1. Martensite is a
   A) Stable phase with body centred tetragonal unit cell
   B) Meta stable phase with body centred tetragonal unit cell
   C) Meta stable phase with body centred cubic unit cell
   D) Stable phase with body centred cubic unit cell

2. Name the type of cast iron in which carbon is present in the form of free graphite flakes.
   A) White cast iron
   B) Malleable cast iron
   C) Grey cast iron
   D) Chilled cast iron

3. Due to its biocompatibility and properties very close to human bone, which of these alloys are extensively used as bone implants ?
   A) Copper alloys
   B) Aluminium alloys
   C) Micro alloy steels
   D) Titanium alloys

4. Jominy end quench test is used to determine the
   A) Hardness of a material
   B) Ductility of a material
   C) Hardenability of a material
   D) Brittleness of a material

5. A uniform circular solid shaft with diameter 2 cm is subjected to a torque of 40 Nm. The shear stress in N/mm^2 at the periphery of the shaft is equal to
   A) 80π
   B) 400π
   C) $80/\pi$
   D) $160/\pi$

6. Which of the following relationships hold good among modulus of elasticity E, modulus of rigidity G and bulk modulus K ?
   A) $K = 9EG/(3E + G)$
   B) $E = 9KG/(3K + G)$
   C) $E = 6KG/(3K + G)$
   D) $G = 9KE/(2K + G)$

7. A rectangular block of height H, length L and depth D is rigidly fixed at the bottom (length L × depth D face). When a tangential force P acts at the top face of the block parallel to the length L, the linear deformation at the top is ΔL. What will be the shear strain of the block ?
   A) $\Delta L/H$
   B) $\Delta L/L$
   C) $\Delta L/D$
   D) None of these

8. A square bar of 40 mm size is subjected to a sudden tensile load of 80 kN. The instantaneous stress in MPa induced in the bar will be
   A) 50
   B) 100
   C) 200
   D) 150

9. Which of the following are true for austenite ?
   i. It is a solid solution of iron, carbon and chromium
   ii. It has FCC crystal structure
   iii. It is stable at room temperature
   iv. Pure austenite is stable in the temperature range of 912 – 1394°C

   A) i and ii B) ii and iii C) i and iv D) ii and iv

10. Which of the following statements agree with the Hume-Rothery Rules for solid solubility ?
   A) The size difference between solvent and solute atoms must be less than 15%
   B) Crystal structure of both the materials must be different
   C) There should be large difference in electronegativity of the materials
   D) The valency of the atoms of the materials must be different

11. In eutectic reaction, which of the following is true ?
   A) Liquid + δ-ferrite ↔ Austenite B) Austenite ↔ α-Ferrite + Cementite
   C) Liquid ↔ Austenite + Cementite D) Ferrite ↔ Austenite + Cementite

12. The case hardening technique suitable for steels with very low carbon content
   A) Cyaniding B) Induction hardening
   C) Electron beam hardening D) Flame hardening

13. What will be the section modulus of a rectangular beam with a breadth of 6 cm and depth of 2 cm ?
   A) 4 cm^3 B) 12 cm^3 C) 8 cm^3 D) 1 cm^3

14. For the shear force S and bending moment M of a beam, which of the following is correct ?
   A) $M = \frac{dS}{dx}$ B) $S = \frac{dM}{dx}$ C) $M = \frac{d^2S}{dx^2}$ D) $S = \frac{d^2M}{dx^2}$

15. What will be the deflection in m at the centre of a simply supported beam of span 2 m, when a point load of 36 kN is applied at the centre (where E in kPa and I in m^4) ?
   A) 6EI B) 12EI C) 6/EI D) 12/EI

16. The Euler's theory of columns is valid when the
   i. Slenderness ratio is greater than or equal to $\sqrt{\frac{\pi^2 E}{\sigma_c}}$
   ii. Crushing stress is ≥ buckling stress
   iii. The column is short
   iv. Crushing stress is < buckling stress

   A) i and ii B) i and iv C) i, ii and iii D) iii and iv

17. Which of the following statements is true with regard to Atomic Packing Factor (APF) ?
A) APF of FCC is equal to APF of HCP
B) APF of SC is greater than APF of BCC
C) APF of BCC is greater than APF of HCP
D) APF of BCC is equal to APF of FCC

18. Which of the following pairs is matched correctly ?
A) Surface defect – Presence of extra partial planes
B) Point defect – Precipitates
C) Line defect – Grain boundary
D) Volume defect – Slag and porosity

