



Booklet No. :

MT - 15

Metallurgy

Duration of Test : 2 Hours

Max. Marks : 120

Hall Ticket No.

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Name of the Candidate : _____

Date of Examination : _____ OMR Answer Sheet No. : _____

Signature of the Candidate

Signature of the Invigilator

INSTRUCTIONS

1. This Question Booklet consists of **120** multiple choice objective type questions to be answered in **120** minutes.
2. Every question in this booklet has 4 choices marked (A), (B), (C) and (D) for its answer.
3. Each question carries **one** mark. There are no negative marks for wrong answers.
4. This Booklet consists of **16** pages. Any discrepancy or any defect is found, the same may be informed to the Invigilator for replacement of Booklet.
5. Answer all the questions on the OMR Answer Sheet using **Blue/Black ball point pen only**.
6. Before answering the questions on the OMR Answer Sheet, please read the instructions printed on the OMR sheet carefully.
7. OMR Answer Sheet should be handed over to the Invigilator before leaving the Examination Hall.
8. Calculators, Pagers, Mobile Phones, etc., are not allowed into the Examination Hall.
9. No part of the Booklet should be detached under any circumstances.
10. The seal of the Booklet should be opened only after signal/bell is given.

MT-15-A



METALLURGY (MT)

1. A value of λ for which the equations $x + y + z = 1$, $x + 2y + 4z = \lambda$ and $x + 4y + 10z = \lambda^2$ are consistent is
(A) 3 (B) 2 (C) 0 (D) None
2. The necessary and sufficient condition that the linear system of equations $AX = B$ is consistent when
(A) $Rank(AB) > Rank(A)$ (B) $Rank(AB) = Rank(A)$
(C) $Rank(AB) \neq Rank(A)$ (D) None
3. The function $f(x) = x^2 \sin x + x \cos x$ in the interval $(-1, 1)$ is
(A) odd function (B) even function
(C) neither even nor odd function (D) discontinuous function
4. The series $\sum_{n=1}^{\infty} \frac{1}{\sqrt{n^2 + 1}}$
(A) converges (B) neither converges nor diverges
(C) diverges (D) oscillatory
5. If $\nabla\phi_1$ and $\nabla\phi_2$ are normals to the surfaces ϕ_1 and ϕ_2 , then the angle between the surfaces is
(A) $\cos^{-1} \left[\frac{\nabla\phi_1 \cdot \nabla\phi_2}{|\nabla\phi_1| |\nabla\phi_2|} \right]$ (B) $\tan^{-1} \left[\frac{\nabla\phi_1 \cdot \nabla\phi_2}{|\nabla\phi_1| |\nabla\phi_2|} \right]$
(C) 0 (D) 90°
6. If S is an open surface bounded by a closed curve C and \vec{F} is a vector differentiable function, then by Stoke's theorem $\oint_C \vec{F} d\vec{r}$
(A) $\iint_S \nabla \cdot \vec{F} ds$ (B) $\iint_S \nabla \times \vec{F} \cdot \vec{n} ds$
(C) $\iint_S \nabla^2 \vec{F} ds$ (D) 0
7. The particular integral $\frac{1}{(D^2 + \alpha^2)} \cos \alpha x$ is
(A) $\frac{x}{2\alpha} \cos \alpha x$ (B) $\frac{x}{2\alpha} \sin \alpha x$ (C) $\frac{x}{\alpha^2} \sin \alpha x$ (D) $\frac{x}{\alpha} \cos \alpha x$

8. The differential equation $M(x,y) dx + N(x,y) dy = 0$ is exact if
- (A) $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$ (B) $xM(x,y) + yN(x,y) = 0$
- (C) $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$ (D) None
9. If the mean and variance of a binomially distributed random variable are 3 and 2 respectively, then its probability distribution function is
- (A) $b(9, \frac{2}{3})$ (B) $b(12, \frac{1}{3})$ (C) $b(9, \frac{1}{3})$ (D) None
10. The iteration formulae used in Euler's method is
- (A) $y_{k+1} = y_k + \frac{h}{2} f(x_k, y_k)$ (B) $y_{k+1} = y_0 - \frac{h}{2} f(x_k, y_k)$
- (C) $y_{k+1} = y_k + hf(x_k, y_k)$ (D) None
11. Quantity of electricity that deposits 1 equivalent weight of the metal is called
- (A) one Faraday (B) one Coulomb (C) one Amp (D) one Amp/sec
12. Which one of the following is an anodic process ?
- (A) Electroplating (B) Electro refining
- (C) Electro polishing (D) Electro deposition
13. Self diffusion
- (A) is the migration of atoms in pure metals
- (B) occurs in binary metals and alloys
- (C) is atomic migration along a phase
- (D) is atomic migration along grain boundaries
14. Ohmic over voltage is due to
- (A) slowest step of the deposition
- (B) electrode coverage by oxidation products
- (C) concentration changes of the electrolyte
- (D) increase in the current density

