TS PGECET 2026 Metallurgical Engineering

Question Paper

Conducted by JNTU, Hyderabad

General Instructions

(i) The test is of 2 hours duration.

(ii) This test paper consists of 120 questions. The maximum marks are 120.

(iii) Each question carries +1 marks for correct answer and there is no negative marking for wrong answer.

1. If

$$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

is an eigenvector of the matrix

$$A = \begin{bmatrix} m & 3 \\ 3 & m \end{bmatrix},$$

then the corresponding eigenvalue is:

(A) $m - 3$

(B) $m + 3$

(C) m

(D) $3m$

---

2. The system of equations

$$x - 2y + 3z = 6, \quad 3x + y - 4z = -7, \quad 5x - 3y + 2z = 5$$

has:

(A) No solution

(B) Unique solution

(C) Infinite number of solutions

(D) Zero solution

---

3. Which of the following series is divergent?

(A) $\sum \sin\left(\frac{1}{n}\right)$

(B) $\sum \left(1+\frac{1}{\sqrt{n}}\right)^{-n^{1/2}}$

(C) $\sum \left(1+\frac{1}{n}\right)^{-n^2}$

(D) $\sum \frac{1}{(\log n)^n}$

---

4. If $f(x)=e^{-x}$ in $(-1,1)$ and the Fourier series of $f(x)$ is given by

$$f(x)=\frac{a_0}{2}+\sum_{n=1}^{\infty}(a_n\cos nx+b_n\sin nx),$$

then the Fourier coefficient a_0 is:

(A) 1

(B) 0

(C) $2\cosh 1$

(D) $2\sinh 1$

---

5. If

$$\vec{F}=(x+2y+az)\hat{i}+(bx-3y-z)\hat{j}+(4x+cy+2z)\hat{k}$$

is irrotational, then (a,b,c) is:

(A) (1,4,2)

(B) (4,2,1)

(C) (4,2,-1)

(D) (2,4,-1)

---

6. If $e^{\sin x}$ is an integrating factor of

$$\frac{dy}{dx}+(y-1)\cos x=e^{-\sin x}\cos x,$$

then the general solution is:

(A) $(e^{\sin x} + c)e^{-\sin x}$

(B) $(\sin x + e^{\sin x} + c)e^{-\sin x}$

(C) $(\cos x + e^{\sin x} + c)e^{-\sin x}$

(D) $(\cos x + e^{\cos x} + c)e^{-\sin x}$

---

7. Find $L\{t\,u(t-2)\}$.

(A) $\frac{e^{-2s}}{s}$

(B) $\frac{e^{-2s}(2s+1)}{s}$

(C) $\frac{e^{-2s}(2s+1)}{s^2}$

(D) $\frac{e^{-2s}(2s+1)}{s^3}$

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8. Using Runge-Kutta method, when $\frac{dy}{dx} = xy + y^2$, $y(0) = 1$ is solved by taking $h = 0.1$, then in the usual notation the value of k_1 is:

(A) 0.001

(B) 0.0001

(C) 0.01

(D) 0.1

---

9. If $X \sim N(\mu, \sigma^2)$ then:

(A) $P(X < \mu) = 1$

(B) $P(X = \mu) = 0$

(C) $P(X > \mu) = 0$

(D) $P(X = \mu) = 0.5$

---

10. Assertion (A): Spearman rank correlation coefficient is used for ordinal data.

Reason (R): It is based on ranks rather than actual values.

(A) A and R are true, and R is correct explanation of A

(B) A and R are true, but R is not correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

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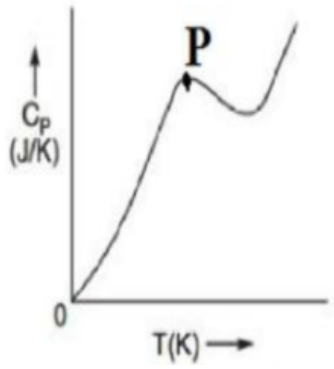
11. The figure shows variation of heat capacity with temperature for Nickel (0–800 K). If the curve shows discontinuity at point P, then this is due to:



(A) Magnetic transformation of Nickel bar

(B) Change due to inclusions in Nickel bar

(C) Change due to porosity in Nickel bar

(D) Change in dimensions of Nickel bar

---

12. Match the following in Ellingham diagram:

Slope Characteristic		Significance in Ellingham Diagram	
A	Slope of ΔG°–T line equals −ΔS°	I	Negligible entropy change with temperature
B	Large negative slope	II	Entropy change of oxidation reaction
C	Nearly horizontal Ellingham line	III	Significant decrease in gaseous disorder
D	Parallel Ellingham lines	IV	Similar entropy change for reactions

