

84/26

Question Booklet Alpha Code

A

Question Booklet Sl. No.

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

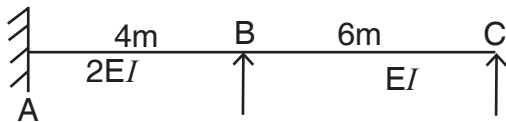
1. A steel cube with a side length of 100 mm is subjected to a tensile force of 10 kN along each of the x, y and z axes. Given that the material has a Young's modulus of 200 GPa and a Poisson's ratio of 0.3, determine the resulting change in volume of the cube.

A) 5 mm^3 B) 6 mm^3 C) 7 mm^3 D) 4 mm^3

2. A solid circular shaft with a diameter of 100 mm transmits 314 kW of power while rotating at 100 rpm. Calculate the maximum shear stress induced in the shaft due to torsion.

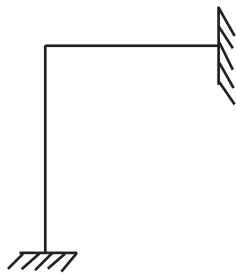
A) $\frac{48}{\pi} \text{ MPa}$ B) $\frac{480}{\pi} \text{ MPa}$
 C) $\frac{4800}{\pi} \text{ MPa}$ D) $\frac{480}{2\pi} \text{ MPa}$

3. In the given structure, what is the relative stiffness of the members BA and BC ?



A) $\frac{I}{2}$ and $\frac{I}{6}$ B) $\frac{I}{2}$ and $\frac{I}{8}$
 C) $\frac{I}{4}$ and $\frac{I}{6}$ D) $\frac{3I}{8}$ and $\frac{I}{6}$

4. The degree of redundancy of the rigid jointed frame shown in figure is equal to



A) 0 B) 4 C) 1 D) 3

5. A turbine works at 60 m head and 400 rpm speed. Its 1 : 2 scale model to be tested under a head of 15 m should have a rotational speed of

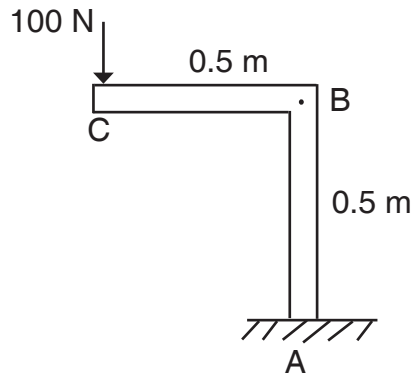
A) 400 rpm B) 800 rpm C) 200 rpm D) 300 rpm

- A**

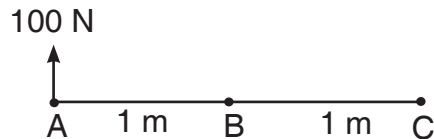
16. As per IS 456 : 2000, in the limit state method of design, the partial safety factor for the material strength of concrete is
A) 1.0 B) 1.15 C) 1.5 D) 1.75
17. In the designation Fe 415 of reinforcing steel, the number 415 denotes
A) the ultimate tensile strength in N/mm^2
B) the characteristic yield strength in N/mm^2
C) the modulus of elasticity in kN/mm^2
D) the percentage elongation at fracture
18. A rectangular reinforced concrete slab supported on all four sides is designed as a ONE-WAY slab when the ratio of the longer span to the shorter span is
A) less than 1 B) equal to 1
C) less than 2 D) greater than 2
19. As per IS 800 : 2007, the modulus of elasticity of structural steel to be adopted in design is
A) $1.0 \times 10^5 \text{ N/mm}^2$ B) $2.0 \times 10^5 \text{ N/mm}^2$
C) $2.0 \times 10^6 \text{ N/mm}^2$ D) $3.0 \times 10^5 \text{ N/mm}^2$
20. A retaining wall H m high retains dry sand with unit weight γ . According to Rankine's theory, the resultant active earth pressure acts at a height of
A) $H/2$ above the base
B) $H/3$ above the base
C) $H/4$ above the base
D) $2H/3$ above the base
21. According to Terzaghi's effective stress principle, the effective stress is equal to
A) Total stress plus pore water pressure
B) Total stress minus pore water pressure
C) Pore water pressure minus total stress
D) Total stress divided by pore water pressure