15. Best material for storage of dilute Sulphuric acid is
 (A) Nickel (B) Stainless steel
 (C) Lead (D) Aluminum
16. Intergranular corrosion is due to
 (A) depletion of C (B) depletion of Cr
 (C) depletion of Ni (D) increase of C
17. A solution containing different ions of Zn and Cd when electrolyzed
 (A) Zn gets deposited first (B) both Zn and Cd get deposited
 (C) Cd gets deposited initially (D) no deposition occurs
18. Austenitic SS exhibit greatest pitting resistance when
 (A) cold worked (B) cold worked and annealed
 (C) solution quenched above 980 °C (D) solution quenched below 980 °C
19. To protect against oxygen reaction, an oxide must possess
 (A) low melting point (B) high vapour pressure
 (C) high electrical conductivity (D) good adherence
20. Ellingham diagrams for the formation of metal oxides are plotted
 (A) ΔG° against $\frac{1}{T}$ (B) ΔG° against $\frac{1}{T^2}$
 (C) ΔG° against $\frac{1}{T^{0.5}}$ (D) ΔG° against T
21. In an adiabatic process
 (A) enthalpy remains constant (B) work done is a path function
 (C) heat transfer is zero (D) temperature
22. The free energy change for a chemical reaction is
 (A) $RT\ln K$ (B) $R\ln K$ (C) $-RT\ln K$ (D) $-R\ln K$
23. In an ideal gas mixture, fugacity of a specie is equal to its
 (A) volume (B) chemical potential
 (C) vapour pressure (D) partial pressure

24. Gibbs free energy per mole for a pure substance is equal to
(A) heat capacity (B) chemical potential
(C) molal boiling point (D) latent heat of vapourisation
25. When a gas in a vessel expands, its internal energy decreases. The process involved is
(A) adiabatic (B) irreversible (C) isothermal (D) reversible
26. The equilibrium constant of a chemical reaction ____ in the presence of a catalyst
(A) decreases
(B) remains unaffected
(C) increases
(D) can either increase or decrease (depends on the type of catalyst)
27. For a zero order reaction, concentration of product increases with
(A) decreases in total pressure (B) increase in initial concentration
(C) increase in reaction time (D) increase in total pressure
28. Half-life period of a first order irreversible reaction, $A \rightarrow B$ is
(A) $\ln 2/k$ (B) $k/2$ (C) $\ln k/2$ (D) $\ln 0.5/k$
29. The reaction with low activation energy is
(A) slow (B) fast
(C) always spontaneous (D) non-spontaneous
30. Which of the following has the highest thermal conductivity ?
(A) Air (B) Brick (C) Copper (D) Water
31. Maximum heat transfer rate is obtained in ____ flow.
(A) creeping (B) transient region (C) laminar (D) turbulent
32. The ratio of the actual mesh dimensions of Taylors series to that of the next smaller screen is
(A) $\sqrt{2}$ (B) 2 (C) 1.5 (D) 2.5