(A) A-II, B-III, C-I, D-IV

(B) A-I, B-II, C-IV, D-III

(C) A-II, B-I, C-III, D-IV

(D) A-III, B-IV, C-II, D-I

---

13. Which of the following is correct for entropy change in a reversible process?

(A) $\Delta S_{system} + \Delta S_{surroundings} > 0$

(B) $\Delta S_{system} < 0$

(C) $\Delta S_{system} + \Delta S_{surroundings} = 0$

(D) $\Delta S_{surroundings} = 0$

14. From Clausius-Clapeyron equation, assuming constant ΔH_v, the slope of $\ln P$ vs $1/T$ is:

(A) $\frac{\Delta H_v}{R}$

(B) $-\frac{\Delta H_v}{R}$

(C) $\frac{R}{\Delta H_v}$

(D) $-\frac{R}{\Delta H_v}$

---

15. The quantity that balances the chemical driving force of a reversible electrochemical reaction is:

(A) Entropy change

(B) Electric current

(C) Electromotive force

(D) Internal energy

---

16. The cell having identical electrodes with different concentrations of electrolytes is:

(A) Battery cell

(B) Galvanic cell

(C) Electrolytic cell

(D) Concentration cell

---

17. Consider the Daniell cell:

$$Zn|Zn^{2+} \,||\, Cu^{2+}|Cu$$

and identify the incorrect statement:

(A) Zinc acts as the anode

(B) Copper undergoes oxidation

(C) Sulphate ions migrate to maintain charge balance

(D) EMF depends on electrolyte concentration

---

18. Pitting corrosion is dangerous in thin sections mainly because:

(A) Uniform metal thinning

(B) Formation of protective corrosion products

(C) Pits detection is difficult due to small size

(D) High cathodic overpotential

---

19. Match the following:

Microstructural features		Causes for corrosion	
A	Grain boundaries	I	Reduced electrochemical activity
B	Dislocations	II	Formation of galvanic microcells
C	Pearlite	III	High energy areas
		IV	High energy lines

(A) A-I, B-II, C-IV

(B) A-III, B-I, C-II

(C) A-IV, B-III, C-I

(D) A-III, B-IV, C-II

---

20. In transient heat conduction, the lumped capacitance method is valid only when:

(A) Internal conduction resistance is greater than surface convection resistance

(B) Biot number is less than 0.1

(C) Fourier number is less than 1

(D) Thermal diffusivity is very high

---

21. Which of the following statement is correct?

(A) Thermal conductivity of gases decreases with temperature

(B) In good conductors, thermal conductivity increases with temperature

(C) In insulators, thermal conductivity decreases with temperature

(D) Liquids (water) have higher thermal conductivity than metals and alloys

---

22. The negative sign in Fick's first law indicates that diffusion flux occurs:

(A) Along increasing concentration

(B) Independent of concentration gradient

(C) Opposite to the concentration gradient

(D) Only at equilibrium

---

23. Match the following:

Formation of Voids		Mechanism	
A	Vacancy creation	I	Impurity particles
B	Vacancy annihilation	II	Hydrostatic compression
C	Void nucleation	III	Negative dislocation climb
D	Stress suppression of pores	IV	Positive dislocation climb

(A) A-I, B-II, C-III, D-IV

(B) A-III, B-IV, C-I, D-II

(C) A-IV, B-III, C-II, D-I

(D) A-III, B-IV, C-II, D-I

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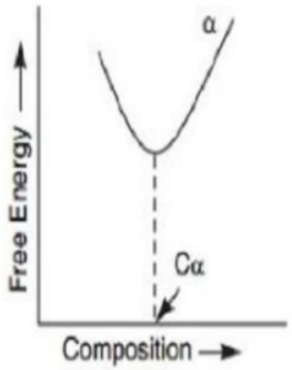
24. At composition C_α, the free energy curve has a minimum. Which statement is correct?