22. Negative skin friction on a pile is likely to develop when
- A) The pile settles more than the surrounding soil
 - B) The surrounding soil settles more than the pile
 - C) The pile is subjected only to uplift load
 - D) The pile is driven into dense sand
23. The liquid limit of a soil is the water content at which the soil changes from
- A) Solid state to semi-solid state
 - B) Semi-solid state to plastic state
 - C) Plastic state to liquid state
 - D) Liquid state to plastic state
24. The aggregate crushing value test indicates the
- A) Abrasion resistance
 - B) Resistance to crushing under gradually applied compressive load
 - C) Resistance to weathering
 - D) Shape characteristics
25. Which planning principle is primarily aimed at minimizing urban sprawl while ensuring efficient utilization of infrastructure ?
- A) Ribbon development
 - B) Leapfrog development
 - C) Linear settlement
 - D) Compact city development
26. Which of the following statements are correct ?
- i. The necessary condition for equilibrium of three forces is that they must be concurrent.
 - ii. The principle of transmissibility can be applied in situations where only the state of the system is considered and not the deformation.
 - iii. The moment of the resultant of a system of forces about an axis is equal to the algebraic sum of the moments of its components.
- A) i and ii B) ii and iii C) i and iii D) i, ii and iii

27. A bracket ABC is fixed at A and loaded by 100 N force at C as shown. What is its effect at point B ?



- A) A clockwise moment of 50 Nm
 B) A counter clockwise moment of 50 Nm
 C) A counter clockwise moment of 50 Nm and a downward force of 100 N
 D) A clockwise moment of 50 Nm and a downward force of 100 N
28. A force of 100 N acting at A is to be resolved into two components at B and C. What will be their values ?



- A) B = 200 N up and C = 100 N up
 B) B = 200 N up and C = 100 N down
 C) B = 100 N up and C = 200 N down
 D) B = 100 N up and C = 200 N horizontal
29. Choose the correct statement(s) related to a TTT diagram for plain carbon eutectoid steel
- i. the area between the nose of the curve and the temperature axis shows a meta stable state.
 - ii. austenite stays in the area above the curve.
 - iii. along the temperature axis from top to bottom, the transformation happen from martensite to pearlite.
- A) only i and ii are true
 B) only ii and iii are true
 C) only ii is true
 D) only iii is true

36. If $\omega/\omega_n = \sqrt{2}$, where ω is the frequency of excitation and ω_n is the natural frequency of vibrations, then transmissibility of vibrations will be
A) 0.5 B) 2.0 C) 1.5 D) 1.0
37. The product of circular pitch and diametral pitch in gears is equal to
A) module B) unity C) $1/\pi$ D) π
38. The maximum efficiency in case of worm and worm wheel is
A) $(1 - \sin\phi)/(1 + \sin\phi)$ B) $(1 - \sin\phi)/\sin\phi$
C) $(1 + \sin\phi)/(1 - \sin\phi)$ D) $\sin\phi/(1 - \sin\phi)$
39. When a hot metal piece is left to cool in air the time rate of cooling of the outer layer will be
A) slower at start and faster near the end
B) faster at start and slower near the end
C) both rates will be the same
D) this will depend on the material
40. In steady state conduction with variable thermal conductivity if the conductivity decreases along the flow direction, then the temperature gradient along the flow direction will become
A) steeper
B) flatter
C) remain constant
D) either of the three depending on heat flow rate
41. In pipe flow
A) for constant heat flux, the initial length is more effective compared to the end length
B) for constant wall temperature the initial length are less effective compared to the end lengths
C) In fully developed flow and constant wall temperature, the effectiveness increases with length
D) In fully developed flow and constant heat flux, the effectiveness decreases with length

