MECHANICAL MEALLURGY

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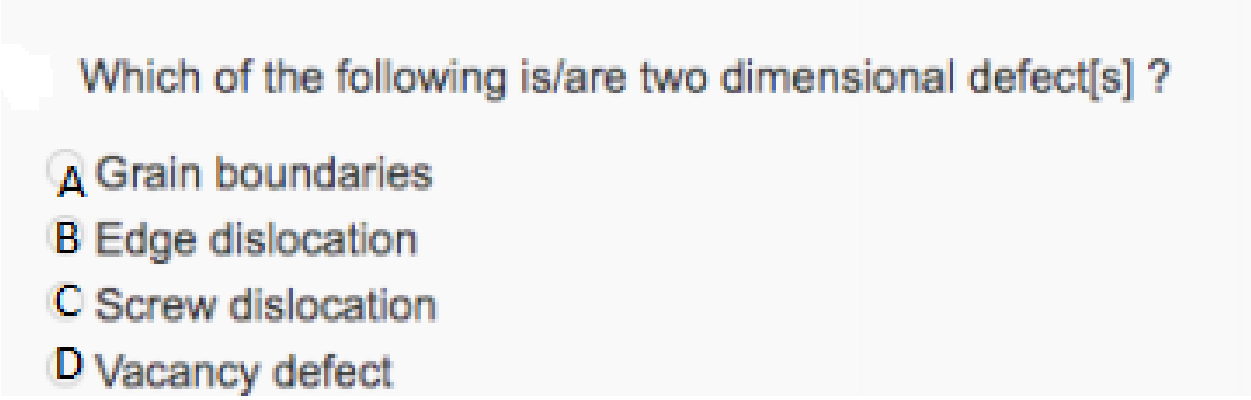
* Required

1. Email *

2. Untitled Question 1 point

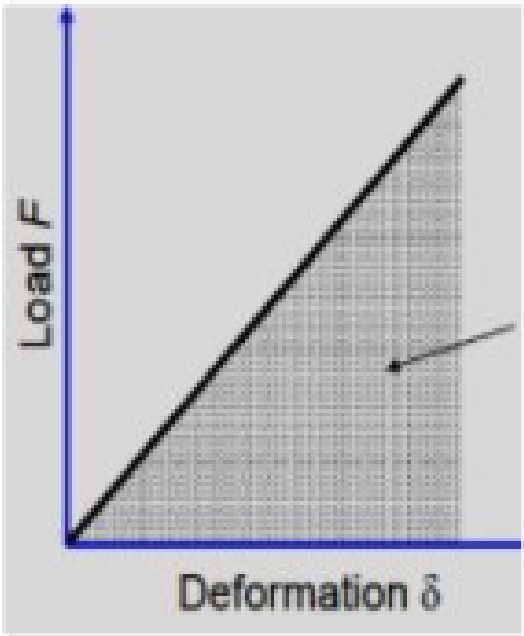


Mark only one oval.

- A
- B
- C
- D

3. 1 point

Area shown in the figure below represents ?



A Yield Stress
B Plastic strain energy
C Elastic strain energy
D Fracture stress

Mark only one oval.

- A
- B
- C
- D

4. 1 point

A uniaxial tensile stress of 100 MPa is applied within elastic limit on a steel block of length 10 cm and a square cross-section of area 4 cm^2. Calculate change in volume (in cm^3) of the block assuming the Young's modulus to be 210 GPa, a poisson ratio = 0.33.

A $4.37x10^{-3}$
B $-4.37x10^{-3}$
C $2.18x10^{-3}$
D $-2.18x10^{-3}$

Mark only one oval.

- A
- B
- C
- D

5. 1 point

Which of the following characteristic[s] of material doesn't affect its elastic properties?

A Bond strength
B Microstructure
C Defects
D Grain orientation

Mark only one oval.

- A
- -
- C
- D

6. 1 point

Which of the following properties are influenced by performing tensile tests at different temperatures?

A Yield strength
B Young's modulus
C Ultimate tensile strength
D Fracture strength

Mark only one oval.

- A
- B
- C
- D

7. 1 point

Which of the following is true for absorbed energy before fracture in materials with similar yield stress.

A Less for brittle fracture
B Cannot be predicted
C Same for both brittle and ductile fracture
D Less for ductile fracture

Mark only one oval.

- A
- B
- C
- D

8. 1 point

A steel sheet of the initial thickness of 10 mm is rolled to a final thickness of 2 mm in 4 passes with equal thickness reduction in all. Calculate the ratio of engineering and true strains in each pass.

A -0.89, -0.86, -0.82, -0.72
B 0.89, 0.86, 0.82, 0.72
C -0.45, -0.43, -0.41, -0.36
D 0.45, 0.43, 0.41, 0.36

Mark only one oval.

- A
- B
- C
- D

9. 1 point

Which of the following is true about the true and engineering stress-strain curve when drawn on the same plot?

A True stress-strain curve shifts up and to the left of the engineering stress-strain curve before necking.
B
True stress-strain curve shifts up and to the right of the engineering stress-strain curve before necking.
C True stress-strain curve shifts down and to the left of the engineering stress-strain curve before necking.
D Both the curves for true as well as engineering stress-strain curves are identical.

Mark only one oval.

- A
- B
- C
- D

10. 1 point

For the slip system (111)[$\bar{1}$01], calculate the resolved shear stress if a load of 500 MPa is applied along the tensile axis [123].

A 350 MPa
B 175 MPa
C 303 MPa
D 152 MPa

Mark only one oval.

- A
- B
- C
- D

11. 1 point

Which of the following is/are true about deformation twinning?

A Deformation due to twinning is the same as the deformation due to slip.
B Deformation due to twinning occurs when the slip systems are less than 5.
C HCP materials deform predominantly by twin deformation
D Reorients a portion of the crystal

Mark only one oval.

- A
- B
- C
- D

12. 1 point

Dislocation density would increase with

A Increase in the amount of cold working
B Increase in the temperature of working
C Change in the dimensions of the sample being worked
D Decrease in the temperature of working

Mark only one oval.

- A
- B
- C
- D

13. 1 point

In which stage(s) during annealing is the decrease in tensile strength is maximum?

A Recrystallization
B Recovery
C Grain growth
D All the above

Mark only one oval.

- A
- B
- C
- D

14. 1 point

According to Hall-Petch equation (where σy is yield strength and d is grain size)

A $\sigma y \propto 1/d$
B $\sigma y \propto 1/\sqrt{d}$
C $\sigma y \propto \sqrt[3]{(1/d)}$
D $\sigma y \propto d$

Mark only one oval.