(A) Unstable equilibrium state

(B) Metastable state

(C) Phase boundary composition

(D) Stable composition of α phase

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25. Given statements:

I. An isolated system exchanges matter and energy with surroundings

II. A closed system exchanges only energy with surroundings

III. An open system does not exchange matter or energy

(A) Both I and II are correct

(B) Both II and III are correct

(C) Only II is correct

(D) Only III is correct

---

26. The ratio of any two extensive properties is independent of:

(A) Total mass

(B) Total heat

(C) Total system

(D) Total time

---

27. Which of the following is true for an adiabatic process?

(A) Temperature remains constant throughout the process

(B) All heat absorbed is equal to work done on the system

(C) Energy change is equal to work done on the system

(D) Energy is static variable and dependent on the path

---

28. Identify the incorrect statement:

(A) Activity of an ideal gas is equal to its partial pressure and is unity

(B) Activity of non-ideal gas is equal to its fugacity and is unity

(C) Activity of pure solid and liquid in standard state is unity

(D) Activity is ratio of fugacity in actual state to standard state fugacity

---

29. According to Trouton's rule, the entropy of vaporization is primarily related to:

(A) Heat of fusion

(B) Fusion temperature

(C) Boiling temperature

(D) Crystal structure

---

30. The quantity representing change in temperature of a gas with pressure at constant enthalpy is called:

(A) Thermal expansion coefficient

(B) Joule-Thomson coefficient

(C) Compressibility factor

(D) Isothermal pressure

---

31. Which factor mainly controls permeability in the bosh region of a blast furnace?

(A) Slag basicity

(B) Coke strength and size

(C) Iron ore reducibility

(D) Blast temperature

---

32. The dead-man zone in a blast furnace mainly consists of:

(A) Molten slag

(B) Molten iron

(C) Undissolved solid coke particles

(D) Reduced iron fines

---

33. Which condition is not essential for desulphurization in an LD converter?

(A) High temperature

(B) Basic slag

(C) High viscosity and low fluidity of slag

(D) Good slag-metal contact

---

34. The primary reason for tapering of blast furnace walls in the bosh region is to:

(A) Compensate for decrease in apparent burden volume

(B) Improve slag foaming

(C) Increase heat losses

(D) Increase raceway depth

---

35. Match the following:

Process		FeO content	
A	Blast Furnace slag	I	Lower FeO
B	DRI	II	Higher FeO
C	Gas-based DR	III	Nearly zero
D	Coal-based DR	IV	Always present

(A) A-III, B-IV, C-I, D-II

(B) A-I, B-II, C-III, D-IV

(C) A-II, B-IV, C-I, D-III

(D) A-III, B-II, C-IV, D-I

---

36. The slag with V-ratio $= \frac{\%CaO}{\%SiO_2}$ less than unity is classified as:

(A) Basic

(B) Neutral

(C) Amphoteric

(D) Acidic

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37. The concept of vacuum degassing was initially introduced primarily for removal of:

(A) Hydrogen in liquid steel

(B) Sulphur in liquid steel

(C) Carbon in liquid steel

(D) Manganese in liquid steel

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38. Uranium extraction involves preparation of uranium tetrafluoride by hydrofluorination from:

(A) Uranium dioxide

(B) Uranyl nitrate

(C) Uranium trioxide

(D) Uranium phosphate

---

39. In extraction of thorium, $ThCl_4$ is prepared from:

(A) Thorium oxalate

(B) Thorium hydroxide

(C) Thorium sulphate

(D) Thorium carbonate

---

40. Roasting is not necessary for:

(A) Low Cu, high FeS concentrates

(B) High grade Cu concentrates (>30% Cu)

(C) Loss of copper from concentrate

(D) Elimination of sulphur from FeS-rich concentrates

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41. In a three-layer refining of Aluminium, the impure Aluminium is alloyed with which of the metals to form a bottom layer?

(A) Titanium

(B) Manganese

(C) Nickel

(D) Copper

---

42. Blue powder is the byproduct of Zinc extractions and it contains mainly:

(A) Mixture of zinc and zinc oxide

(B) Mixture of zinc and zinc sulphide

(C) Mixture of zinc oxide and zinc hydride

(D) Mixture of zinc sulphide and zinc oxide

---

43. Beach marks are observed in:

(A) Impact failure

(B) Tensile failure

(C) Shear failure

(D) Fatigue failure

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44. Magnesium cannot be obtained by electrolysis of aqueous $MgCl_2$ or $MgSO_4$ because:

(A) Hydrogen is evolved before Mg is deposited

(B) Reduction potential of Mg^{2+} is higher than water

(C) Mg is dissolved in solution

(D) Use of amalgam cathode increases deposition potential

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45. The kinetics of the Pidgeon process is controlled by:

