$**

248. Which of the following is a dynamic hardness test?

- a) Brinell
- b) Poldi**
- c) Knoop
- d) Vickers

249. What is the standard height of impact for shore test?

- a) 125 mm
- b) 250 mm**
- c) 500 mm
- d) 750 mm

250. What is a weight of hammer in shore test?

- a) 2.0 gm
- b) 2.3 gm
- c) 2.4 gm**
- d) 3.0 gm

251. As the height of rebound enhances the material's hardness _____

- a) Increases**
- b) Decreases
- c) First Increases and then decreases
- d) Remains constant

252. Specimen less than 1 kg must be clamped because of _____

- a) Elastic recovery
- b) Penetration
- c) Inertial effect**
- d) Personal error

253. What is a disadvantage of shore test?

- a) Very slow
- b) Deep indentation
- c) Clamping problem**
- d) Heavy machinery

254. Which test should be preferred for finished lathe machine bed?

- a) Brinell
- b) Poldi

c) Shore

d) Rockwell

255. What is the height of Poldi apparatus?

a) 10 mm

b) 100 mm

c) 150 mm

d) 250 mm

256. What is the disadvantage of Poldi hardness test?

a) Expensive

b) Not portable

c) Not accurate

d) Can't perform on heavy machinery

257. Poldi hardness test gives a value of _____ also along with dynamic hardness.

a) Yield strength

b) Tensile strength

c) Toughness

d) Young's modulus

258. Tensile strength is given in tonnes per square inch in Poldi test.

a) True

b) False

259. Hardness of heavy components can't be measured by Poldi test.

a) True

b) False

260. What is the disadvantage of LPI?

a) Expensive

b) Slow

c) Not reliable

d) Depth restriction

261. LPI can't be used on _____ specimen.

a) Large

b) Simple

c) Complex

d) Internally defected

262. Which order is right for LPI?

a) Penetrant apply, development, inspection, surface preparation

b) Surface preparation, penetrant apply, development, inspection

c) Penetrant apply, development, surface preparation, inspection

d) Development, surface preparation, penetrant apply, inspection

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263. What is general dwell time?

- a) 20 seconds
- b) 2 minutes
- c) 20 minutes**
- d) 2 hours

264. _____ increases the visibility of the flaw in LPI.

- a) Developer**
- b) Penetrant
- c) Benzene
- d) Spirit

265. Developer is chosen such as benzene.

- a) True
- b) False**

266. Small components are dipped in penetrant.

- a) True**
- b) False

267. Which materials can be tested by MPI?

- a) Magnetic
- b) Non-magnetic
- c) Paramagnetic
- d) Ferromagnetic**

268. Which material can't be tested by MPI?

- a) Co
- b) Fe
- c) Ni
- d) Mg**

269. What is Curie point for most of the ferrous magnetic materials?

- a) 550°C
- b) 760°C**
- c) 910°C
- d) 1133°C

270. The minimum width of crack, which can be inspected by MPI, is

- a) 1nm
- b) 1µm**
- c) 10µm
- d) 1mm

271. What is the advantage of using DC in MPI?

- a) Battery maintenance
- b) Demagnetize easy

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c) Variable voltage supply

d) Subsurface detection

272. Benzene and alcohol are used to decrease component.

a) True

b) False

273. Plain carbon steels are applied with magnetic particles by a residual method?

a) True

b) False

274. What principle defines eddy current inspection (ECI)?

a) Lenz law

b) Biot-Savart Law

c) Electromagnetic induction principle

d) Faraday's law

275. ECI is generally restricted to a depth below _____

a) 1 μ m

b) 1mm

c) 2mm

d) 6mm

276. What is the reason for the limitation of depth below 6mm in ECI?

a) Surface coating

b) Electron hole pair generation

c) Skin effect

d) Residual stresses

277. The total resistance of the coil of ECI is known as _____

a) Impedance

b) Inductance

c) Reactance

d) Capacitance

278. The density of eddy current _____ with distance from the surface in center.

a) Increase linearly

b) Increase exponentially

c) Decrease linearly

d) Decrease exponentially

279. ECI is only used for ferromagnetic materials.

a) True

b) False

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280. Standard penetration depth varies from material to material.

- a) **True**
- b) False

281. Which of the following is the poorest transmitter of sound?

- a) Oil
- b) Water
- c) **Air**
- d) Copper

282. Which of the following is the best transmitter of sound?

- a) Oil
- b) Aluminum
- c) **Steel**
- d) Copper

283. What is the drawback of ultrasonic testing?

- a) Low depth
- b) **High sensitivity**
- c) Shape restriction
- d) Higher errors

284. What is a type of piezoelectric crystal?

- a) **Natural**
- b) Normal
- c) Angle
- d) Transverse

285. The object under inspection must have parallel surfaces.

- a) **True**
- b) False

286. Ultrasonic testing is destructive testing?

- a) True
- b) **False**

287. Radiographic inspection use _____

- a) Sound waves
- b) AC
- c) **X-rays**
- d) Visible light

288. The dark areas represent an object with _____

- a) **Lower density**
- b) High density
- c) Porosity
- d) Grain boundaries

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289. The film in radiographic inspection is called _____

- a) Plate
- b) Radiograph**
- c) Micrograph
- d) X-ray sheet

290. _____ produce light area on film.