- A
- B
- C
- D

15. 1 point

Bowing of dislocations between two precipitates is favorable for the case of

A Precipitates spaced far apart
B Incoherent precipitates
C Coherent precipitates
D Large precipitates

Mark only one oval.

- A
- B
- C
- D

16. 1 point

According to the Griffith Theory of brittle fracture

A The theory is applicable only for brittle materials
B brittle material contains a large number of fine cracks
C Explains why engineering materials typically have fracture stresses that are lower than the theoretical value.
D All of the above.

Mark only one oval.

- A
- B
- C
- D

17. 1 point

If a through surface crack causing a fracture in a brittle material is made twice as deep, the fracture strength will

A decrease by a factor of √2
B decrease by a factor of 2
C decrease by a factor of 4
D No change

Mark only one oval.

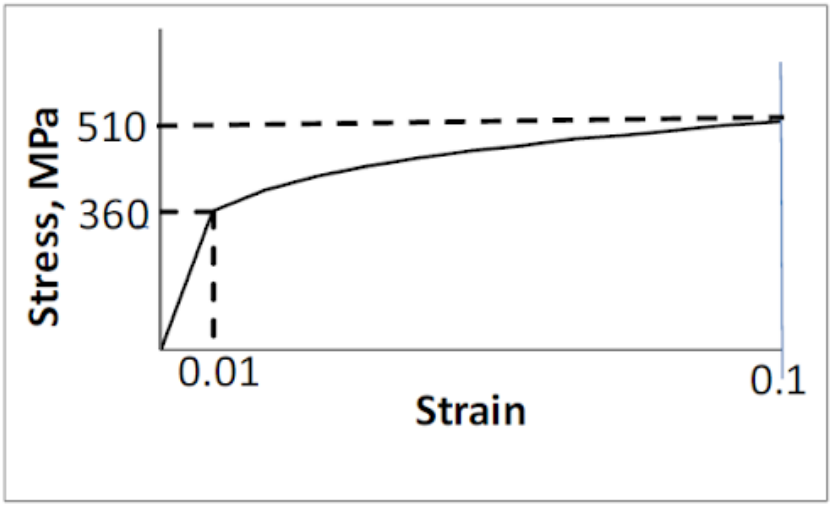
- A
- B
- C
- D

18. 1 point

The Burger's vector of a dislocation in a cubic crystal (with lattice parameter **a**) is $\frac{a}{2}[110]$ and dislocation line is along [112] direction. The angle (in degrees) between the dislocation line and its Burger's vector is_____

19. 1 point

For the tensile stress-strain curve of a material shown in the schematic, the resilience (in MPa) is _____



20. 1 point

Railway tracks are typically manufactured using

(A) Forging
(B) Extrusion
(C) Deep Drawing
(D) Rolling

Mark only one oval.

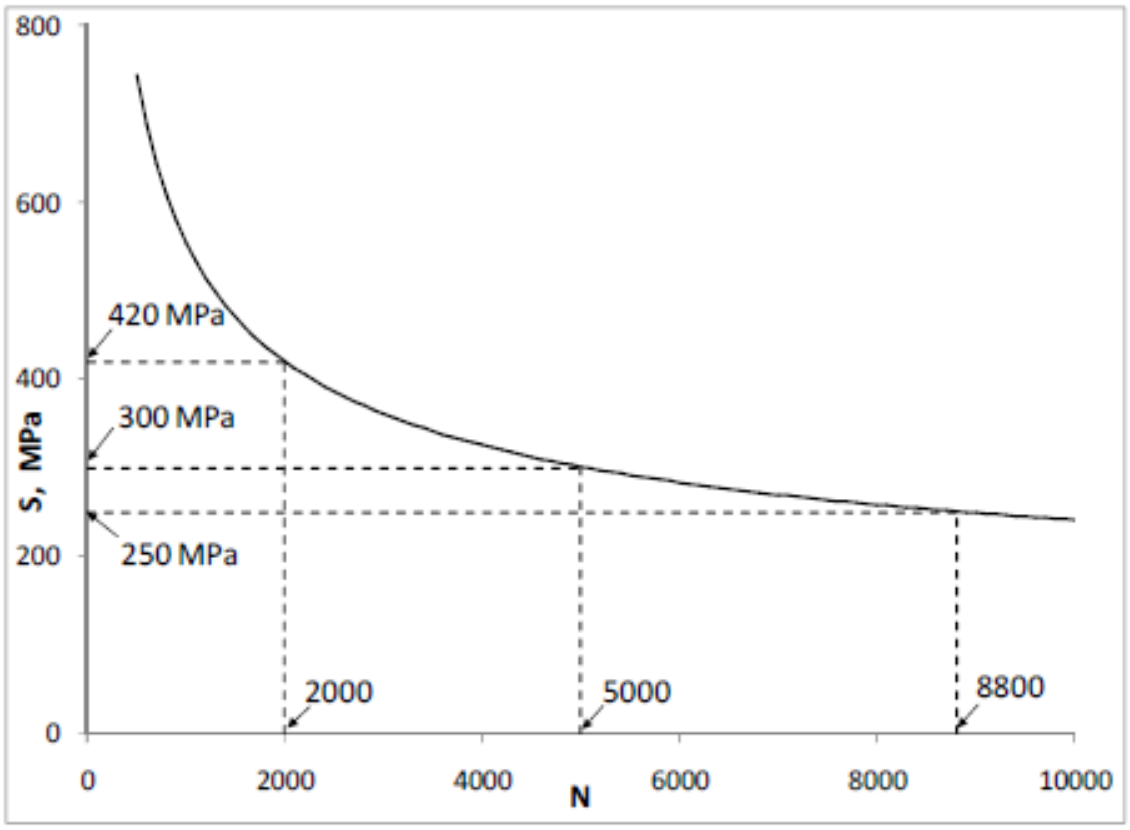
- A
- B
- C
- D

21. 1 point

A rolling mill has a roll diameter of 200 mm. If coefficient of friction is 0.1, then the maximum possible reduction (in mm) during rolling of a 250 mm thick plate is _____

22. 1 point

Fatigue behaviour of an aluminium alloy is shown in the S-N plot. A piston rod made of this material is subjected to: (i) 1000 cycles at 420 MPa, followed by (ii) 1000 cycles at 300 MPa. Using Miner's rule of cumulative damage, the remaining fatigue life (in terms of number of cycles) at stress of 250 MPa is _____



Mark only one oval.

Option 1

23. 1 point

A glass plate has two parallel cracks. One of them is an internal crack of length 5 μm and the other is a surface crack of length 3 μm. A tensile stress is applied perpendicular to the crack surfaces. The fracture stress (in MPa) is _____

Given data (for glass plate):
Young's Modulus = 70 GPa
Surface energy per unit area = 1 $J.m^{-2}$

Mark only one oval.