(A) H_2O vapour

(B) SiO vapour

(C) MgO vapour

(D) H_2 vapour

---

46. In the Mond process, nickel reacts with carbon monoxide to form:

(A) NiO

(B) Ni_2O

(C) NiCO

(D) $Ni(CO)_4$

---

47. Which of the following metals does NOT have face-centered cubic (fcc) structure?

(A) Copper

(B) Nickel

(C) Silver

(D) Sodium

---

48. Match the following:

Ore product		Meaning	
A	Concentrate	I	Enriched mineral or high concentration of the valuable mineral
B	Tailings	II	Unwanted minerals found in the ore before processing
C	Middlings	III	Waste materials left over after the processing
D	Gangue	IV	Intermediate material needs more processing

(A) A-I, B-II, C-III, D-IV

(B) A-II, B-I, C-IV, D-III

(C) A-IV, B-III, C-II, D-I

(D) A-III, B-II, C-I, D-IV

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49. Jigging operation depends on the difference in:

(A) Surface chemistry

(B) Electrical conductivity

(C) Specific gravity

(D) Magnetic susceptibility

---

50. Which industrial process uses heavy suspension?

(A) Lessing process

(B) Bertrand process

(C) DuPont process

(D) Chance sand-flotation process

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51. The stress at which the stress-strain curve deviates from linearity is:

(A) Endurance limit

(B) Proportionality limit

(C) Elastic limit

(D) No limit

---

52. Which of the following is not related to Mohr's circle in three dimensions?

(A) Determining principal stresses

(B) Calculating maximum shear stress

(C) Visualizing stress on any plane

(D) Determining elastic modulus

---

53. The basis on which the Von Mises criterion is preferred compared to maximum shear stress criterion theoretically is:

(A) It has lower accuracy

(B) It considers all three principal stresses

(C) It considers maximum shear stress

(D) Its energy is associated with change of volume of material

---

54. An example of a liquid metal mixture which produces near ideal solutions is:

(A) Copper - Magnesium

(B) Bismuth - Cadmium

(C) Iron - Silver

(D) Bismuth - Tin

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55. The effect of ferrite stabilizers on Fe–Fe_3C phase diagram is:

(A) Lowers A1 point and raises A4 point

(B) Increases the austenite region

(C) Decreases the amount of carbon in gamma iron

(D) Raises the eutectoid temperature

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56. Nitrogen pickup by liquid steel is low in:

(A) LD process

(B) Bessemer process

(C) Open-hearth process

(D) Twin hearth process

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57. Which of the following metal has low stacking fault energy?

(A) Gold

(B) Silver

(C) Copper

(D) Nickel

---

58. Dislocations with burgers vectors b and b2, combine to produce a resultant dislocation b3. The vector b3 is given by the vector sum of b and b2, the dissociation reaction $b_1 \rightarrow b_2 + b_3$ will occur when

(A) $b_1^2 > b_2^2 + b_3^2$

(B) $b_1^2 < b_2^2 + b_3^2$

(C) $b_1^2 = b_2^2 + b_3^2$

(D) $b_1^2 \div b_2^2 + b_3^2$

---

59. "Dislocation lines are not straight but rather dislocation lines are flexible" is given by

(A) Mott and Nabarro

(B) Taylor and Quinney

(C) Frank and Read

(D) Cottrell and Bilby

---

60. The shear stress required to move a dislocation through a crystal lattice is called:

(A) Critical resolved shear stress

(B) Flow stress

(C) Hoop stress

(D) Peierls stress

---

61. Which of the following is not a mechanism by which solute atoms interact with dislocations?

(A) Elastic interaction

(B) Magnetic interaction

(C) Stacking-fault interaction

(D) Electrical interaction

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62. The sensitivity of fracture of brittle solids to surface conditions is termed as the

(A) Hall-Petch effect

(B) Joffe effect

(C) Bauschinger effect

(D) Portevin-Le Chatelier effect

---

63. The law which states that fracture occurs when the resolved normal stress on a plane reaches a critical value is

(A) Griffith law

(B) Nabbaro's law

(C) Sohncke's law

(D) Tresca criterion

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64. Brittle fractures occur in a trans granular manner. If the grain boundaries contain a film of brittle constituent, the fracture will occur

(A) In an intergranular manner along grain boundaries

(B) By ductile rupture through the grains

(C) With significant plastic deformation at grain boundaries

(D) By cleavage independent of grain boundary condition

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65. The analytical treatment of ductile fracture using a model of cylindrical holes with initial radius (b) and average spacing (L) was proposed by

(A) Griffith

(B) Orowan

(C) Hall-Petch

(D) McClintock

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66. Consider the following Assertion (A): A notch increases the tendency for brittle fracture in a material. Reason (R): A notch produces high local stresses, introduces a triaxial tensile state of stress, causes local strain hardening, cracking and magnifies the local strain rate.