19. Which of the following is true for Burger's vector in edge dislocation ?
A) Perpendicular to the dislocation line
B) Parallel to the dislocation line
C) Inclined to the dislocation line
D) None of these

20. A typical metallic sheet of 10 mm thickness and cross-sectional area of 0.25 m^2 is used as a steady state diffusion membrane in a hydrogen purifier. Find the mass of hydrogen purified in kg per second, if the difference in hydrogen concentration across the sheet is 1 kg/m^3 and the diffusion coefficient is 1×10^{-8} m^2/s.
A) 4×10^{-6}
B) 2.5×10^{-7}
C) 5×10^{-7}
D) 3×10^{-6}

21. Which of the following statements are true for Mohr's circle in a plane stress condition ?
i. Maximum shear is at the top and bottom of the circle
ii. The maximum shear stress is equal to the radius of the circle
iii. The principal stresses are located at the horizontal axis where shear is zero
iv. The maximum shear stress is equal to twice the radius of the circle
A) i and iv
B) i, ii and iii
C) iii and iv
D) All the above

22. A metallic cube of side 5 cm is triaxially loaded with 50 kN and 75 kN tensile loads and 100 kN compressive load in the x, y and z directions, respectively. If the Poisson's ratio is 0.25 and the Young's modulus is E N/mm^2, the volumetric strain will be
A) – 330/E
B) 300/E
C) 410/E
D) 330/E

23. For a cantilever beam of length L with uniformly distributed load w/unit length and a point load of W at the free end, the bending moment at a distance x from the free end is given by
A) $wx^2/8 + Wx^2$
B) $wx^2/2 - Wx$
C) $wx^2/4 + Wx$
D) $wx^2/2 + Wx$

24. A metallic rod of uniform diameter and length L with coefficient of thermal expansion α and Young's modulus E is constrained between two rigid walls. If the temperature rise is ΔT, the thermal stress developed in the rod is

A) $E\alpha\Delta T$ B) $E\alpha/\Delta T$ C) $\alpha\Delta T$ D) $E\alpha\Delta T^2$

25. In Carnot cycle, the addition of heat takes at

A) constant pressure
B) constant volume
C) constant temperature
D) partly at constant pressure and partly at constant volume

26. Which of the following is a correct statement ?

A) a reversible adiabatic process is an isentropic process
B) an isentropic process is an adiabatic process
C) an irreversible adiabatic process is a constant entropy process
D) entropy decreases during an irreversible adiabatic process

27. For the same compression ratio and heat supplied, the air standard efficiency of an Otto cycle compared to that of a Diesel cycle is

A) less B) equal C) more D) unpredictable

28. If an axial flow compressor is designed for a constant velocity through all stages, then the area of annulus of the succeeding stage will

A) remain the same
B) progressively decrease
C) progressively increase
D) depend upon number of stage

29. Increasing the number of reheating stages in a gas turbine to infinity makes the expansion tending

A) isothermal
B) isobaric
C) adiabatic
D) reversible adiabatic

30. A refrigerator working on a reversed Carnot cycle has a COP of 4.5. If it works as a heat pump and consumes 1 kW, the heating effect will be

A) 1 kW B) 4.5 kW C) 5 kW D) 5.5 kW

31. For a given set of operating pressure limits of a Rankine cycle, the highest efficiency occurs for

A) superheated cycle
B) saturated cycle
C) reheat cycle
D) regenerative cycle

32. The steam engine part which guides motion of the piston rod and prevents it from bending is called

A) crankshaft B) cross head C) valve rod 9 D) eccentric

33. In an impulse reaction turbine, the heat drops in the fixed and moving blades are 20 kJ/kg and 40 kJ/kg respectively. The degree of reaction for this stage will be
A) 1/2 B) 2/3 9 C) 1/3 D) None of the above

34. In aqua ammonia and Li-Br water absorption refrigeration systems, the refrigerants are
A) water and water B) water and Li-Br
C) ammonia and Li-Br D) ammonia and water

35. During chemical dehumidification process of air
A) dry bulb temperature and specific humidity decrease
B) dry bulb temperature decreases and specific humidity increases
C) dry bulb temperature increases and specific humidity decreases
D) dry bulb temperature and specific humidity increase

36. An increase in fin effectiveness is caused by high values of
1. convective coefficient
2. thermal conductivity
3. cross sectional area
4. circumference

Identify the correct statement.
A) 1 and 3 B) 2 and 3
C) 3 and 4 D) 2 and 4

37. Change in enthalpy in a closed system is equal to heat transferred, if the reversible process takes place at constant
A) temperature B) internal energy C) entropy D) pressure