Option 1

24. 1 point

A tensile stress is applied along the [100] direction in a FCC metal crystal. The critical resolved shear stress is 6 MPa. The tensile stress (in MPa) required for initiating slip on the (111) slip plane is_____

Mark only one oval.

Option 1

25. 1 point

Match the deformation processes in **Column I** with the corresponding stress states listed in **Column II**

Column I	Column II
[P] Wire Drawing	[1] Direct Compression
[Q] Forging	[2] Indirect Compression
[R] Stretch Forming	[3] Tension
[S] Cutting	[4] Shear

(A) P-1; Q-2; R-3; S-4
(B) P-1; Q-2; R-4; S-3
(C) P-2; Q-1; R-3; S-4
(D) P-2; Q-1; R-4; S-3

Mark only one oval.

- A
- B
- C
- D

26. 1 point

Primary mechanisms of accommodating plastic strain at low temperatures in crystalline metals are:

(A) twinning and dislocation-slip
(B) dislocation-climb and dislocation-slip
(C) dislocation-slip and diffusion
(D) viscous-flow and dislocation-slip

Mark only one oval.

- A
- B
- C
- D

27. 1 point

A brittle material (Young's modulus = 60 GPa and surface energy = 0.5 $J.m^{-2}$) has a surface crack of length 2 μm. The fracture strength (in MPa) of this material is _____

Mark only one oval.

- Option 1

28. 1 point

Stress required to operate a Frank-Read source of length L is approximately given by:

(A) $\frac{Gb}{L}$ (B) $\frac{Gb^2}{L}$

(C) $\frac{Gb^2}{L^2}$ (D) $\frac{Gb^2}{2L^2}$

Mark only one oval.

- A
- B
- C
- D

29. 1 point

A rod is elastically deformed by a uniaxial stress resulting in a strain of 0.02. If the Poisson's ratio is 0.3, the volumetric strain is _____

Mark only one oval.

- Option 1

30. 1 point

During heat treatment of a cold worked metal, recrystallization is 20% complete after 100 s. The transformation (in %) in 400 s is _____ *(answer up to two decimal places)*

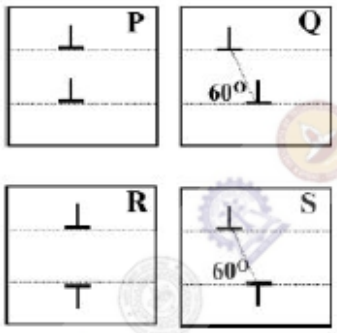
(Assume Avrami exponent, n =2)

Mark only one oval.

- Option 1

31. 1 point

At low temperature, two parallel edge dislocations lying on parallel slip planes are shown in different configurations below.



Match the following:

Configuration [P]	[1] Dislocations repel
Configuration [Q]	[2] Dislocations attract
Configuration [R]	[3] Dislocations are in stable equilibrium
Configuration [S]	[4] Dislocations are in unstable equilibrium

(A) P-3, Q-2, R-4, S-1
(B) P-4, Q-1, R-3, S-2
(C) P-1, Q-3, Q-2, R-4
(D) P-2, Q-4, R-1, S-3

Mark only one oval.

- A
- B
- C
- D

32. 1 point

A single crystal of an FCC metal is subjected to a sufficiently large tensile stress along the [110] direction to activate some of the slip systems. Which one of the following slip systems will be activated:

(A) $\frac{a}{2}[\bar{1}10](111)$ (B) $\frac{a}{2}[011](11\bar{1})$

(C) $\frac{a}{2}[011](1\bar{1}1)$ (D) $\frac{a}{2}[110](\bar{1}1\bar{1})$

Mark only one oval.

- A
- B
- C
- D

33. 1 point

A perfectly elastic-plastic material has a yield stress of 450 MPa and fractures at a strain of 0.45. The ratio of resilience to toughness for this material is _____

(Given the Young's modulus E = 4.5 GPa)

Mark only one oval.

- Option 1

34. 1 point

A 250 mm thick slab of a nickel alloy is subjected to cold rolling using a roll of diameter 450 mm. If the angle of bite during rolling is 10° the maximum possible reduction (in mm) during rolling is _____

Mark only one oval.

- Option 1

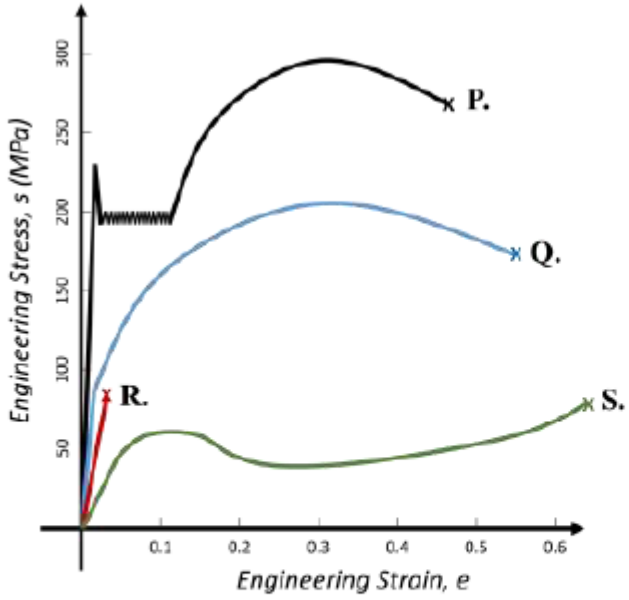
35. 1 point

A plate of thickness h = 120 mm is cold rolled in a mill with a roll diameter of 200 mm. If the coefficient of friction μ is 0.1, the maximum possible reduction Δh in a single pass is

_____

36. 1 point

Match the four tensile stress-strain curves (P,Q, R, S) with the materials listed in the box:



1. Polyester (PET)
2. High purity Copper
3. Mild Steel
4. Soda-lime Glass

(A) P-1, Q-2, R-3, S-4
(B) P-3, Q-1, R-4, S-2
(C) P-3, Q-2, R-4, S-1
(D) P-2, Q-3, R-4, S-1

Mark only one oval.

- A
- B
- C
- D

37. 1 point

Consider the following stress state imposed on a material:

$$\sigma = \begin{bmatrix} 90 & 50 & 0 \\ 50 & -20 & 0 \\ 0 & 0 & 140 \end{bmatrix} \text{MPa.}$$

If the material responds elastically with a volumetric strain $\Delta = 3.5 \times 10^{-4}$, what is its bulk modulus?