(A) Both A and R are true, and R is the correct explanation of A

(B) Both A and R are true, but R is not the correct explanation of A

(C) A is true, but R is false

(D) A is false, but R is true

---

67. Consider the following Assertion (A): The shape and magnitude of the stress-strain curve of a metal depend on its composition, heat treatment, prior plastic deformation, strain rate, temperature and state of stress during testing. Reason (R): Tensile strength and yield strength are strength parameters, whereas percent elongation and reduction of area are measures of ductility.

(A) Both A and R are true, and R is the correct explanation of A

(B) Both A and R are true, but R is not the correct explanation of A

(C) A is true, but R is false

(D) A is false, but R is true

---

68. The fundamental assumption behind Barba's law in tensile testing is that

(A) Plastic deformation remains uniform up to fracture

(B) The elastic strain contribution is negligible

(C) Specimens that are geometrically similar develop similar necked regions

(D) Necking is governed only by material composition

---

69. In Dynamic hardness testing, the hardness is measured by

(A) Size of the permanent indentation produced under a static load

(B) Resistance to plastic deformation

(C) Energy of impact

(D) Diagonal length of the indentation by a pyramidal indenter

---

70. The correct statement for a cold-worked material is

(A) Both Meyer and Brinell hardness increase with load

(B) Meyer hardness is constant and independent of load

(C) Brinell hardness remains constant with load

(D) Meyer hardness decreases with increasing load

---

71. According to Irwin, the local stresses near a crack depend on the product of

(A) Nominal stress and square root of crack length

(B) Nominal stress and crack length

(C) Nominal strain and crack length

(D) Yield stress and crack width

---

72. Fatigue data are commonly presented using

(A) Maximum stress only

(B) Mean stress and strain

(C) Minimum stress only

(D) Stress ratio and amplitude ratio

---

73. The two statistical methods used for making a statistical estimate of the fatigue limit are

(A) Miner rule and Cumulative damage theory

(B) Probit analysis and Staircase method

(C) Goodman relation and Soderberg criterion

(D) Basquin equation and Coffin-Manson relation

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74. In Andrade's analysis of creep, the two components that together form the creep curve are

(A) Elastic strain and plastic flow

(B) Dislocation creep and diffusion creep

(C) Primary creep and tertiary creep

(D) Transient creep and constant-rate viscous creep

---

75. The creep mechanism observed at very low stresses with stress exponent $n = 1$ is given by

(A) Harper-Dorn creep

(B) Nabarro-Herring creep

(C) Coble creep

(D) Power-law breakdown creep

---

76. With respect to mechanical behavior, ceramic materials are generally

(A) Soft and highly ductile

(B) Weak but very flexible

(C) Stiff and strong compared to metals

(D) Elastic with low stiffness

---

77. The incorrect statement about polymers is

(A) Most polymers exhibit high electrical conductivity

(B) Polymers are generally chemically inert in many environments

(C) Many polymers are ductile and can be easily shaped into complex forms

(D) Polymers are usually nonmagnetic in nature

---

78. Which of the following statement is incorrect based on covalent bond characteristics?

(A) Covalent bonds are non-directional in nature

(B) Diamond has a very high hardness due to strong covalent bonding

(C) Silicon and germanium form covalently bonded crystal structures

(D) Covalent bonding involves shared electrons between atoms

---

79. Match the following:

Metal		Crystal structure & Atomic radius	
A	Molybdenum	I	FCC & 0.139 nm
B	Silver	II	BCC & 0.136 nm
C	Titanium (α)	III	HCP & 0.145 nm
D	Platinum	IV	FCC & 0.145 nm
E	Cadmium	V	HCP & 0.149 nm

(A) A-II, B-IV, C-III, D-I, E-V

(B) A-I, B-III, C-II, D-V, E-IV

(C) A-III, B-IV, C-V, D-I, E-II

(D) A-V, B-IV, C-III, D-II, E-I

80. The microstructure is revealed by the following surface treatment process, using an appropriate chemical reagent

(A) Polishing

(B) Grinding

(C) Buffing

(D) Etching

---

81. The sets of planes which can appear in an FCC diffraction pattern is

(A) (100), (110), (111)