48. In a casting process a spherical drop of molten metal of diameter 4 mm was found to solidify in 12 seconds. If another spherical drop of the molten metal of diameter 'd' is found to be solidify in 1 minute 48 seconds, then what is the value of 'd' in mm.
 A) 18 B) 6 C) 9 D) 12
49. The power source characteristics of an arc welding can be approximated by a straight line with no load voltage of 80 Volts and short circuit current of 800 Ampere. The length of the DC arc is characterized by $l = \frac{v}{20} - 1$, where 'v' is the arc voltage and 'l' is the arc length in cm. Find the optimum value of 'l' in mm.
 A) 1 B) 7.8 C) 10 D) 5
50. 40 flat pieces of initial dimensions 200 mm × 25 mm × 1 mm is to be milled in a single cut using end milling to the final dimension of 200 mm × 20 mm × 1 mm. The specifications of the cutter used is: diameter = 25 mm, number of teeth = 10 and is rotating at 100 rpm. Horizontal feed of the table is 10 mm/min. Assuming single teeth in contact, the total material removal rate is
 A) 3.33 mm³/sec B) 0.833 mm³/sec
 C) 33.33 mm³/sec D) 133.33 mm³/sec
51. Most suitable conveyor for transportation of bulk loose materials
 A) screw conveyor B) pneumatic conveyor
 C) belt conveyor D) forklifts
52. Choose the correct option for the following screens in the order of their highest capacity.
 i. Grizzlies
 ii. Shaking screen
 iii. Vibrating screen
 A) i > ii > iii B) ii > iii > i C) i > iii > ii D) iii > ii > i
53. In constant pressure filtration the rate of filtration is
 A) proportional to square of the filtrate volume
 B) directly proportional to filtrate volume
 C) inversely proportional to the filtrate volume
 D) does not depend on the filtrate volume

54. Which of the following size reduction equipment's are used as intermediate grinders ?
- Gyratory crushers
 - Rod mills
 - Attrition mills
 - Hammer mills
- A) i and ii B) ii and iii C) ii, iii and iv D) i, ii and iii
55. For a mixing tank the power number varies with diameter of the impeller as
- A) D^5 B) $D^{0.5}$ C) $D^{-0.5}$ D) D^{-5}
56. A gas occupies 5 L at 2 atm and 300 K. It is compressed to 2 L and heated to 600 K. The final pressure is approximately
- A) 2 atm B) 10 atm C) 11.25 atm D) 15 atm
57. A gas mixture contains 4 mol N_2 , 3 mol O_2 and 1 mol CO_2 . If the total pressure is 800 kPa, the partial pressure of oxygen is
- A) 100 kPa B) 150 kPa
C) 250 kPa D) 300 kPa
58. A gas mixture contains 40 mol% methane, 35 mol% nitrogen and 25 mol% carbon dioxide. If total pressure is 12 bar, the partial pressure of CO_2 is
- A) 2 bar B) 2.5 bar C) 3 bar D) 4 bar
59. What metal combination is used to construct a Type K thermocouple ?
- A) Iron/Constantan B) Copper/Constantan
C) Chromel/Alumel D) Platinum/Rhodium
60. The actual velocity at vena-contracta for flow through an orifice from a reservoir is given by
- A) $C_v\sqrt{2gH}$ B) $C_c\sqrt{2gH}$
C) $C_d\sqrt{2gH}$ D) $C_v C_a$

61. Which of the following processes is followed by unsaturated air (with dry bulb temperature 12°C and relative humidity 47%) passing through water spray washer (temperature of water being constant at 40°C) ?

- A) Humidification only B) Heating only
C) Both heating and humidification D) Evaporative cooling

62. Match the following :

Principle of operation	Device
i. An emf is generated across the junctions of two dissimilar metals when the junction is heated	a. Piezo electric device
ii. An emf is generated when external force is applied on certain crystalline materials	b. Thermocouple
iii. Resistance of a thin film is varied by convection cooling in stream of liquid flows	c. Resistance strain gage
iv. Resistance of metallic wire element is changed by elongation or compression due to externally applied stress	d. Hot film anemometer
A) i-b, ii-c, iii-d, iv-a	
B) i-d, ii-c, iii-b, iv-a	
C) i-c, ii-d, iii-a, iv-b	
D) i-b, ii-a, iii-d, iv-c	

63. The unit impulse response of a first order process is given by $2e^{-0.5t}$. The gain and time constant of the process are, respectively,
- A) 4 and 2
 - B) 2 and 2
 - C) 2 and 0.5
 - D) 1 and 0.5
64. In the five level automation hierarchy of computer integrated industrial process, using bottom up approach, order the following: Corporate level management information, Plant control level, Supervisory control level, Process control level and Measurement level
- A) Corporate level management information -> Plant control level -> Supervisory control level -> Process control level -> Measurement level
 - B) Process control level -> Measurement level -> Supervisory control level -> Plant control level -> Corporate level management information
 - C) Measurement level -> Process control level -> Supervisory control level -> Plant control level -> Corporate level management information
 - D) Process control level -> Supervisory control level -> Measurement level -> Plant control level -> Corporate level management information
65. For steady-state equimolar counter diffusion of two gases A and B, which of the following expressions correctly represents the molar flux N_A ?
- A) $N_A = \frac{D_{AB}}{RTz} (\bar{p}_{A1} - \bar{p}_{B1})$
 - B) $N_A = \frac{D_{AB}}{RTz} (\bar{p}_{B1} - \bar{p}_{A1})$
 - C) $N_A = \frac{D_{AB}}{RTz} (\bar{p}_{A2} - \bar{p}_{A1})$
 - D) $N_A = \frac{D_{AB}}{RTz} (\bar{p}_{A1} - \bar{p}_{A2})$