(A) 150 GPa (B) 350 GPa (C) 200 GPa (D) 400 GPa

Mark only one oval.

- A
- B
- C
- D

38. 1 point

A single crystal of aluminium is subjected to 10 MPa tensile stress along the [321] crystallographic direction. The resolved shear stress on the $(11\bar{1})$ [101] slip system is _____

Mark only one oval.

- Option 1

39. 1 point

The ideal plastic work involved in extruding a cylindrical billet of length 100 mm, from an initial diameter of 20 mm to a final diameter of 16 mm is _____ (in J)

The flow stress in compression is 40 MPa, and remains constant throughout the process.

Mark only one oval.

- Option 1

40. 1 point

During low strain rate (≤ 0.1 per second) deformation of a metal at room temperature, the one that deforms by twinning mode is _____.

(A) Fe (B) Mg (C) Al (D) Ni

Mark only one oval.

- A
- B
- C
- D

41. 1 point

Alligatoring is a defect commonly observed in _____.

(A) Extrusion

(B) Deep drawing

(C) Sheet metal forming

(D) Rolling

Mark only one oval.

- A
- B
- C
- D

42. 1 point

A plate of width 100 cm and thickness 5 cm is rolled to a thickness of 3 cm. If the entry velocity is 10 $cm.s^{-1}$, the exit velocity of the plate (in $cm.s^{-1}$)

is _____.

Assume no change in the width of the plate.

43. 1 point

An aluminium single crystal is loaded in tension along $[1\,\bar{1}\,0]$ axis. Among the following slip systems, the one that will be activated first is_____.

(A) $(1\,\bar{1}\,\bar{1})[0\,\bar{1}\,1]$

(B) $(\bar{1}\,\bar{1}\,1)[0\,1\,1]$

(C) $(\bar{1}\,\bar{1}\,1)[1\,\bar{1}\,0]$

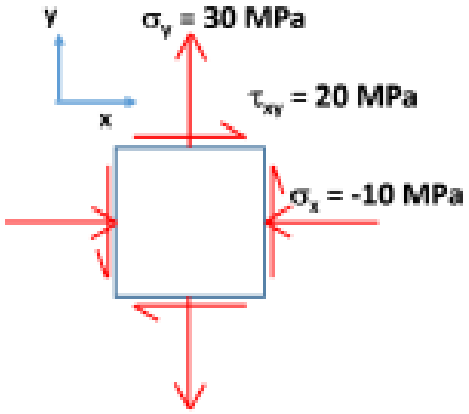
(D) $(\bar{1}\,\bar{1}\,1)[1\,0\,1]$

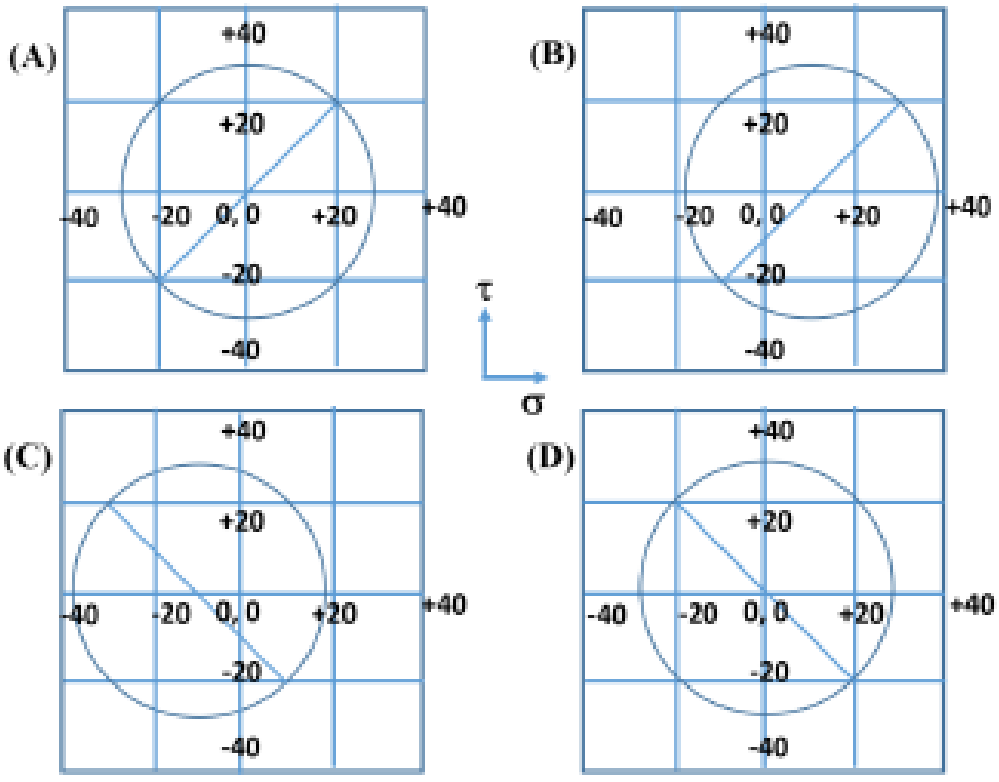
Mark only one oval.

- A
- B
- C
- D

44. 1 point

The correct Mohr's circle construction for the stress state given below is _____.





Mark only one oval.

- A
- B
- C
- D

45. 1 point

Cold working of iron leads to increase in dislocation density from 10^{10} to $10^{15}\ m^{-2}$. The associated stored energy (in $\boldsymbol{MJ.m^{-3}}$) is _____.

Given: Shear modulus of iron = 82 GPa, Burger's vector, $\vec{b} = \frac{a_0}{2}[111]$,

$a_0 = 0.2856$ nm.

Mark only one oval.

- Option 1

46. 1 point

True stress - true strain behavior of a metal is given by the flow curve equation $\sigma = 1750\varepsilon^{0.37}$, where σ is in MPa. The true stress at necking (in MPa) is _____.

Mark only one oval.

- 1211.358
- 0
- 1750
- NONE OF THE ABOVE

47. 1 point

The maximum possible reduction (in mm) of a 100 mm thick slab during rolling is _____.

Given: The coefficient of friction between roll and the slab is 0.2, and the roll diameter is 200 mm.

48. 1 point

A slip system consists of a slip plane and a slip direction. Which one of the following is NOT a valid slip system in a FCC copper crystal?

(A) $(1\,1\,1)[1\bar{1}0]$

(B) $(\bar{1}\,1\,1)[0\,1\,1]$

(C) $(1\bar{1}1)[10\bar{1}]$

(D) $(1\,1\bar{1})[1\,0\,1]$

Mark only one oval.