- a) Inclusions**
- b) Pores
- c) Voids
- d) Blow holes

291. Radiography don't give _____

- a) Thickness of material
- b) Hardness**
- c) Blow holes in casting
- d) Pores in weldment

292. Planar defects can't be detected by radiography.

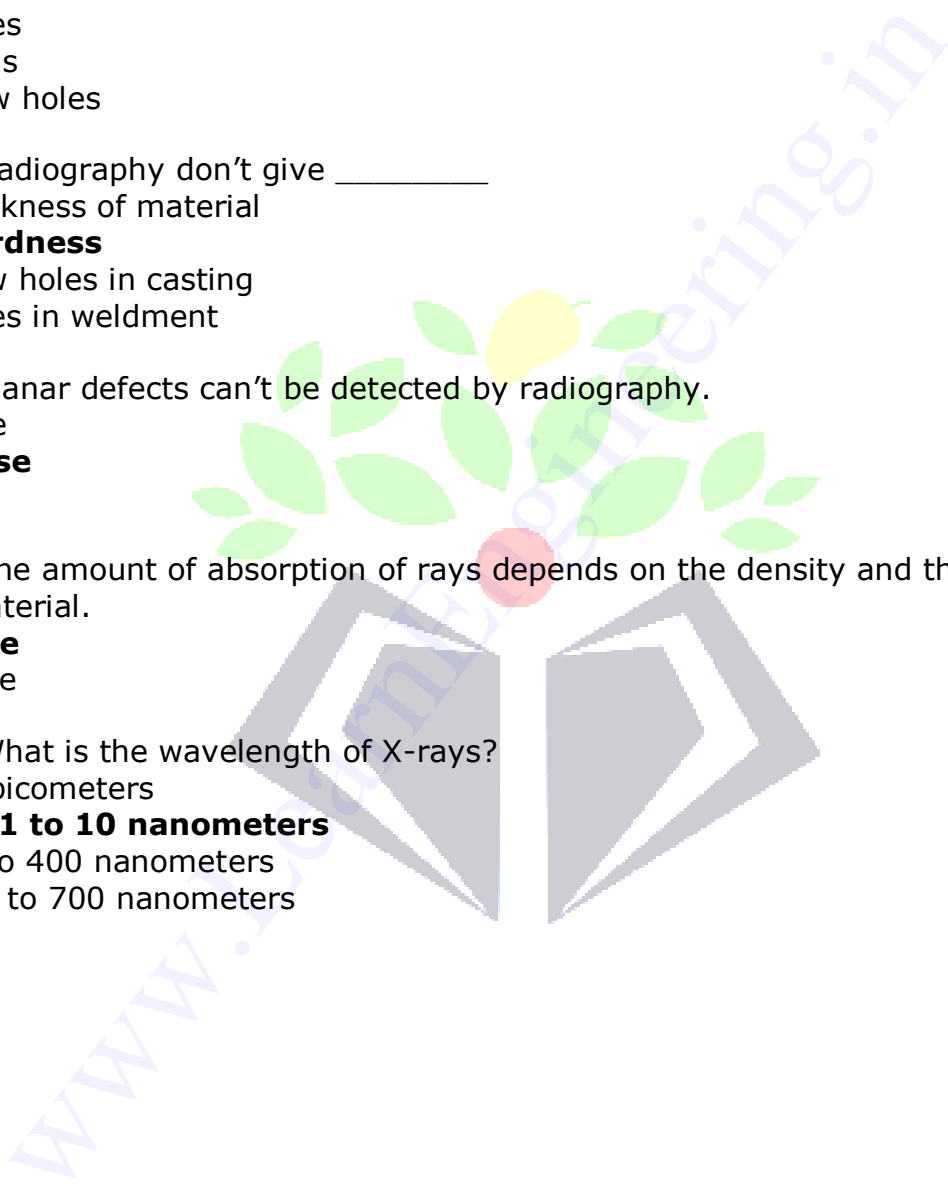
- a) True
- b) False**

293. The amount of absorption of rays depends on the density and thickness of the material.

- a) True**
- b) False

294. What is the wavelength of X-rays?

- a) 10 picometers
- b) 0.01 to 10 nanometers**
- c) 10 to 400 nanometers
- d) 400 to 700 nanometers



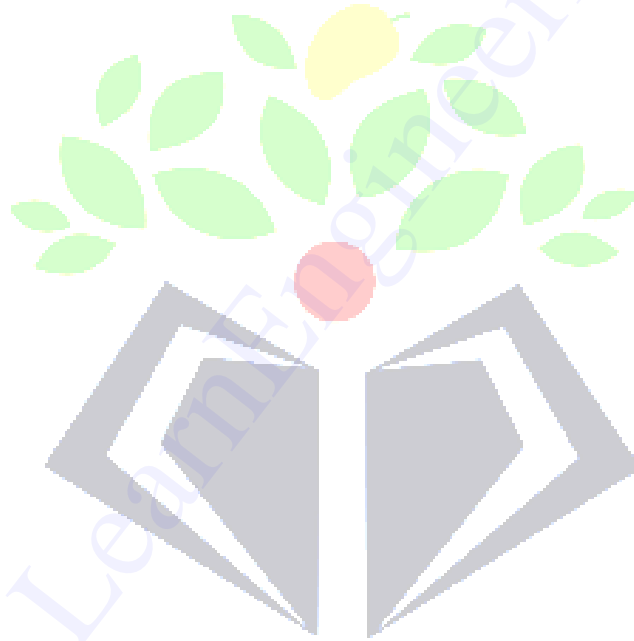
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