# 68/26

**Question Booklet Alpha Code**

**A**

| Question Booklet Sl. No. |
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| |

A

**Total Number of Questions : 100** **Time : 90 Minutes**

**Maximum Marks : 100**

## INSTRUCTIONS TO CANDIDATES

1. The Question Paper will be given in the form of a Question Booklet. There will be four versions of Question Booklets with Question Booklet Alpha Code viz. **A, B, C** & **D**.
2. The Question Booklet Alpha Code will be printed on the top left margin of the facing sheet of the Question Booklet.
3. The Question Booklet Alpha Code allotted to you will be noted in your seating position in the Examination Hall.
4. If you get a Question Booklet where the alpha code does not match to the allotted alpha code in the seating position, please draw the attention of the Invigilator IMMEDIATELY.
5. The Question Booklet Serial Number is printed on the top right margin of the facing sheet. If your Question Booklet is un-numbered, please get it replaced by new Question Booklet with same alpha code.
6. The Question Booklet will be sealed at the middle of the right margin. Candidate should not open the Question Booklet, until the indication is given to start answering.
7. Immediately after the commencement of the examination, the candidate should check that the Question Booklet supplied to him/her contains all the 100 questions in serial order. The Question Booklet does not have unprinted or torn or missing pages and if so he/she should bring it to the notice of the Invigilator and get it replaced by a complete booklet with same alpha code. This is most important.
8. A blank sheet of paper is attached to the Question Booklet. This may be used for rough work.
9. **Please read carefully all the instructions on the reverse of the Answer Sheet before marking your answers.**
10. Each question is provided with four choices **(A), (B), (C)** and **(D)** having one correct answer. Choose the correct answer and darken the bubble corresponding to the question number using Blue or Black Ball Point Pen in the OMR Answer Sheet.
11. **Each correct answer carries 1 mark and for each wrong answer 1/3 mark will be deducted. No negative mark for unattended questions.**
12. No candidate will be allowed to leave the examination hall till the end of the session and without handing over his/her Answer Sheet to the Invigilator. Candidates should ensure that the Invigilator has verified all the entries in the Register Number Coding Sheet and that the Invigilator has affixed his/her signature in the space provided.
13. Strict compliance of instructions is essential. Any malpractice or attempt to commit any kind of malpractice in the Examination will result in the disqualification of the candidate.

A

1. The radius of Mohr's circle drawn to scale 1 cm = 10 MPa, for a plane stress system subjected with normal stresses 50 MPa (compressive) and 50 MPa (tensile) in X and Y directions respectively is

   A) Zero B) 10 cm C) 2.5 cm D) 5 cm

2. A tensile test specimen of radius 2 cm recorded an extension of 0.45 mm when put to an axial pull of 200 kN in UTM on a gauge length of 150 mm and a decrease of 0.024 mm in diameter. Then the Poisson's ratio of the material will be

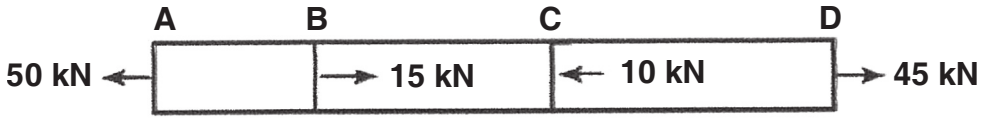
   A) 0.2 B) 0.3 C) 0.4 D) None of these

3. The area under the stress strain curve of a mild steel plotted during the tensile test upto rupture gives

   A) The toughness of the material B) The stiffness of the material

   C) The resilience of the material D) All of the above

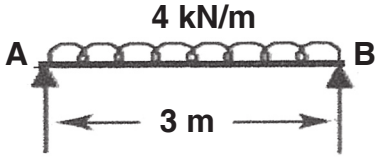
4. The stress in the section BC of the steel bar of cross section 20 mm $\times$ 10 mm acted upon by the forces as shown in Figure is




   A) 25 MPa (Compressive) B) 175 MPa (Compressive)

   C) 25 MPa (Tensile) D) 175 MPa (Tensile)

5. For the simply supported beam with uniformly distributed load as shown in the Figure, the maximum shear force and bending moment will be