- A
- B
- C
- D

49. 1 point

For a material to exhibit superplasticity, one of the requirements is:

(A) Coarse-grained microstructure

(B) High strain-rate sensitivity

(C) Low strain-hardening exponent

(D) High modulus of elasticity

Mark only one oval.

- A
- B
- C
- D

50. 1 point

In cold-rolling, for the sheet to be drawn into rolls, the angle of contact (or angle of bite) should be less than or equal to _____ degree

Given, the coefficient of friction between sheet and roll is 0.1

51. 1 point

Which one of the following dislocation reactions is NOT feasible in a FCC crystal?

(A) $\frac{1}{2}[0\bar{1}1] \rightarrow \frac{1}{6}[1\bar{2}1] + \frac{1}{6}[\bar{1}\bar{1}2]$

(B) $\frac{1}{2}[1\bar{1}0] + \frac{1}{2}[1\bar{1}0] \rightarrow [1\bar{1}0]$

(C) $\frac{1}{6}[11\bar{2}] + \frac{1}{3}[111] \rightarrow \frac{1}{2}[110]$

(D) $\frac{1}{2}[\bar{1}01] \rightarrow \frac{1}{6}[\bar{2}11] + \frac{1}{6}[\bar{1}\bar{1}2]$

Mark only one oval.

- A
- B
- C
- D

52. 1 point

The yield point phenomenon observed in annealed low carbon steels is due to the presence of

(A) silicon (B) chromium (C) phosphorous (D) carbon

Mark only one oval.

- A
- B
- C
- D

53. 1 point

A metal with an average grain size of 36 μm has yield strength of 250 MPa and that with 4 μm has 500 MPa. The friction stress of the metal in MPa is

(A) 31.2 (B) 62.5 (C) 125 (D) 250

Mark only one oval.

- A
- B
- C
- D

54. 1 point

The slip directions on a $(\bar{1}1\bar{1})$ plane of a fcc crystal are

(A) $[\bar{1}01]$, $[011]$, $[110]$
(B) $[101]$, $[\bar{1}\bar{1}0]$, $[10\bar{1}]$
(C) $[\bar{1}0\bar{1}]$, $[\bar{1}\bar{1}0]$, $[0\bar{1}\bar{1}]$
(D) $[0\bar{1}1]$, $[01\bar{1}]$, $[\bar{1}10]$

Mark only one oval.

- A
- B
- C
- D

55. 1 point

The correct statements among the following are

(P) screw dislocations cannot climb
(Q) screw dislocations cannot cross-slip
(R) edge dislocations cannot climb
(S) edge dislocations cannot cross-slip

(A) P, R (B) P, S (C) Q, R (D) Q, S

Mark only one oval.

- A
- B
- C
- D

56. 1 point

A steel bar (elastic modulus = 200 GPa and yield strength = 400 MPa) is loaded to a tensile stress of 1 GPa and undergoes a plastic strain of 2%. The elastic strain in the bar in percent is

(A) 0 (B) 0.2 (C) 0.5 (D) 2.0

Mark only one oval.

- A
- B
- C
- D

57. 1 point

Two samples P and Q of a brittle material have crack lengths in the ratio 4:1. The ratio of fracture strengths of P and Q, measured normal to the cracks, will be

(A) 1:4 (B) 1:2 (C) 2:1 (D) 4:1

Mark only one oval.

- A
- B
- C
- D

58. 1 point

The defects that are NOT observed in extruded products are

(P) chevron cracking
(Q) fold
(R) piping
(S) surface cracking
(T) alligatoring

(A) P, Q (B) R, T (C) P, S (D) Q, T

Mark only one oval.

- A
- B
- C
- D

59. 1 point

A property that CANNOT be obtained from a tensile test is

(A) Young's modulus (B) yield strength

(C) ultimate tensile strength (D) endurance limit

Mark only one oval.

- A
- B
- C
- D

60. 1 point

Match the processes given in Group 1 with the corresponding typical defects given in Group 2.

Group 1		Group 2	
P.	Forging	1.	Alligatoring
Q.	Rolling	2.	Cold shut
R.	Deep drawing	3.	Chevron cracks
S.	Extrusion	4.	Wrinkles

(A) P-1, Q-2, R-3, S-4 (B) P-2, Q-1, R-4, S-3

(C) P-2, Q-1, R-3, S-4 (D) P-3, Q-1, R-4, S-2

Mark only one oval.

- Option 1

61. 1 point

A unit dislocation with a Burgers vector $\vec{b}_1$ will dissociate into two partial dislocations with Burgers vectors $\vec{b}_2$ and $\vec{b}_3$, if and only if

P. $b_1^2 > b_2^2 + b_3^2$

Q. $b_1^2 < b_2^2 + b_3^2$

R. $\vec{b}_1 = \vec{b}_2 + \vec{b}_3$

S. $\vec{b}_1 \neq \vec{b}_2 + \vec{b}_3$

(A) P, R (B) P, S (C) Q, R (D) Q, S

Mark only one oval.

- A
- B
- C
- D

62. 1 point

A 3.0 mm diameter single crystal is loaded to 400 N along $[001]$ direction. The resolved shear stress on $(111)[\bar{1}01]$ slip system is

(A) 5.8 MPa (B) 11.5 MPa (C) 23.1 MPa (D) 46.2 MPa

Mark only one oval.

- A
- B
- C
- D

63. 1 point

The stress applied on a material is

$$\sigma_{ij} = \begin{bmatrix} 21 & 0 & 0 \\ 0 & 21 & 0 \\ 0 & 0 & 21 \end{bmatrix} \text{MPa.}$$

The maximum shear stress experienced by it is

(A) 0 MPa (B) 10.5 MPa (C) 21 MPa (D) 63 MPa

Mark only one oval.

- A
- B
- C
- D

64. 1 point

A metallic rod with 2 mm × 2 mm square cross-section is being tested in tension and has the following mechanical properties:

Young's modulus = 100 GPa Poisson's ratio = 0.30

Yield stress = 500 MPa Work hardening exponent = 0.25

Ultimate tensile strength = 1000 MPa

The rod is loaded to 1000 N, the magnitude of transverse strain is

(A) 0.025% (B) 0.075% (C) 0.15% (D) 0.25%

Mark only one oval.

- A
- B
- C
- D

65. 1 point

For a simple cubic unit cell with unit vectors **i**, **j** and **k**, the angle between lattice vectors [100] and [111] in degrees is

(A) 35.2 (B) 54.7 (C) 60 (D) 90

Mark only one oval.