38. An engine operates between temperatures limits of 900 K and T_2 and another engine operates between T_2 and 400 K. For both engines to be equally efficient, T_2 should be equal to
A) 650 K B) 600 K C) 625 K D) 700 K

39. The throttling of certain gases may be used for getting the refrigerating effect. The value of Joule coefficient (μ) for such a process is
A) $\mu = 0$ B) $\mu = 1$ C) $\mu > 1$ D) $\mu < 0$

40. The ratio of hydrodynamic to thermal boundary layer thickness varies as
A) root of Prandtl number B) one-third of Prandtl number
C) two-third power of Stanton number D) four-fifth power of Nusselt number

41. In a counter flow heat exchanger, cold fluid enters at 30°C and leaves at 50°C, whereas the hot fluid enters at 150°C and leaves at 130°C. The mean temperature difference for this case is
A) 20°C
B) 80°C
C) 100°C
D) indeterminate

42. For subsonic flow through a nozzle, the following changes occur in velocity and pressure along the flow direction
A) pressure decreases, velocity increases
B) pressure increases, velocity decreases
C) increase in both pressure and velocity
D) velocity increases and pressure remains constant

43. The volumetric efficiency of a well-designed SI engine lies in the range
A) 40 – 50%
B) 51 – 60%
C) 61 – 70%
D) 71 – 90%

44. In two-stage reciprocating air compressor, the suction and delivery pressures are 1 and 4 bar respectively. For maximum efficiency, the intercooler pressure is
A) 3 bar
B) 2.5 bar
C) 2 bar
D) 1.5 bar

45. Which parameter can be considered to remain constant if the value of exponent n in the polytropic equation pv^n = Constant talks a unit value ?
A) enthalpy
B) internal energy
C) entropy
D) pressure or volume

46. As differentials, heat and work would be described mathematically as
A) exact
B) discontinuity
C) inexact
D) point function

47. The mean effective pressure of an Otto cycle is
A) Independent of pressure ratio
B) Inversely proportional to pressure ratio
C) Proportional to the square root of pressure ratio
D) Directly proportional to pressure ratio

48. The thermodynamic property which is evaluated with the help of Maxwells equations from the data of other measurable properties of a system is
A) entropy
B) enthalpy
C) specific heat
D) latent heat

49. Which one of the following gases will have the maximum value of characteristic gas constant ?
A) oxygen
B) nitrogen
C) carbon dioxide
D) sulfur dioxide

50. For a heat engine operating on Carnot cycle, the work output is 25% of the heat rejected to the sink. The thermal efficiency for the engine would be

A) 10% B) 50% C) 30% D) 20%

51. As per common design practices, the three types of hydraulic turbines in descending order of flow rates are

A) Pelton, Francis, Kaplan
B) Francis, Kaplan, Pelton
C) Pelton, Kaplan, Francis
D) Kaplan, Francis, Pelton

52. A draft tube is not required for a

A) Francis turbine
B) Kaplan turbine
C) Pelton wheel turbine
D) None of the above

53. A pitot-static tube measures

A) Dynamic pressure
B) Difference in static and dynamic pressure
C) Static pressure
D) Atmospheric pressure

54. For steady incompressible three-dimensional flow, the continuity equation is given as

A) $\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0$
B) $\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=0$
C) $\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=\frac{\partial p}{\partial t}$
D) None of the above

55. Moody's chart is used to determine the

A) Reynolds number
B) Nusselt number
C) Friction factor
D) Surface tension

56. Specific speed of a centrifugal pump is

A) $N\sqrt{Q}H^{\frac{3}{4}}$
B) $N^2\sqrt{Q}H^{\frac{3}{4}}$
C) $N\sqrt{Q}H^{\frac{1}{4}}$
D) $\frac{N\sqrt{Q}}{H^{\frac{3}{4}}}$

57. For a completely submerged body with center of gravity 'G' and center of buoyancy 'B', the condition of stability will be pressure

A) G is located above B
B) G is located below B
C) G and B are coincident
D) None of the above

58. Consider the turbulent flow of a fluid through a circular pipe of diameter, D. Identify the correct pair of statements.
1. Fluid is well mixed
2. Fluid is un mixed
3. Reynolds number less than 2300
4. Reynolds number greater than 2300.