(B) (111), (200), (220)

(C) (110), (211), (310)

(D) (100), (200), (210)

---

82. In an X-ray diffraction pattern, reflections from a BCC crystal will appear only when

(A) h, k, l is all odd

(B) h, k, l is all even

(C) h+k+l is an even number

(D) h+k+l is an odd number

---

83. Which of the following represents octahedral interstitial site in an FCC lattice?

(A) $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$

(B) $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

(C) $(\frac{1}{3}, \frac{1}{3}, \frac{1}{3})$

(D) (0,0,0)

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84. The following statements describe the procedure for determining the Miller indices of a crystallographic plane, but they are not in the correct order. Arrange them in the proper sequence.

I. The final set of integers is written within parentheses as (h k l) representing the plane indices.

II. The intercepts made by the plane on the x, y, and z axes are determined and denoted as a,

b, and c.

III. If the plane passes through the origin, an equivalent parallel plane is drawn or the origin is shifted to another lattice point.

IV. The reciprocals of the intercepts are taken; an infinite intercept results in a zero index.

V. The reciprocals are multiplied by the corresponding lattice parameters a, b, and c to normalize them.

VI. The normalized values are converted into the smallest possible integers by multiplying or dividing by a common factor

(A) III, II, IV, V, VI, I

(B) III, IV, V, VI, II, I

(C) II, III, IV, V, I, VI

(D) IV, V, VI, III, II, I

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85. An electron micrograph shows a scale bar labeled $2\ \mu m$. When measured on the printed image, the scale bar length is 15 mm. What is the magnification of the micrograph?

(A) 2500×

(B) 5000×

(C) 7500×

(D) 15000×

---

86. Which one of the following statements is incorrect?

(A) In substitutional solid solutions, impurity atoms replace host atoms in the lattice

(B) Dislocations are zero-dimensional crystalline defects

(C) Microscopy is used for observing microstructure using suitable microscopes

(D) The intercept method is used to measure grain size in a material

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87. What happens in a eutectoid reaction on cooling?

(A) Liquid transforms into two solids

(B) One solid transforms into two different solids

(C) Two solids combine to form one solid

(D) Liquid transforms into one solid

---

88. Match the following:

List-1		List-2	
A	Austenite	I	Soft and ductile BCC phase of iron
B	Ferrite	II	High-temperature FCC phase of iron
C	Cementite	III	Mixture of ferrite and cementite in layered form
D	Pearlite	IV	Iron carbide with fixed composition (Fe_3C)

(A) A-I, B-III, C-IV, D-II

(B) A-II, B-I, C-IV, D-III

(C) A-IV, B-I, C-II, D-III

(D) A-III, B-II, C-I, D-IV

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89. Compared to homogeneous nucleation, the activation free energy required for heterogeneous nucleation is

(A) Lower

(B) Same

(C) Higher

(D) Independent of temperature

---

90. The equation that describes how the extent of phase transformation changes with time is known as

(A) Arrhenius equation

(B) Gibbs phase rule

(C) Clausius-Clapeyron equation

(D) Avrami equation

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91. Which sequence correctly orders steel microstructures from highest to lowest hardness?

(A) Fine pearlite, Martensite, Bainite, Spheroidite

(B) Martensite, Tempered martensite, Bainite, Spheroidite

(C) Bainite, Martensite, Fine pearlite, Spheroidite

(D) Tempered martensite, Fine pearlite, Martensite, Spheroidite

92. An engineer needs a material for springs with minimal permanent deformation under load. Which property - alloy combination best satisfies this requirement?

(A) High ductility - electrolytic copper

(B) High yield strength - beryllium copper

(C) Moderate strength - cartridge brass

(D) Low elongation - leaded brass

---

93. The true strain (ϵ) and engineering strain (e) are related by

(A) $\epsilon = \ln(e)$

(B) $e = \ln(\epsilon)$

(C) $\epsilon = \ln(1 + e)$

(D) $e = \ln(1 + \epsilon)$

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94. Consider the following

Assertion (A): Jominy end-quench test is not suitable for evaluating maximum hardness of steel.