- A
- B
- C
- D

66. 1 point

Which one of the following reactions in fcc/bcc crystals with lattice parameter 'a' is energetically favorable?

(A) $\frac{a}{2}[\bar{1}10]+\frac{a}{2}[0\bar{1}1]$

(B) $\frac{a}{2}[\bar{1}10]+\frac{a}{2}[\bar{1}10]$

(C) $\frac{a}{2}[111]+\frac{a}{2}[11\bar{1}]$

(D) $\frac{a}{2}[111]+\frac{a}{2}[111]$

Mark only one oval.

- A
- B
- C
- D

67. 1 point

An aluminium billet of 300 mm diameter is extruded with an extrusion ratio of 16.

What is the diameter of the final product?

(A) 150 mm (B) 75 mm (C) 59 mm (D) 19 mm

Mark only one oval.

- Option 1

68. 1 point

Shear modulus of copper is 45 GPa. Lattice parameter of copper is 3.61 Å

The magnitude of burgers vector in copper is

(A) 2.54 Å (B) 2.39 Å (C) 2.20 Å (D) 2.18 Å

Mark only one oval.

- A
- B
- C
- D

69. 1 point

The property of a material that CANNOT be significantly changed by heat treatment is

(A) Yield strength
(B) Ultimate tensile strength
(C) Ductility
(D) Elastic modulus

Mark only one oval.

- A
- B
- C
- D

70. 1 point

A unit dislocation splits into two partial dislocations. The correct combination of the Burgers vectors of the partial dislocations for a given unit dislocation having Burgers vector $\frac{a}{2}[1\,\bar{1}\,0]$ is

(A) $\frac{a}{6}[2\,\bar{1}\,1]$ and $\frac{a}{6}[1\,\bar{2}\,\bar{1}]$
(B) $\frac{a}{6}[1\,\bar{1}\,2]$ and $\frac{a}{6}[\bar{1}\,\bar{2}\,1]$
(C) $\frac{a}{6}[1\,1\,\bar{2}]$ and $\frac{a}{6}[2\,\bar{1}\,\bar{1}]$
(D) $\frac{a}{6}[2\,1\,1]$ and $\frac{a}{6}[1\,2\,\bar{1}]$

Mark only one oval.

- A
- B
- C
- D

71. 1 point

Match the phenomena listed in **Group I** with the possible mechanisms in **Group II**

Group I	**Group II**
P. Fatigue	1. Grain boundary sliding
Q. Creep	2. Slip band extrusion and intrusion
R. Strain hardening	3. Cottrell atmosphere
S. Yield point phenomenon	4. Dislocation interaction

(A) P-2, Q-3, R-4, S-1
(B) P-2, Q-4, R-3, S-1
(C) P-2, Q-1, R-4, S-3
(D) P-1, Q-2, R-4, S-3

Mark only one oval.

- A
- B
- C
- D

72. 1 point

The flow stress ($\bar{\sigma}$) of an alloy varies with strain rate $(\dot{\varepsilon})$ as $\bar{\sigma} = 100\ (\dot{\varepsilon})^{0.1}$ MPa. When the alloy is hot extruded from 10 cm diameter to 5 cm diameter at a speed of 2 cm/s, the flow stress is

(A) 1000 MPa (B) 105 MPa (C) 150 MPa (D) 1050 MPa

Mark only one oval.

- A
- B
- C
- D

73. 1 point

Match the defects listed in **Group I** with the processes listed in **Group II**

Group I	Group II
P. Cold shut	1. Rolling
Q. Earing	2. Forging
R. Alligatoring	3. Deep drawing
S. Shrinkage porosity	4. Fusion welding

(A) P-2, Q-4, R-1, S-4
(B) P-2, Q-4, R-3, S-1
(C) P-2, Q-3, R-1, S-4
(D) P-4, Q-1, R-2, S-3

Mark only one oval.

- A
- B
- C
- D

74. 1 point

The strain hardening behaviour of an annealed rod during cold rolling is given by $\bar{\sigma} = 700\ (\varepsilon)^{0.2}$ MPa, where $\bar{\sigma}$ is the flow stress at strain ε.

Flow stress after 50% reduction in area of the annealed rod on cold rolling is approximately

(A) 750 MPa (B) 650 MPa (C) 609 MPa (D) 559 MPa

Mark only one oval.

- A
- B
- C
- D

75. 1 point

The yield strength of a polycrystalline metal increases from 100 MPa to 145 MPa on decreasing the grain size from 64 µm to 25 µm. The yield strength of this metal (in MPa) having a grain size of 36 µm is

(A) 110 (B) 125 (C) 140 (D) 165

Mark only one oval.

- A
- B
- C
- D

76. 1 point

A 480 mm thick slab is hot-rolled using a roll of 720 mm diameter. For a coefficient of friction of 0.5, the maximum possible reduction (in mm) is

(A) 90 (B) 180 (C) 240 (D) 360

Mark only one oval.

- A
- B
- C
- D

77. 1 point

Match the defects listed in **Group I** with the corresponding manufacturing process listed in **Group II**

Group I	Group II
(P) Orange-peel effect	(1) Extrusion
(Q) Chevron cracking	(2) Deep drawing
(R) Flash	(3) Arc welding
(S) Undercut	(4) Forging

(A) P-1, Q-2, R-4, S-3
(B) P-2, Q-3, R-1, S-4
(C) P-3, Q-4, R-2, S-1
(D) P-2, Q-1, R-4, S-3

Mark only one oval.

- A
- B
- C
- D

78. 1 point

Which of the following metal working operations can be categorized as an indirect compression process?

(A) Forging (B) Wire drawing (C) Extrusion (D) Stretch forming

Mark only one oval.

- A
- B
- C
- D

79. 1 point

Which of the following metal forming techniques is used to produce soft drink cans from aluminium sheets?