   A) 12 kN and 13.5 kN-m B) 6 kN and 4.5 kN-m

   C) 6 kN and 9 kN-m D) 12 kN and 18 kN-m

6. For a simply supported beam subjected with a central point load, which of the following statement is/are correct ?

   I. The stiffness of the beam depends on Young's modulus of the material

   II. The stiffness of the beam increases as moment of inertial of the beam cross section increases

   III. The stiffness of the beam depends on the strength of the beam

   IV. The stiffness of the beam is proportional to its area of the cross section

   A) Both I and II B) Only II C) III and IV D) II and III

7. When a metal bar of uniform cross-section with its ends fixed between two rigid concrete blocks, is cooled to ice temperature, which of the following statements is correct regarding the stress developed in the bar ?

   A) The stress depends on length and area of cross section of the bar

   B) The stress developed is compressive

   C) The stress depends on Young's modulus of the bar

   D) The stress is halved if the area of cross section is doubled

8. The strain energy stored in a cantilever beam of length 'L' with an end load 'P' is given as 150 N-m. If the length of the cantilever is doubled, the strain energy stored will be

   A) 600 N-m B) 1200 N-m C) 75 N-m D) 300 N-m

9. Choose the correct statement for a simply supported I-section beam with a transverse point load applied at the center

   A) The shearing stress is zero at the neutral axis

   B) The shearing stress distribution is parabolic and continuous across the entire cross section

   C) The shearing stress is maximum at the top of the cross section

   D) The shearing stress is maximum at the neutral axis

10. The crippling load for a very long column fixed at both ends is identified as 1000 N. If the length of the column is halved, the critical load will be

    A) 250 N B) 2000 N C) 4000 N D) 500 N

11. The maximum deflection of a steel cantilever beam (E = 210 GPa) subjected with a point load at the free end is given as 12 mm. If the beam was made of aluminium (E = 70 GPa) with half the length of steel, what would have been the deflection ?

    A) 4 mm B) 4.5 mm C) 8 mm D) 9 mm

12. The reactions at the supports of a statically indeterminate linear elastic structure can be determined by

    A) Cauchy's formula B) Maxwell's reciprocal theorem

    C) Castigliano's theorem D) Lagrange's method

13. The Zeroth Law of Thermodynamics provides the operational basis for the measurement of

    A) Volume B) Enthalpy

    C) Temperature D) Pressure

14. The Second Law of Thermodynamics serves as the foundational basis for defining which property ?

A) Work B) Heat C) Entropy D) Enthalpy

15. The Clausius-Clapeyron equation is used to determine the slope of a curve on which type of thermodynamic diagram ?

A) P-V diagram B) P-h diagram C) T-S diagram D) P-T diagram

16. A refrigeration system's condenser rejects heat at a rate of 120 kW, and its compressor uses 30 kW of power. Calculate the system's Coefficient of Performance (COP).

A) 4 B) 0.25 C) 3 D) 2

17. An adiabatic nozzle receives air at 300 kPa, 227°C and 10 m/s through an inlet area of 80 $cm^2$. The air leaves the nozzle at a pressure of 100 kPa and a speed of 180 m/s. If $C_p$ = 1008 J/kgK, find the exit temperature of the air (in °C).

A) 211 B) 243 C) 195 D) 259

18. An engine operates on an ideal air-standard Otto cycle with a compression ratio of 8.5. Assuming the specific heat ratio ($\gamma$) for air is 1.4, determine the thermal efficiency of the cycle as a percentage.

A) 95 B) 52.7 C) 57.5 D) 48.3

19. Heat flows at a rate of 100 kW through a steady-state wall. If the boundary temperatures of the wall are 400 K and 300 K, calculate the resulting entropy generation rate in W/K.

A) 44.33 B) 23.33 C) 66.66 D) 83.33

20. Which of the following is considered an extensive property ?

A) Pressure B) Density C) Volume D) Temperature

21. Which of the following expressions correctly defines Gibbs free energy ?

A) G = H/TS B) G = U – TS C) G = H – TS D) None of these

22. A reversible power cycle operates between temperature limits of 800 K and 300 K. If the cycle receives 400 kJ of heat, what is the amount of unavailable work in kJ ?