A) 1, 4 B) 1, 3 C) 2, 3 D) 2, 4

59. A flow field which has only convective acceleration is
A) A steady uniform flow
B) An unsteady uniform flow
C) A steady non uniform flow
D) All of the above

60. Surface tension is due to
A) Adhesion
B) Gravity and adhesion
C) Stagnation pressure
D) Cohesion

61. The pressure gradient in the horizontal direction (x-direction) in a static fluid is represented by

A) $\frac{\partial p}{\partial x} = 0$ B) $\frac{\partial p}{\partial x} = g$

C) $\frac{\partial p}{\partial x} = -g$ D) $\frac{\partial p}{\partial x} = \rho g$

62. The Newton's law of viscosity relates
A) The shear stress and rate of shear strain
B) The stress and strain in a fluid
C) The viscosity and density of fluid
D) The shear stress, gravity and viscosity

63. Match the following.

P	Q
i. Worm Gear Drive	i. Shafts are intersecting at an angle
ii. Oldham's coupling	ii. Approximate straight-line mechanism
iii. Paucellier Mechanism	iii. Large speed reduction
	iv. Co-axial shafts with a small misalignment
	v. Exact straight-line Mechanism

A) Pi – Qiii, Pii – Qiv, Piii – Qii B) Pi – Qiii, Pii – Qiv, Piii – Qv
C) Pi – Qiii, Pii – Qi, Piii – Qii D) Pi – Qiii, Pii – Qi, Piii – Qv

64. A cantilever beam with length L, moment of inertia of cross section I with respect to the neutral axis, and modulus of elasticity E carries a machine of weight W at its free end. Neglecting the mass of the beam, what is the frequency of free vibration of the system ?

A) $\omega_n = \sqrt{\frac{3EIg}{Wl^2}}$

B) $\omega_n = \sqrt{\frac{Wl^3}{3EIg}}$

C) $\omega_n = \sqrt{\frac{Wl^3}{48EIg}}$

D) $\omega_n = \sqrt{\frac{3EIg}{Wl^3}}$

65. The outside diameter of a hollow shaft is double the inside diameter. The ratio of the torque carrying capacity to that of a solid shaft of the same material and of the same outside diameter is

A) 1/16
B) 1/2
C) 15/16
D) 3/4

66. The tearing efficiency of a riveted joint is 80 percent, then the ratio of the rivet hole diameter to the pitch is equal to

A) 0.25
B) 0.2
C) 0.3
D) 0.4

67. A flywheel connected to a punching machine has to supply energy of 320 Nm which is running at a mean angular speed of 20 rad/s. If the total fluctuation of speed is not to exceed ± 2%, the mass moment of inertia of the flywheel in kg – m^2 is

A) 25
B) 20
C) 30
D) 40

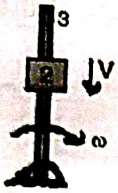
68. The swaying couple is maximum or minimum when the angle of inclination in degrees of the line of stroke is equal to

A) 180 and 315
B) 225 and 135
C) 225 and 45
D) 180 and 225

69. The principal stresses of a two dimensional state of stress are σ_1 and σ_2, σ_1 is greater than σ_2 and both are tensile, then which one of the following would be the correct criterion for failure according to maximum shear stress theory ?

A) $\sigma_1/2 = \pm\sigma_y/2$
B) $\sigma_1 = 2\sigma_y$
C) $\sigma_2/2 = \pm\sigma_y/2$
D) $(\sigma_1 - \sigma_2)/2 = \pm\sigma_y/2$

70. The slider 2 moves inwards with a velocity of v along a link 3 which is rotating clockwise with an angular velocity ω. The magnitude and direction of the Coriolis acceleration is



A) $\overleftarrow{\omega v}$ B) $\overrightarrow{2\omega v}$ C) $\overrightarrow{\omega v}$ D) $\overleftarrow{2\omega v}$

71. Oldham's coupling is an inversion of

A) Four bar chain
B) Slider-crank chain
C) Double slider crank chain
D) Five link chain

72. Which of the following statements are true ?

i. Interference occurs in involute gears.
ii. Involute profile gears are easy to manufacture.
iii. With involute tooth form, the centre distance errors do not affect the velocity ratio.