66. The absorption factor is defined as

Where

L = liquid flow rate,

G = gas flow rate and

m = slope of the equilibrium line

A) $\frac{L}{mG}$

B) $\frac{G}{mL}$

C) $\frac{mL}{G}$

D) $\frac{mG}{L}$

67. For the system air-water vapor, $\frac{h_G}{k_Y C_S}$ is approximately equal to C_S (or) approximately $\frac{h_G}{k_Y C_S} = 1$. This is so called

Where

h_G = heat transfer coefficient

k_Y = gas-phase mass transfer coefficient

C_S = humid heat

A) Psychrometric ratio

B) Lewis relation

C) Wet-bulb depression

D) Reynolds relation

68. The rate of heat transferred from hot bulk air (surroundings) to the surface the wet solid is exactly equal to the rate of heat absorbed for drying. This period of drying is called

A) Heat absorption period

B) Falling rate period

C) Constant rate period

D) Initial adjustment period of drying

69. At the minimum reflux ratio, the distillation column requires
- A) Minimum number of trays, and consequently the fixed cost and the operating costs are least.
 - B) Finite number of trays, and consequently the fixed cost is finite but the operating costs are least.
 - C) Infinite number of trays, and consequently the fixed cost is infinite but the operating costs are least.
 - D) Maximum number of trays, and consequently the fixed cost and the operating cost are maximum.
70. The sugar beets are cut into thin, wedge-shaped slices called _____ before leaching in order to reduce the time required for the solvent water to reach the individual plant cells.
- A) Cane sugar bits
 - B) Sugar slice
 - C) Sugar beats
 - D) Cossettes
71. Nylon-6,6 is produced from the following raw material.
- A) Cellulose
 - B) Adipic acid
 - C) Caprolactam
 - D) Polyols
72. Which raw material is employed in the production of polyacrylonitrile ?
- A) Hexamethylene diamine
 - B) Dimethyl Terephthalate
 - C) Propylene
 - D) Ethylene
73. Which catalyst is used in the manufacturing of high-density polyethylene ?
- A) Titanium tetrachloride
 - B) Antimony
 - C) Vanadium pentoxide
 - D) Aluminum oxide

74. Which polymerization is employed in the manufacturing of Butadiene-Styrene copolymer ?
- A) Bulk polymerization
 - B) Solution polymerization
 - C) Emulsion polymerization
 - D) Suspension polymerization
75. Which polymer exhibits highest glass transition temperature ?
- A) Polyethylene
 - B) Polystyrene
 - C) Polyisoprene
 - D) Nylon-6,6
76. What is the primary purpose of a clariflocculator in water treatment ?
- A) To filter suspended particles
 - B) To facilitate coagulation and sedimentation
 - C) To disinfect water
 - D) To adjust pH levels
77. What is the typical rate of filtration in a slow sand filter ?
- A) 10-50 l/m²/hr
 - B) 50-100 l/m²/hr
 - C) 100-200 l/m²/hr
 - D) 200-300 l/m²/hr
78. How does the settling velocity of inorganic particles (size between 0.1 mm and 1 mm) vary with their diameter (d) ?
- A) Proportional to $d^{0.5}$
 - B) Proportional to d
 - C) Proportional to d^2
 - D) Proportional to d^3

79. What is the primary function of a foot valve in a water pumping system ?
- A) Prevent backflow of water in suction pipes
 - B) Regulate pressure in distribution lines
 - C) Control flow velocity in discharge pipes
 - D) Reduce energy consumption in pumps
80. What is the primary purpose of using activated carbon in water treatment ?
- A) Removing dissolved gases
 - B) Eliminating turbidity
 - C) Removing taste and odours
 - D) Disinfecting water
81. Which of the following methods is most effective for detecting hidden leaks in a water distribution system ?
- A) Visual inspection
 - B) Pressure drop analysis
 - C) Acoustic leak detection
 - D) Dye testing
82. The Hardy Cross method is primarily used for ?
- A) Pipe sizing
 - B) Flow rate estimation in loops
 - C) Chlorine dosage calculation
 - D) Leak detection
83. What is the major disadvantage of using open channels for water transmission ?
- A) High capital cost
 - B) Difficult maintenance
 - C) High evaporation and contamination risk
 - D) High pressure loss