Reason (R): The Jominy end-quench test measures hardness variation along the length of a standard specimen

(A) Both A and R are true, and R is the correct explanation of A

(B) Both A and R are true, but R is not the correct explanation of A

(C) A is true, but R is false

(D) A is false, but R is true

---

95. Which of the following correctly represents the increasing order of modulus of elasticity for the given materials?

(A) Zirconia < Soda-lime glass < Aluminium oxide

(B) Aluminium oxide < Zirconia < Soda-lime glass

(C) Soda-lime glass < Aluminium oxide < Zirconia

(D) Soda-lime glass < Zirconia < Aluminium oxide

---

96. The hardening process normally used for the hardening of machine tool guideways is

(A) Martempering

(B) Flame hardening

(C) Austempering

(D) Induction hardening

---

97. Match the following:

Refractory Material		Major Composition/Oxide	
A	Fireclay	I	$ZrSiO_4$
B	Silica	II	MgO
C	Periclase	III	SiO_2
D	Zircon	IV	$Al_2O_3 + SiO_2$

(A) A-I, B-II, C-III, D-IV

(B) A-IV, B-III, C-II, D-I

(C) A-II, B-III, C-IV, D-I

(D) A-IV, B-II, C-III, D-I

---

98. Which of the following represents the correct decreasing order of their electrical conductivity?

(A) Silver > Gold > Aluminium > Platinum

(B) Silver > Aluminium > Gold > Platinum

(C) Gold > Silver > Aluminium > Platinum

(D) Silver > Gold > Platinum > Aluminium

---

99. Which of the following materials are having high thermal conductivity? I. Silver II. Gold III. Nickel IV. Brass

(A) I and II only

(B) I and III only

(C) II and IV only

(D) III and IV only

100. Which of the following is soft magnetic material?

(A) Alnico

(B) Cunife

(C) Tungsten steel

(D) Supermalloy

---

101. Complete the analogy: Avoids mould sticking: Parting sand :: Improves surface finish :

(A) Backing sand

(B) Facing sand

(C) System sand

(D) Core sand

---

102. Match the following:

Process		Description	
A	Centrifugal casting	I	Pattern is made of foam
B	Full mould casting	II	Wax pattern is used
C	Investment casting	III	Hollow parts made without core
D	Die casting	IV	Molten metal forced into metal mould

(A) A-I, B-II, C-III, D-IV

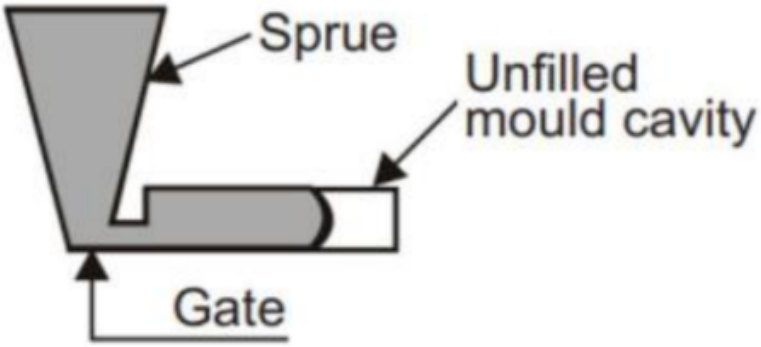
(B) A-II, B-III, C-IV, D-I

(C) A-III, B-I, C-II, D-IV

(D) A-I, B-IV, C-II, D-III

---

103. Identify the casting defect shown in the given figure:



(A) Porosity

(B) Hot Tears

(C) Swell

(D) Misrun

---

104. Liquid contraction during solidification of a casting will be taken care by

(A) Runner

(B) Sprue

(C) Riser

(D) Gate

---

105. Consider the following:

Assertion (A): In SAW, the welding arc is not visible during welding.

Reason (R): The arc is completely submerged under a layer of granular flux.

(A) Both A and R are true, and R is the correct explanation of A

(B) Both A and R are true, but R is not the correct explanation of A

(C) A is true, but R is false

(D) A is false, but R is true

---

106. Consider the following statements:

Statement-I: In TIG welding, electrode consumption contributes to metal deposition

Statement-II: MIG welding is preferred for automation due to continuous wire feeding