A) i and ii only
B) ii and iii only
C) i and iii only
D) i, ii and iii

73. With the decrease of governor speed

A) Radius of rotation decreases but the height of it increases
B) Radius of rotation and height of it decreases
C) Radius of rotation and the height of it increases
D) Radius of rotation increases but the height of it increases

74. Given that T_1 and T_2 are the tensions on the tight and slack slide of the belt respectively, the initial tension of the belt taking the account of centrifugal tension T_c is equal to

A) $(T_1 + T_2 + T_c)/2$
B) $(T_1 + T_2 + 2T_c)/2$
C) $(T_1 + T_2 + T_c)/3$
D) $(T_1 + T_2 + 2T_c)/3$

75. A single plate clutch having single side friction has outer and inner diameters of 100 mm and 40 mm respectively. Assuming a uniform pressure of 2 MPa and coefficient of friction of the liner material is 0.4, the torque carrying capacity of the clutch is

A) 150 Nm B) 372 Nm C) 196 Nm D) 490 Nm

76. The life of a ball bearing at a load of 10 kN is 8000 hrs. Its life in hours if the load is increased to 20 kN, keeping all other conditions the same, is
A) 1000 B) 2000 C) 500 D) 4000

77. A main advantage of ECM over EDM is that
A) it can cut harder material B) it is more accurate and precise
C) it consumes less power D) its tool wear is negligible

78. Which one of the following is the most accurate instrument ?
A) Optical projector B) Slip gauge
C) Screw gauge D) Vernier caliper

79. For a CNC machining process, which of the following is not applicable ?
A) Close tolerances required B) Part geometry is complex
C) Design changes are frequent D) No inspection is required

80. In the context of industrial psychology, the groups where the individuals are in face-to-face relationships with each other are called
A) Primary groups B) Secondary groups
C) Working groups D) Quality circle

81. In a bath tub curve, the zone which represents the failures due to limitations inherent in the design and accidents caused by usage is
A) Random failure zone B) Secondary failure zone
C) Wear out failure zone D) Infant mortality zone

82. Matrix organisation is created by
A) Merging line and staff organisation
B) Merging project organisation with functional organisation
C) Merging project organisation with military organisation
D) Merging with functional organisation with committees

83. In sand casting process, when the mold consists of more than two pieces, the additional parts are called
A) Foundations B) Cheeks C) Necks D) Copes

84. Cores are employed in castings to
A) Make desired recess in castings B) Save moulding sand
C) Strengthen the casting D) None of the above

85. Which one of the following is the strongest among the following brazing joints ?
A) Inclined B) Lap C) Butt D) V-butt

86. In production planning and control, loading means
A) Maximum utilisation of the facility
B) Assigning jobs to work centres
C) Determining the time required for each operation
D) Giving work orders for initiating the work

87. The selective inventory technique ABC gives importance to
A) Items which are rare
B) Items which are critical
C) Value of the items
D) Demand for the items

88. In operations research, Hungarian method is used to solve
A) Queuing problems
B) Assignment problems
C) Transportation problems
D) Game theory

89. Seam welding is a
A) Single spot welding process
B) Arc welding process
C) A type of stud welding
D) Continuous spot welding process

90. Hot forging is used for producing
A) Piston
B) Crankshaft
C) Carburettor
D) All the above

91. In ultrasonic machining process, the metal removal rate will be higher for materials with
A) Higher toughness
B) Higher ductility
C) Lower toughness
D) Higher fracture strain

92. A type of company which is being managed by the Board of Directors is
A) Joint Stock Company
B) Private Limited Company
C) Public Limited Company
D) Cooperative Organisation

93. The type of conveyor most suitable for moving granular materials
A) Roller conveyor
B) Chain conveyor
C) Bucket conveyor
D) Fork truck

94. Which one of the following is not an element in the factor comparison method of job evaluation ?
A) Physical effort
B) Skill
C) Responsibility
D) Employee worth

95. Among the conventional machining processes, maximum specific energy is consumed in
A) Turning
B) Drilling
C) Planing
D) Grinding

96. Plain milling of mild steel plates produces
A) Irregular shaped discontinuous chips
B) Regular shaped discontinuous chips
C) Continuous chips without built up edge
D) Jointed chips

97. The NC system which is applicable to a milling machine is called the
A) Point to point system
B) Continuous path system
C) Zig-zag machining system
D) Contour system

98. The type of layout suitable for simpler production scheduling, high volume of output and high labour efficiency is
A) Fixed position layout
B) Product layout
C) Process layout
D) Combination layout

99. A SIMO chart is used for studying the relationship of
A) Operator and machines
B) Operator and materials
C) Different limbs of an operator
D) Time and motion of operators

100. Break-even point gives the production level at which annual ?
A) Contribution is equal to fixed cost
B) Fixed cost is equal to variable cost
C) Sales revenue is equal to variable cost
D) Sales revenue is equal to fixed cost