84. As the pH of water decreases, the contact time required for effective chlorination
- A) Decreases
 - B) Increases
 - C) Stays constant
 - D) Varies randomly
85. Which of the following statements about pressure filters is TRUE ?
- A) They require a higher initial cost than slow sand filters
 - B) They are less efficient in removing suspended solids than slow sand filters
 - C) They cannot be backwashed
 - D) They operate at very low pressure
86. Which component in a pumping system is primarily responsible for controlling water hammer damage ?
- A) Surge Tank
 - B) Check Valve
 - C) Gate Valve
 - D) Foot Valve
87. In a water audit, which parameter is used to determine the percentage of unaccounted-for water (UFW) ?
- A) $(\text{Water Supplied} - \text{Water Billed}) / \text{Water Supplied}$
 - B) $(\text{Water Supplied} - \text{Water Lost}) / \text{Total Customers}$
 - C) $(\text{Water Billed} / \text{Water Supplied}) \times 100$
 - D) $(\text{Water Revenue} - \text{Operational Cost}) / \text{Total Population}$
88. Which of the following flow meter types is best suited for measuring water flow in a partially filled pipe ?
- A) Vortex Flow Meter
 - B) Venturi Meter
 - C) Orifice Meter
 - D) Electromagnetic Flow Meter

89. Which telemetry and SCADA system parameter is most critical for real-time monitoring of a water distribution network ?
- A) Water Hardness
 - B) pH Value
 - C) Pressure and Flow Rate
 - D) Chlorine Concentration
90. In water treatment, chlorinated copperas is preferred as a coagulant when the raw water is
- A) Low in turbidity and high in alkalinity
 - B) High in turbidity and low in alkalinity
 - C) Low in turbidity and low in alkalinity
 - D) High in turbidity and high in alkalinity
91. What is the main purpose of an Activated Sludge Process ?
- A) Remove solid waste from wastewater
 - B) Facilitate biological decomposition of organic matter
 - C) Neutralize acidic wastewater
 - D) Kill pathogens using chlorine
92. What is the primary disadvantage of using trickling filters ?
- A) High energy consumption
 - B) Requires continuous chemical dosing
 - C) Inefficient in removing nitrogen compounds
 - D) Clogging and biofilm build-up

93. The sludge digestion process in an anaerobic digester primarily produces
- A) Carbon monoxide
 - B) Methane and carbon dioxide
 - C) Oxygen and nitrogen
 - D) Hydrogen sulphide and ammonia
94. The efficiency of a sedimentation tank depends on
- A) Flow velocity and detention time
 - B) pH of the water
 - C) Amount of dissolved oxygen
 - D) Chemical composition of sludge
95. Which of the following is a major concern in the disposal of wastewater effluent into natural water bodies ?
- A) Increase in pH levels
 - B) Thermal pollution
 - C) Eutrophication
 - D) Decrease in salinity
96. In wastewater treatment, the F/M ratio (Food to Microorganism ratio) is used to control
- A) Sludge retention time
 - B) Oxygen supply
 - C) Pathogen removal efficiency
 - D) The growth rate of activated sludge bacteria

97. In the design of wastewater treatment plants, what is the significance of Hydraulic Retention Time (HRT) ?
- A) Determines the time needed for bacteria to grow
 - B) Defines the time wastewater spends in the treatment unit
 - C) Measures the efficiency of disinfection
 - D) Calculates sludge volume index
98. In an UASB reactor, what is the primary mechanism for sludge stabilization ?
- A) Chemical oxidation
 - B) Aerobic biodegradation
 - C) Sedimentation and coagulation
 - D) Anaerobic microbial digestion
99. The concept of “Zero Liquid Discharge” (ZLD) in industrial wastewater management primarily aims to
- A) Minimize the use of chemicals
 - B) Reduce carbon footprint
 - C) Enhance aeration efficiency
 - D) Recycle wastewater leaving only solid waste
100. In a Sequencing Batch Reactor (SBR) system, the treatment process is carried out in
- A) A continuously flowing system
 - B) A series of interconnected tanks
 - C) A trickling filter followed by a clarifier
 - D) A single tank in sequential batch mode
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Space for Rough Work