33. Froth floatation is most suitable for treating
(A) Carbonate ores (B) Sulphide ores (C) Quartzite (D) Iron ores
34. Cu-O-S and Fe-O-S equilibrium diagrams are known as
(A) Kellog diagrams (B) Pourbaix diagrams
(C) Arrhenius diagrams (D) Equilibrium diagrams
35. Flash smelting process is autogenous when the combustant contains about ____ Oxygen
(A) 20% (B) more than 40% (C) 35% (D) 30%
36. Zinc refining is carried out by
(A) zone refining (B) fractional distillation
(C) fire (D) electrolytic
37. Matte smelting is used for the production of
(A) Pb (B) Zn (C) Ni (D) Sn
38. The following metal is extracted in gaseous state
(A) Lead (B) Zirconium (C) Zinc (D) Nickel
39. Dissolution of sulphides in bacterial leaching is due to
(A) ferric ions (B) ferrous ions
(C) H_2SO_4 (D) presence of Thiobacillus ferrooxidans
40. Flux is added to lower _____ of the slag.
(A) activity (B) liquidus temperature
(C) density (D) surface tension
41. Minimum size of riser is obtained from ____ shape.
(A) spherical (B) semi-spherical
(C) cylindrical (D) cubical
42. Anode effect occurs in an electrolytic cell when normal Al_2O_3 level from ____ drops to below 1%.
(A) 6-10% (B) 18-26% (C) 27-32% (D) 33% - 41%

43. Nickel is produced directly from nickel mattes through the following converter :
(A) Peirce-Smith (B) Hoboken (C) Top blown rotary (D) LD
44. Chief source of sulphur in the blast furnace charge is
(A) flux (B) iron ore (C) sinter (D) coke
45. Permeability of the charge in the bosh region of blast furnace is maintained by
(A) lime stone (B) iron ore (C) sinter (D) coke
46. Main activity in the tuyere region of iron blast furnace is
(A) combustion of coke (B) melting of slag
(C) reduction of iron oxide (D) solution loss reaction
47. Sudden sinking of the stock in the blast furnace caused by collapse of scaffold, hanging etc. is called
(A) channeling (B) pillaring
(C) slipping (D) break out
48. Hard driving of blast furnace is due to
(A) charging coarse coke
(B) blowing maximum volume of blast in the furnace
(C) charging hard coke (having low M_{10} value)
(D) maintaining highly permeable coke bed in the bosh region
49. IRSID/CAFL process of steel making employs
(A) acid brick lining in the furnace (B) external heating
(C) suppressed combustion (D) open combustion
50. High alumina refractories when compared to fire clay refractories have
(A) high resistance to thermal shock and creep
(B) less load bearing capacity
(C) less resistance to slag attack
(D) low refractoriness

51. Carbon refractories
(A) don't resist temperature fluctuations
(B) have very low thermal and electrical conductivities
(C) don't burn/oxidize when exposed to air on heating
(D) are not attacked by slags as they are not wetted by melts
52. Use of pulverized coal in boiler operations provide
(A) better combustion (B) higher calorific value
(C) smokeless burning (D) less erosion on furnace wall
53. Most of the coking coals are
(A) anthracite (B) lignite (C) bituminous (D) peat
54. Calorific value (C.V.) of coke oven gas is about _____ kcal/Nm³
(A) 1900 (B) 7500 (C) 900 (D) 4200
55. Materials with metallic bonds are necessarily
(A) have low electrical conductivity (B) hard
(C) ductile under stress (D) gases at room temperature
56. During cooling of steel containing 0.8% carbon from 1000 °C, pearlite occurs at _____ °C.
(A) 910 (B) 480 (C) 768 (D) 723
57. What is the criterion used for the determination of hardness of steel ?
(A) shape and distribution of carbide in iron
(B) method of steel production
(C) carbon content
(D) alloying elements contents
58. Case carburizing is the most widely used method for steel parts with
(A) high corrosion resistance (B) high hardness
(C) low carbon content (D) low tensile strength
59. Martensite has _____ lattice.
(A) body centered cubic (B) body centered tetragonal
(C) face centered cubic (D) closed packed hexagonal

60. Toughness of a material implies
(A) machinability (B) stress relieving
(C) conductivity (D) strength
61. Boron in steel increases its
(A) hardenability (B) impact resistance
(C) corrosion resistance (D) weldability
62. The fine austenitic grain size in steel increases
(A) rough machinability (B) hardenability
(C) impact toughness (D) creep strength
63. Which stainless steel has the highest thermal conductivity ?
(A) Martensitic (B) Ferritic (C) Austenitic (D) All of the above
64. Tool steel should be first hardened and then
(A) normalised (B) annealed (C) cooled (D) tempered
65. With increase in temperature, the grain size produced by annealing
(A) increases (B) increase or decrease
(C) remains unchanged (D) decreases
66. What is the maximum solubility of carbon in iron at 1130 °C ?
(A) 3.5% (B) 2% (C) 1% (D) 0.5%
67. Sub zero treatment of steel is applicable for
(A) high speed tool steels
(B) steels containing < 0.2% carbon
(C) steels not containing retained austenite
(D) low carbon steels
68. For paramagnetic materials, the value of K is
(A) small and positive (B) large and negative
(C) large and positive (D) small and negative