A) 150 B) 280 C) 120 D) 220

23. Given that a gas has a specific heat ratio of 1.4 and a specific heat at constant pressure of 7 kJ/kg·K, what is the value of $C_p - C_v$ in kJ/kg·K ?

A) 2 B) 2.4 C) 1.4 D) 3

24. A gas mixture undergoes expansion from an initial volume of 0.03 $m^3$ to a final volume of 0.06 $m^3$ under a constant pressure of 1 MPa. If the system absorbs 84 kJ of heat during this expansion, what is the resulting change in its internal energy ?

A) 84 kJ B) 114 kJ C) 54 kJ D) 30 kJ

25. The shear stress on a fluid layer is directly proportional to shear strain.

A) The above statement is known as Hydrostatic law

B) The above statement is known as Pascal's law

C) The above statement is known as Newton's law of viscosity

D) The above statement is incorrect

26. The pressure intensity at a point in a fluid is 4.905 $N/cm^2$. What will be the corresponding height of an oil column of specific gravity 0.8 ?

A) 6.25 m B) 4.905 m C) 5 m D) 3.924 m

27. A rectangular plane surface is 2 m wide and 3 m deep. It lies in vertical plane in water. Determine the position of centre of pressure on the plane surface when its upper edge is horizontal and coincides with water surface.

A) 0.5 m B) 1.0 m C) 1.5 m D) 2 m

28. Which is the condition for stable equilibrium of a floating body ?

A) The centre of buoyancy should be above centre of gravity

B) The centre of buoyancy should be below centre of gravity

C) The metacentre should be above centre of gravity

D) The metacentre should be below centre of gravity

29. The following are the assumptions of Bernoulli's equation :

i. The fluid is ideal

ii. The flow is uniform

iii. The flow is incompressible

Which of the above point is/are correct ?

A) Only i and ii B) Only ii and iii

C) Only i and iii D) All of the above i, ii and iii

30. The equation of motion where only pressure force and gravity force are considered, is

A) Reynolds equation B) Euler's equation

C) Bernoulli's equation D) Navier-Stokes equation

31. For finding the fluid velocity at any point in a pipe, the following instrument is used

A) Pitot tube
B) Pitot static tube
C) Orificemeter
D) Venturimeter

32. The friction factor for laminar flow in pipes is given by
(Where Re is the Reynolds number)

A) 16/Re
B) 64/Re
C) $0.079/Re^{0.25}$
D) $0.316/Re^{0.25}$

33. Water flows as a free jet from one end of a smooth horizontal pipe at a velocity of 9.81 m/s, while the other end of the pipe is connected to a tank. The height of water in the tank is 5 m from the centerline of the pipe. Calculate the loss of head at the free end of the pipe.

A) 19.62 m of water
B) 9.81 m of water
C) 4.905 m of water
D) 2.453 m of water

34. Water flowing through a pipe moves out through a nozzle at a velocity of 40 m/s. The cross sectional area of the nozzle is 0.005 $m^2$. The work done per second by the above jet on a fixed flat plate is

A) 8 kW
B) 160 kW
C) 320 kW
D) None of the above

35. The ratio of the pitch diameter of the Pelton wheel to the diameter of the jet is known as

A) Jet ratio
B) Speed ratio
C) Speed coefficient
D) Pitch ratio

36. The head against which a centrifugal pump has to work is known as

A) Manometric head
B) Piezometric head
C) Static head
D) Dynamic head

37. The unit cell with three lattice parameters is

A) tetragonal
B) orthorhombic
C) monoclinic
D) triclinic

38. The number of members in the family in a cubic crystal are

A) 8
B) 12
C) 24
D) 48

39. In Hume-Rothery rules for extensive solid solubility, the atomic diameter of the solute and the solvent atoms should not differ by more than

A) 50%
B) 15%
C) 2%
D) 0%

40. A cation vacancy and an anion vacancy in a crystal of the type AB is called
    A) Schottky defect
    B) Frenkel defect
    C) Pair of vacancies
    D) None of these

41. The t vector is parallel to the b vector in a dislocation of the type
    A) screw
    B) edge
    C) mixed
    D) none of these