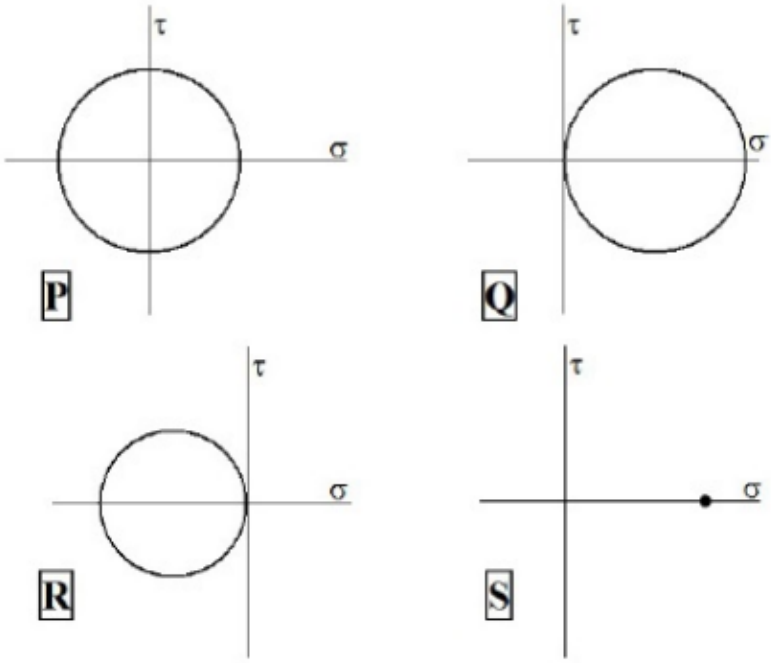
(A) Rolling (B) Forging (C) Deep drawing (D) Extrusion

Mark only one oval.

- A
- B
- C
- D

80. 1 point

Which of the following Mohr's circles of a plane-stress condition corresponds to equi-biaxial tension?



(A) P (B) Q (C) R (D) S

Mark only one oval.

- A
- B
- C
- D

81. 1 point

In an FCC crystal, the strain energy per unit length of a dislocation with Burgers vector $\frac{a}{2}\langle 110\rangle$ *is* _____ *times that of a* $\frac{a}{6}\langle 112\rangle$ *dislocation.*

Mark only one oval.

- Option 1

82. 1 point

On the basis of working temperature, metal forming is classified as hot working, cold working and

Mark only one oval.

- Warm working
- Cryo working
- Ultra high temp working
- Sub zero working

83. 1 point

A material has yield strength of 420 MPa at a strain rate of 10^{-3} s^{-1}. If material behavior is given by $\sigma = C\dot{\varepsilon}^m$, where m=0.01. Find yield strength if the same material was given same strain at a strain rate of 10^4 s^{-1}

Mark only one oval.

- 493 MPa
- 420 MPa
- 220 MPa
- 100 MPa

84. 1 point

Hydrostatic stress produces

Mark only one oval.

- Only elastic volume changes and not plastic deformation
- Only plastic deformation and not elastic volume changes
- Only permanent deformation and not volume changes
- Only volume changes and no plastic deformation

85. 1 point

Which of the following is true regarding plastic strain and the path through which it has been given the deformation

Mark only one oval.

- Plastic strain is path dependent
- Plastic strain is path independent
- It depends on the deformation configuration, whether plastic strain is path dependent
- Nothing can be said about plastic strain with regard to the path of deformation

86. 1 point

Match the following:

A.	Cold working	(i)	0.3 Tm < T < 0.5 Tm
B.	Warm working	(ii)	0.5 Tm < T
C.	Hot working	(iii)	T < 0.3 Tm

Mark only one oval.

- A-i, B-ii, C-iii
- A-iii, B-ii, C-i
- A-iii, B-i, C-ii
- A-ii, B-iii, C-i

87. 1 point

Recrystallization during hot working is characterized by

Mark only one oval.

- Rearrangement of defects/dislocations inside grains
- Nucleation of strain free grains
- No major microstructural changes
- Large growth of grains

88. 1 point

Consider a metal whose strain hardening behavior follow $\bar{\sigma} = 250\bar{\epsilon}^{0.25}\ MPa$. Its an annealed bar, pulled in tension from D_0=12.7 mm to D_f = 11.5 mm. What is the work per unit volume?

Mark only one oval.

- 3.93 MJ/m3
- 9.34 MJ/m3
- 26.5 MJ/m3
- 250 MJ/m3

89. 1 point

In a general deformation condition' for a body in equilibrium, how many independent elements are present in the stress tensor

Mark only one oval.

- 4
- 6
- 8
- 9

90. 1 point

How many principal stresses would exist in a 3 dimensional stress state?

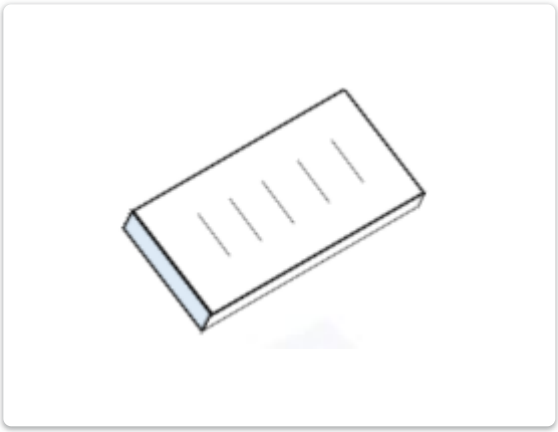
Mark only one oval.

- 1
- 2
- 3
- 4

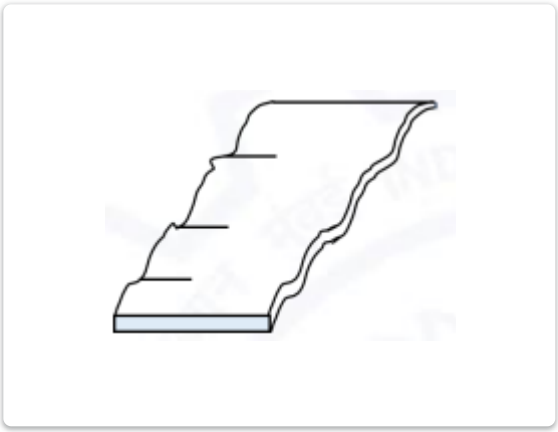
91. 1 point

Which one of the following is 'center split' defect in rolling operation?

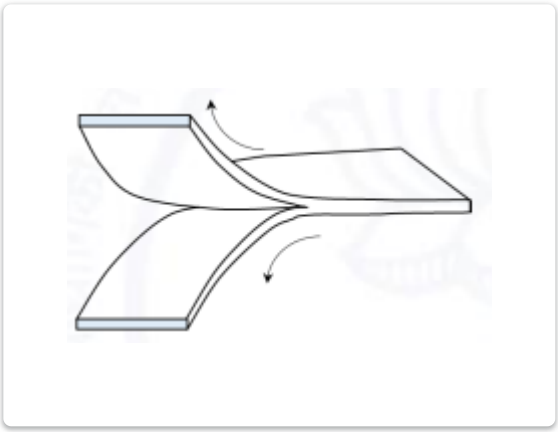
Mark only one oval.