69. Which of the following have the most stable atomic structure ?
 (A) Alkali metals (B) Transition elements
 (C) Rare gases (D) Rare earth metals
70. Diffusion in solid solution is given by
 (A) Schrodinger equation (B) Kirkendal effect
 (C) De' Broglie expression (D) Fick's law
71. Mathematical expression, $n\lambda = 2d \sin \theta$, is called
 (A) De Broglie expression (B) Fick's law
 (C) Bragg's law (D) Pauli exclusion principle
72. Energy associated with an electron at absolute zero temperature (which is the maximum value for that electron) is called _____ energy.
 (A) fermi (B) degenerate (C) ionisation (D) electron
73. _____ is used for tracing stereographic projection.
 (A) Logarithmic graph paper (B) Wulff net
 (C) Ordinary graph paper (D) Ternary phase diagram
74. Which of the following property of a material is not affected by the grain boundaries or crystal imperfections ?
 (A) Impact strength (B) Hardness
 (C) Yield strength (D) Coefficient of thermal expansion
75. A high reduction of cross sectional area of a metal (on application of tensile load) indicates that the material has
 (A) lost its malleability
 (B) lost its ductility
 (C) a low rate of hardening by deformation
 (D) a high rate of hardening by deformation
76. The thickness of the test specimen in BHN test should not be less than _____ times the depth of impression.
 (A) ten (B) two (C) five (D) seven

77. Which of the following is liable to creep even at room temperature ?
(A) Aluminium (B) Low carbon steel (C) Copper (D) Lead
78. The fatigue limit of metals is decreased by
(A) cold working (B) decarburising (C) carburising (D) nitriding
79. With increase in Izod value of metals, its fatigue limit
(A) increases
(B) remains same
(C) may increase or decrease; there is no direct relationship between the two
(D) decreases
80. Which of the following is not a nondestructive test ?
(A) Wohler fatigue test (B) Ultrasonic testing
(C) Radiography (D) Magnaflux method
81. Which of the following has the least Young's modulus ?
(A) Aluminium (B) Copper (C) Steel (D) Iron
82. Compression test is mostly used for _____ materials.
(A) soft (B) hard (C) ductile (D) brittle
83. Recrystallisation of which of the following metals can occur even at room temperature ?
(A) Nickel (B) Iron (C) Zinc (D) Copper
84. Cold working of a metal
(A) does not cause work hardening
(B) results in strain hardening
(C) is always carried out at room temperature for all the metals
(D) is carried out above its recrystallization temperature
85. Which type of rolling mill is suitable for the production of very thin strip in hard materials ?
(A) Tandem (B) Three high (C) Four high (D) Cluster

86. Work hardening of metals
(A) does not affect ductility (B) increases ductility
(C) decreases ductility (D) decreases tensile strength
87. Cold working of metals does not improve
(A) yield strength (B) residual stresses
(C) hardness (D) Izod value
88. Heating ratio of ingot is defined as the ratio of
(A) soaking time to heating time (B) heating time to soaking time
(C) heating time to track time (D) tracking time to heating time
89. Which fuel gas is commonly used for hot machine scarfing of steel ?
(A) LD gas (B) Blast furnace gas
(C) Acetylene gas (D) Coke oven gas
90. A material which does not possess identical properties in all directions is called _____ material.
(A) plastic (B) isotopic (C) anisotropic (D) homogeneous
91. Piercing is done for producing
(A) seamless tubes (B) forged parts
(C) wires (D) cup shaped parts
92. Which of the following cold working operation involves drawing ?
(A) Punching (B) Spinning (C) Slitting (D) Impact intrusion
93. Young's modulus of elasticity is the
(A) slope of the plastic region of the stress – strain curve
(B) ratio of strain to elasticity
(C) slope of initial linear portion of the stress – strain curve
(D) ratio of strain to stress