42. The fraction of pearlite in a 0.55% C steel is
    A) 0.55
    B) 0.31
    C) 0.71
    D) 0

43. Among the following elements, the one with the largest diffusion coefficient in steel at 1000°C is
    A) Mn
    B) W
    C) Ni
    D) C

44. The free energy decrease during recrystallization comes mainly from
    A) excess point defects
    B) excess dislocations
    C) grain boundaries
    D) lower energy of the new crystal structure

45. The length of the Frank-Read source operating after work hardening to double the initial yield stress is approximately
    A) half
    B) same as before
    C) double
    D) 4 times

46. Eutectoid steels have structure of
    A) pearlite alone
    B) phases of ferrite and pearlite
    C) phases of cementite and pearlite
    D) phases of ferrite and cementite

47. Sorbite is the structure obtained by
    A) Quenching austenite
    B) Quenching austenite and then heating into the range of 200 to 375°C
    C) Quenching austenite and then heating into the range of 375 to 660°C
    D) Quenching austenite and then heating into the range of 660 to 700°C

48. The hardness and tensile strength in austenitic stainless steel can be increased by
    A) hardening and cold working
    B) normalizing
    C) martempering
    D) full annealing

49. Highest Useful Compression Ratio (HUCR) of an engine is

A) The critical compression ratio at which the engine give maximum output

B) The compression ratio at which the engine can be run

C) The critical compression ratio at which a fuel can be used without detonation in a test engine

D) The highest compression ratio at which maximum of heat of combustion occurs

50. The relative density of a Lead-Acid battery on being tested by a hydrometer gives a reading of 1.110 means that the battery is

A) Fully charged B) Partially discharged

C) Fully discharged D) Three-fourth charged

51. A certain mass of wet steam mixture consists of $m_s$ kg and $m_w$ kg of dry steam and water vapour respectively, then the quality of steam is given by

A) $\frac{m_s}{m_s + m_w}$ B) $\frac{m_w}{m_s + m_w}$ C) $\frac{m_s}{m_w}$ D) $\frac{m_w}{m_s}$

52. The refrigerant R717 stands for

A) $SO_2$ B) $NH_3$

C) Methyl Chloride D) $CO_2$

53. The clearance factor for a compressor is the ratio of

A) Clearance volume to swept volume

B) Swept volume to clearance volume

C) Clearance volume to cylinder volume

D) Cylinder volume to clearance volume

54. In the electromagnetic spectrum the wavelength of a thermal radiation extended over a range of

A) 0.1 – 100 μm B) 0.01 – 0.1 μm C) 10 – 30 μm D) 100 – 1000 μm

55. A crank angle of 18° duration is required for the injection of the fuel for a four stroke diesel engine running at 2000rpm. What is the injection duration in milliseconds ?

A) 0.75ms B) 1.5ms C) 3ms D) 1.25ms

56. A body whose radiation output has the same distribution as a blackbody but is reduced by a constant fraction is called

A) Coloured body B) White body C) Gray body D) Dark body

57. For the same compression ratio, the Otto cycle efficiency 'η' for the working fluids having compression index, n = 1.3, 1.4, 1.67 can be related as

A) $\eta_n = 1.67 > \eta_n = 1.4 > \eta_n = 1.3$ B) $\eta_n = 1.67 < \eta_n = 1.4 < \eta_n = 1.3$

C) $\eta_n = 1.67 = \eta_n = 1.4 = \eta_n = 1.3$ D) No change in the efficiency

58. What is the role of heavy water in a nuclear reactor ?

A) It serves as a neutron absorber

B) It serves as a coolant

C) It serves as a neutron moderator

D) It serves as a neutron moderator and coolant

59. In a two stage gas turbine plant, reheating after first stage, the thermal efficiency

A) Decreases B) Increases C) No change D) Unpredictable

60. For a counter flow heat exchanger, the temperature of hot fluid at inlet and outlet are 100°C and 50°C and the corresponding cold fluid are 30°C and 80°C respectively. Then the LMTD of the heat exchanger is

A) 0°C B) 20°C C) Infinity D) Undetermined

61. A 40 kW engine running at rated rpm has a mechanical efficiency of 80%. What is its approximate mechanical efficiency at half rated load ?