Statement-III: MMAW electrodes require controlled storage conditions

(A) Statement-I and Statement-II are true

(B) Statement-II and Statement-III are true

(C) Statement-I and Statement-III are true

(D) Statement-I, Statement-II and Statement-III are true

---

107. In the AWS electrode classification E6013, the number "60" indicates

(A) Type of coating

(B) Welding position

(C) Minimum tensile strength of weld metal

(D) Polarity of welding current

---

108. Which one of the following pairs is correctly matched?

(A) Drawing - Direct compression

(B) Forging - Tension type

(C) Blanking - Shearing

(D) Bending - Indirect compression

---

109. Which method permits point-by-point calculation of stress but is limited to plane-strain conditions only?

(A) Slip-line field theory

(B) Uniform-deformation energy method

(C) Slab method

(D) Finite element methods

---

110. Tomlinson and Stringer defined the coefficient of spread S in cogging as the ratio of

(A) Increase in length to decrease in width

(B) Increase in width to reduction in height

(C) Reduction in height to increase in length

(D) Reduction in width to increase in height

---

111. Temper rolling improves all of the following except

(A) Surface quality

(B) Flatness

(C) Yield-point elongation behaviour

(D) Grain size refinement

---

112. The term merchant mill refers to a rolling mill designed to roll

(A) Plates

(B) Sheets

(C) Bars

(D) Foils

---

113. Impact extrusion is a process used to produce

(A) Long solid bars

(B) Short lengths of hollow shapes

(C) Thin flat sheets

(D) Large solid billets

---

114. As per the Ugine-Sejournet process, the lubricant most commonly used for high-temperature extrusion is

(A) Molten glass

(B) Oil

(C) Soap solution

(D) Solid wax

---

115. In the production sequence of pipe or tubing, a rolling mill is used to remove

(A) Surface cracks

(B) Scale formation

(C) Slight oval shape

(D) Residual stresses

---

116. In the Hoeganaes process, which statement is not correct?

(A) Limestone acts as a flux and limits sulphur contamination

(B) Mill scale is the raw material used

(C) The final reduction stage occurs in a hydrogen atmosphere

(D) Treatment is carried out in silicon carbide containers

---

117. The following steps are involved in unidirectional die compaction in powder metallurgy, but they are jumbled:

I. Removal of load by retracting the punch

II. Ejection of the green compact

III. Charging the powder mix

IV. Applying load using a punch to compact the powders

Choose the correct sequence:

(A) III, IV, I, II

(B) III, I, IV, II

(C) IV, III, I, II

(D) IV, I, III, II

---

118. Which of the following statements regarding liquid phase sintering is/are correct?

Statement-I: An appreciable amount of liquid phase must be present

Statement-II: There must be appreciable solubility of the solid in the liquid

Statement-III: Complete wetting of the solid by the liquid is required

(A) Statement-I only

(B) Statement-I and Statement-II only

(C) Statement-II and Statement-III only

(D) Statement-I, Statement-II and Statement-III

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119. The method which is related to pressure less powder shaping method is

(A) Powder extrusion

(B) Injection moulding

(C) Slurry moulding

(D) Wet compaction

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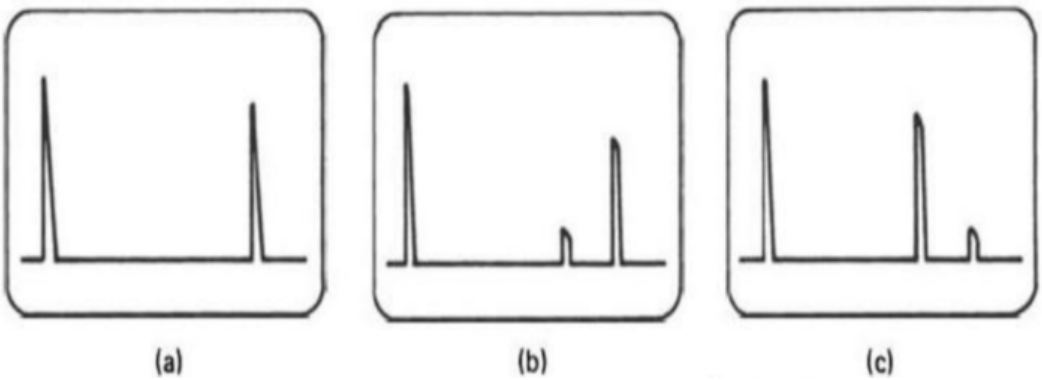
120. Which of the following statement is correct based on the ultrasonic testing screen display

as shown in the figure?



(A) Increase in defect size increases the backwall echo height

(B) Defect-free material shows both defect echo and backwall echo

(C) A large defect produces a large defect echo and a small backwall echo

(D) A small defect completely eliminates the backwall echo