94. Which of the following is mainly responsible for tertiary stage creep to occur ?
(A) Low stress and high temperature level
(B) High stress and low temperature level
(C) High stress and high temperature level
(D) Low stress and low temperature level
95. Maximum pressure build up in the rolling of plates is at _____ of the plate.
(A) mid center (B) both ends
(C) one third of length (D) two third of length
96. In hot rolling of steel
(A) annealing operation is must (B) surface finish is not good
(C) surface finish is excellent (D) grain refinement is not possible
97. Oxygen to acetylene ratio in case of oxidizing flame is
(A) 2 : 1 (B) 1.5 : 1 (C) 1 : 1 (D) 2.5 : 1
98. Function of flux in brazing is to
(A) facilitate the wetting by reducing the viscosity of the melt
(B) prevent oxide formation both on base metal and brazing material
(C) avoid thermal distortion and cracking
(D) dissolve surface oxide coating formed prior to brazing
99. For welding aluminium, in inert gas arc welding _____ is used.
(A) Noncombustible electrode with helium and direct current
(B) Straight polarity direct current
(C) CO₂ and high speed
(D) Combustible electrode and argon with alternating current
100. Temperature attained in soldering of metals is about _____ °C
(A) 1000-1500 (B) 150-300 (C) 750-1000 (D) 1500-2000

- 101.** Ultrasonic welding
- (A) is useful for joining sections with different thicknesses
 - (B) is cheapest of all the welding processes
 - (C) is not used in lap form of construction
 - (D) cannot join materials of different construction
- 102.** Which of the following is the most weldable of all metals ?
- (A) Brass
 - (B) Aluminium
 - (C) Plain carbon steel
 - (D) Stainless steel
- 103.** Which joining process is used for joining two stainless steel foils of 0.075 mm thickness ?
- (A) Arc welding
 - (B) TIG welding
 - (C) MIG welding
 - (D) Plasma arc welding
- 104.** TIG welding is best used for welding
- (A) Titanium
 - (B) Aluminium
 - (C) Cast iron
 - (D) Stainless steel
- 105.** Which material is used in brazing ?
- (A) Spelter
 - (B) Copper rod
 - (C) Flux rod
 - (D) Solder
- 106.** Oxy-acetylene welding is employed with _____ flame.
- (A) carburising
 - (B) oxidizing
 - (C) neutral
 - (D) reducing
- 107.** _____ welding uses consumable electrode.
- (A) Thermit
 - (B) Laser
 - (C) MIG
 - (D) TIG
- 108.** Weld decay occurs in _____ steel when heated in the range of 510 °C to 790 °C
- (A) plain carbon
 - (B) maraging
 - (C) high speed
 - (D) stainless
- 109.** Thermit welding is a form of _____ welding.
- (A) arc
 - (B) fusion
 - (C) gas
 - (D) resistance
- 110.** Preheating of material to be welded is necessary in the case of
- (A) Cast iron
 - (B) High speed steel
 - (C) Stainless steel
 - (D) Copper

111. The best moulding process for production of intricate castings weighing more than 100 tons is
(A) Cement moulding (B) Ceramic moulding
(C) Pit moulding (D) Green sand moulding
112. Plastic articles are manufactured by _____ moulding.
(A) Dry sand (B) Shell (C) Pit (D) Injection
113. Skim bob is attached to
(A) pouring cup (B) risers (C) in-gates (D) sprue
114. Small precision castings are made by _____ process.
(A) Centrifugal (B) Lost wax (C) Shell moulding (D) Die casting
115. Casting defect which results in mismatching of the top and bottom part of the casting is known as
(A) Sand wash (B) Scab (C) Swell (D) Shift
116. The property of sand due to which the sand grains stick together is known as
(A) cohesiveness (B) permeability (C) collapsibility (D) adhesiveness
117. Shrinkage allowance for cast iron is about ____ mm/metre
(A) > 20 (B) < 1 (C) 10 (D) 20
118. Cupola is used for producing _____ iron.
(A) grey cast (B) pig (C) malleable (D) nodular
119. By using the following, the efficiency of raiser can be enhanced :
(A) bottom gate (B) chills (C) chaplets (D) sprue
120. The following process is used for the casting of dental alloys :
(A) dry sand (B) true centrifugal (C) die casting (D) investment casting

SPACE FOR ROUGH WORK