A) 40% B) 32% C) 66% D) 50%

62. Air with a velocity of 'V' is passing through a rectangular duct of size 'X' and 'Y' (X > Y). If the same fluid with same velocity is passing through a circular ducts of diameter 'D' then the equivalent diameter '$D_e$' of circular duct for the same pressure drop per unit length is given by

A) $\frac{X+Y}{XY}$ B) $\frac{2XY}{X+Y}$ C) $\frac{2Y}{X+Y}$ D) $\frac{2X}{X-Y}$

63. Gear tooth interference can be reduced by

A) Increasing pressure angle

B) Reducing the number of teeth on the pinion

C) Increasing addendum

D) Decreasing the center distance

64. Pressure angle in gear is

A) Angle between the common tangent at the point of tooth contact and the common tangent to the pitch circles

B) The angle between the common normal at the point of tooth contact and the common tangent to the pitch circles

C) Angle between the line of action and the common normal to the pitch circles

D) Either A) or C)

65. For the same speed, load and center distance, the efficiency of flat belt is

A) Higher than V belt B) Lower than V belt

C) Same as that of V belt D) None of the above

66. If semi cone angle of a cone clutch falls below the angle of static friction

A) Clutch will slip B) Clutch will self-lock

C) Clutch will disengage D) None of the above

67. A flywheel stores 10 kJ of energy at 100 rpm. If the speed increases to 200 rpm, the stored energy becomes

A) 20 kJ B) 40 kJ C) 60 kJ D) 80 kJ

68. What happens to the gyroscopic couple if the angular momentum is doubled, keeping precision velocity the same

A) Gyroscopic couple becomes two times the previous value

B) Gyroscopic couple becomes four times the previous value

C) Requires more data to predict

D) None of the above

69. Choose the correct option regarding the following :

**Assertion (A) :** Complete balancing of reciprocating masses is not possible.

**Reason (R) :** The inertia force due to reciprocating motion acts along a straight line and changes direction periodically.

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

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

C) (A) is true but (R) is false

D) (A) is false but (R) is true

70. A spring-mass system with mass $m_1$ and stiffness $k_1$ has double the frequency of another system having mass $m_2$ and stiffness $k_2$. If the mass $m_2$ is one half of $m_1$, the stiffness ratio $k_1/k_2$ will be

A) 1 B) 2 C) 4 D) 8

71. Choose the correct option regarding the following :

**Assertion (A) :** A highly damped system may not be suitable for vibration isolation at high frequencies.

**Reason (R) :** Excess damping decreases force transmissibility in the isolation region.

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

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

C) (A) is true but (R) is false

D) (A) is false but (R) is true

72. If a joint is required to be both lightweight and highly efficient, the preferred choice is

A) Riveted joint B) Bolted joint C) Welded joint D) Screwed joint

73. Which shaft design modification most effectively improves fatigue life without significantly increasing weight ?

A) Increasing shaft length

B) Introducing sharp shoulders

C) Providing generous fillet radii and good surface finish

D) Increasing keyway depth

74. A designer replaces a ball bearing with a roller bearing of similar size. The most likely reason is

A) To increase the operating speed

B) To increase radial load carrying capacity

C) To increase the axial load carrying capacity

D) None of the above

75. Repeated braking at short intervals may lead to

A) Brake fade B) Premature wear and tear

C) Warping of brake pads D) All of the above

76. The ratio of the maximum stress in a member at a geometrical discontinuity to the nominal stress at the same section based upon net area is called

A) Notch sensitivity factor

B) Theoretical or form stress concentration factor

C) Surface finish factor

D) None of the above

77. As grain size of a cast alloy decreases

A) strength decreases

B) ductility increases

C) microporosity increases

D) tendency to crack during solidification increases

78. If subscript 1 denotes the top of the sprue and subscript 2 denotes the bottom, assuming that pressure at the top of the sprue is equal to the pressure at the bottom and that there are no frictional losses, the relationship between height h and cross sectional area A at any point in the sprue is given by