A



B

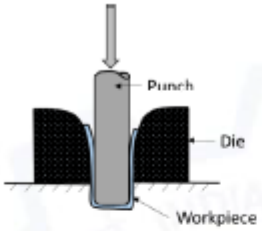
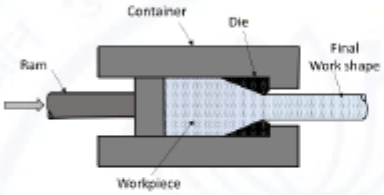
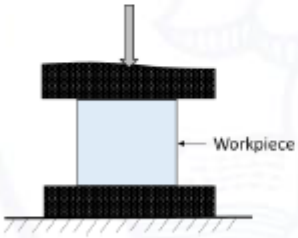
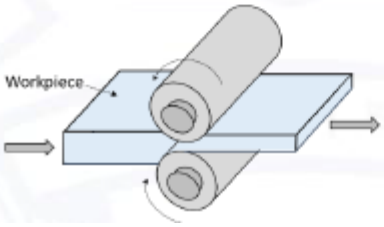


C

D

92. 1 point

Match the forming process (in Column I) with its name (in Column II):

Column I	Column II
(P) 	1. Extrusion
(Q) 	2. Rolling
(R) 	3. Deep Drawing
(S) 	4. Open Die Forging

Mark only one oval.

- P-1,Q-2,R-3,S-4
- P-3,Q-1,R-4,S-2
- P-3,Q-4,R-1,S-2
- P-1,Q-4,R-3,S-2

93. A single crystal aluminium sample is subjected to uniaxial tension along[112] direction. If the applied tensile stress is 100 MPa and the critical resolved shear stress (CRSS) is 25 MPa, which one of the following slip systems will be activated? 1 point

Mark only one oval.

- $[1\bar{0}1](111)$
- $[\bar{1}\bar{1}0](111)$
- $[101](11\bar{1})$
- $[011](11\bar{1})$

94. 1 point

A body is subjected to a state of stress given by the following stress tensor:

$$\begin{pmatrix} 50 & 0 & 0 \\ 0 & 200 & 0 \\ 0 & 0 & 100 \end{pmatrix}$$ **MPa.**

If yielding is predicted by the Tresca Criterion, the uniaxial tensile yield stress (in MPa) of the body should be less than or equal to: _____ (round off to nearest integer).

Mark only one oval.

- 150
- 50
- 200
- 0

95. 1 point

If a material is subjected to two incremental true strains namely ε1 and ε2, then the total true strain is

A ε1 * ε2
B ε1 - ε2
C ε1 + ε2
D ε1 / ε2

Mark only one oval.

- A
- B
- C
- D

96. 1 point

The materials which have the same elastic properties in all directions are called

A Isotropic
B Brittle
C Homogeneous
D Hard

Mark only one oval.

- A
- B
- C
- D

97. 1 point

Which of the following occurs at higher value of stress?

A Proportionality stress
B True elastic limit
C 0.2% offset yield strength
D Stress at elastic limit

Mark only one oval.

- A
- B
- C
- D

98. 1 point

Which of the following metals will have highest elastic modulus?

A Aluminium
B Copper
C Iron
D Tungsten

Mark only one oval.

- A
- B
- C
- D

99. 1 point

For a true strain of 0.5, the corresponding engineering strain is

A 0.45
B 2.65
C 0.65
D 0.75

Mark only one oval.

- A
- B
- C
- D

100. 1 point

Value of strain hardening coefficient lie in range of

A 0.1-1
B 0.1-0.5
C 0.5-1
D 0-2

Mark only one oval.

- A
- B
- C
- D

101. 1 point

In a tension test of a bar, the neck region has a _____ state of stress.

A Uniaxial
B Biaxial
C Triaxial
D Hydrostatic

Mark only one oval.

- A
- B
- C
- D

102. 1 point

Which of the following is the plane with highest atomic density in a BCC crystal?

A (111)
B (110)
C (100)
D (112)

Mark only one oval.

- A
- B
- C
- D

103. 1 point

Upon plastic deformation of a material, what is/are likely to happen?

A Poisson's ratio of the sample changes
B Volume of the sample remains constant
C There is a change in the lattice parameter of the material
D There is a change in hardness of the sample

Mark only one oval.

- A
- B
- C
- D

104. 1 point

Energy of a dislocation (Gb^2) with Burger's vector 'b' in a BCC crystal of lattice parameter 'a' is

A $G.a^2/2$
B $G.a^2/4$
C $3G.a^2/4$
D $3G.a^2$

Mark only one oval.

- A
- B
- C
- D

105. 1 point

If the distance between pining sites increases by two times, the stress required to move the dislocation:

A Increases by 2 times
B Decreases by 2 times
C Increases by 4 times
D Decreases by 4 times

Mark only one oval.

- A
- B
- C
- D

106. 1 point

What of the following happens during dislocation motion in a metal?

A No change in Volume
B No change in Crystal structure
C Change in dimensions
D Change in Elastic Modulus

Mark only one oval.

- A
- B
- C
- D

107. 1 point

Theoretical shear strength of a material is approximately

A G/π
B $G/2\pi$
C $G/3\pi$
D $G/4\pi$

Mark only one oval.

- A
- B
- C
- D

108. 1 point

What is the unit of dislocation density?

A mm^{-2}
B mm^{-3}
C mm^{2}
D mm

Mark only one oval.

- A
- B
- C
- D

109. 1 point

In comparison to corresponding engineering stress strain curve, the onset of necking in a true stress strain curve will be represented at

A High strain
B Lower strain
C Same value of strain
D at stain of 0.2%

Mark only one oval.

- A
- B
- C
- D

110. 1 point

What are the limiting values of Poisson's ratio?

A -1 to 1
B -1 to 0
C 0 to 0.5
D 0 to 1

Mark only one oval.

- A
- B
- C
- D

111. 1 point

A tensile specimen was deformed to a true strain of 0.405. The change in the gauge length was 5 mm. The final gauge length of the specimen, in mm, is

(A) 10 (B) 12 (C) 15 (D) 18

Mark only one oval.

- A
- B
- C
- D

112. 1 point

Identify the **INCORRECT** statement with respect to grain growth.

(A) As the average grain size increases, the grain boundary energy per unit area decreases.

(B) The driving force for grain growth is the decrease in grain boundary energy per unit volume of the material.

(C) Higher the temperature, the faster is the grain growth.

(D) Impurity atoms segregated at grain boundaries can retard grain growth.

Mark only one oval.

- A
- B
- C
- D

113. 1 point

A tensile specimen was deformed at a constant crosshead speed of 6 mm/min. The strain rate at the start of the testing was 5×10^{-3} s^{-1}. The initial gauge length of the specimen (in mm) was _____

Mark only one oval.

- 10
- 20
- 30
- 15