A) $A1/A2 = h1/h2$

B) $A1/A2 = h2/h1$

C) $A1/A2 = \sqrt{(h1/h2)}$

D) $A1/A2 = \sqrt{(h2/h1)}$

79. Lamellar tears may develop in welding because of

A) melting away of the base metal resulting in groove generation

B) joint not getting filled with the proper amount of weld

C) shrinkage of the restrained components of the structure during cooling

D) localized heating and cooling during welding resulting in expansion and contraction of the weld area

80. The primary rolling operation used to manufacture the spherical balls for ball bearings

A) profile rolling

B) ring rolling

C) transverse rolling

D) skew rolling

81. If $\phi$ is the shear angle and $\alpha$ is the rake angle, chip-thickness ratio r of an orthogonal cutting operation is given by

A) $r = \cos\phi/\sin(\phi - \alpha)$

B) $r = \sin\alpha/\cos(\phi - \alpha)$

C) $r = \sin\phi/\cos(\phi - \alpha)$

D) $r = \cos\alpha/\sin(\phi - \alpha)$

82. BUE (Built Up Edge) formation during machining can be reduced by

A) decreasing cutting speed

B) decreasing depth of cut

C) decreasing rake angle

D) all of the above

83. A machining process used to create flat horizontal surfaces

A) slab milling

B) form milling

C) straddle milling

D) face milling

84. The medium used in Mond process for manufacture of metal powders

A) Graphite B) Carbon monoxide

C) Charcoal D) Hydrocarbon

85. Among the following non-traditional machining methods, which one offers the highest material removal rate ?

A) Electric Discharge Machining (EDM) B) Electro Chemical Machining (ECM)

C) Ultrasonic Machining (USM) D) Laser Beam Machining (LBM)

86. GO limit corresponds to

i. lower limit for shaft and upper limit for hole.

ii. upper limit for shaft and lower limit for hole.

iii. maximum material condition.

iv. minimum material condition.

Which among the above are true ?

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

87. How many fundamental standard grades of tolerance are there ?

A) 10 B) 14 C) 18 D) 25

88. The degree of reproducibility of a measurement

A) precision B) accuracy C) resolution D) tolerance

89. What do you mean by delegation in management ?

A) Assignment of responsibility to subordinates

B) Giving orders to subordinates

C) Supervising employees

D) Controlling the performance

90. Which of the following is(are) correct statement(s) controlling function in management ?

i. The controlling function involves monitoring progress and making needed changes.

ii. The controlling function involves assigning tasks to the employees.

A) i B) ii C) i and ii D) None

91. A data entry operator completes his task in 300 minutes with a performance rating of 80%. The standard time for the task is 276 minutes. The allowance provided for the task is

A) 20 percentage B) 8 percentage C) 15 percentage D) None of these

92. Which of the following concept involves unit load principle ?

A) Containerization B) Palletization C) Unitization D) All of these

93. Which of the following is(are) correct statement(s) for production planning ?

i. Critical ratio is the ratio of 'the time remaining until due date' to 'total shop time remaining'.

ii. Critical ratio is a sequencing rule used in production planning.

A) i B) ii C) i and ii D) None

94. In the following, which is not a therblig ?

A) Plan B) Move C) Position D) Assemble

95. Which of the following is not a sequencing rule in production planning ?

A) First-Come, First-Served B) Earliest Due Date

C) Shortest Processing Time D) None

96. Forecasting technique of gaining consensus from a group of experts while maintain their anonymity is

A) Brain storming B) Expert opinion method

C) Delphi method D) Survey method

97. Which of the following is(are) correct statement(s) for Economic order quantity ?

i. Economic order quantity is the lot size that minimises total annual inventory holding and ordering costs.

ii. Economic order quantity is the lot size at which the annual holding and ordering costs are same.

A) i B) ii C) i and ii D) None

98. A layout in which a set of machines chosen so that it can carry out the complete processing of a given family of products is

A) Product layout B) Group layout C) Process layout D) None

99. Which of the following is not a management development technique ?

A) Action learning B) Job rotation

C) Role playing D) Programmed learning

100. If the gain of one player equals loss of other player in a game, it is called

A) Corporative game B) Zero sum game

C) Dynamic game D) None

Space for Rough Work