

# 073/2022

Question Booklet  
Alpha Code

A

Question Booklet  
Serial Number

Total No. of Questions : 100

Maximum : 100 Marks

Time : 1 Hour 30 Minutes

## 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 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. Blank sheets of paper is attached to the question booklet. These 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.

073/2022-A





1. The rank of the matrix  $A = \begin{bmatrix} 4 & 2 & 3 \\ 8 & 4 & 6 \\ -2 & -1 & -1.5 \end{bmatrix}$  is
- (A) 3 (B) 2  
(C) 1 (D) 0
2. If  $A = \begin{bmatrix} 4 & 1 \\ 3 & 2 \end{bmatrix}$ , then the Eigen values of  $2A^2$  is
- (A) 1, 5 (B) 2, 50  
(C) 4, 2 (D) 8, 4
3. If  $u = \tan^{-1} \frac{x^3 + y^3}{x + y}$ , then  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$  is
- (A)  $\tan 2u$  (B)  $\cos 2u$   
(C)  $\cos^2 2u$  (D)  $\sin 2u$
4. The rectangular solid of maximum volume that can be inscribed in a given sphere is
- (A) parallelepiped (B) cuboid  
(C) rectangular box (D) cube
5. The vector field  $\bar{F}$  defined by  $\bar{F} = 2xyz\hat{i} + x^2z^3\hat{j} + 3x^2yz^2\hat{k}$  is
- (A) irrotational (B) rotational  
(C) solenoidal (D) potential
6. The particular integral of  $(D - 2)^2y = 8(e^{2x} + \sin 2x + x^2)$  is
- (A)  $4e^{2x} + \cos x + x^2 + 2x + 3$  (B)  $4x^2e^{2x} + \cos 2x + 2x^2 + 4x + 3$   
(C)  $x^2e^{2x} + \sin 2x + x^2 + x + 2$  (D)  $xe^{2x} + \sin 2x + x^2 + 2x + 2$
7.  $\oint_C (z - a)^n dz$  where  $C$  is the circle  $|z - a| = r$  is
- (A)  $2\pi i$  (B)  $-2\pi i$   
(C) 0 (D)  $\pi i$

8. The Laplace transform of  $\frac{\cos 2t - \cos 3t}{t}$  is

- (A)  $\frac{1}{2} \log \frac{s^2 + 9}{s^2 + 4}$  (B)  $\frac{1}{2} \log \frac{s + 3}{s + 2}$   
(C)  $\frac{s}{s^2 + 4} - \frac{s}{s^2 + 9}$  (D)  $\frac{1}{2} \log \frac{s^2 + 4}{s^2 + 9}$

9. The sum of residues of the function  $f(z) = \frac{z^2}{(z - 1)^2 (z + 2)}$  is

- (A)  $\frac{5}{9}$  (B) 1  
(C)  $\frac{4}{9}$  (D)  $\frac{3}{2}$

10. The Fourier series for the function  $f(x) = x^2, -\pi < x < \pi$  is

- (A)  $\frac{\pi^2}{3} - 4 \left( \frac{\cos x}{1^2} - \frac{\cos 2x}{2^2} + \frac{\cos 3x}{3^2} - \frac{\cos 4x}{4^2} + \dots \right)$   
(B)  $\frac{\pi^2}{3} - 2 \left( \frac{\cos x}{1^2} - \frac{\cos 2x}{2^2} + \frac{\cos 3x}{3^2} - \frac{\cos 4x}{4^2} + \dots \right)$   
(C)  $\frac{2\pi^2}{3} - 4 \left( \frac{\cos x}{1^2} + \frac{\cos 2x}{2^2} + \frac{\cos 3x}{3^2} + \frac{\cos 4x}{4^2} + \dots \right)$   
(D)  $\frac{2\pi^2}{3} - 2 \left( \frac{\cos x}{1^2} + \frac{\cos 2x}{2^2} + \frac{\cos 3x}{3^2} + \frac{\cos 4x}{4^2} + \dots \right)$

11. A simply supported beam I carries a point load at its mid span. Another identical beam II carries the same load but uniformly distributed over the entire span. The ratio of maximum deflections for I and II will be

- (A)  $\frac{2}{3}$  (B)  $\frac{3}{2}$   
(C)  $\frac{8}{5}$  (D)  $\frac{2}{5}$

12. A body is said to be in equilibrium if,

- (A) No force acts on it.  
(B) Resultant of all the forces acting on it is zero.  
(C) Algebraic sum of all the forces in the X direction, Y direction and moment of all the forces about any point is equal to zero.  
(D) All the above.

13. For the principal axes of a section
- (A) Sum of moment of inertia is zero.
  - (B) Difference of moment of inertia is zero.
  - (C) Product of inertia is zero.
  - (D) None of these.
14. The maximum compressive strain in concrete at the outermost compression fibre in bending is
- (A) 0.002
  - (B) 0.0035
  - (C) 0.67
  - (D) 0.42
15. According to IS 456-2000 the modulus of elasticity of concrete is
- (A) directly proportional to compressive strength
  - (B) inversely proportional to compressive strength
  - (C) directly proportional to square root of compressive strength
  - (D) inversely proportional to square root of compressive strength
16. For a simply supported beam of span 8 m, the minimum effective depth to satisfy the vertical deflection limits should be
- (A) 400 mm
  - (B) 310 mm
  - (C) 450 mm
  - (D) 600 mm
17. Out of the following, select the most suitable type of bolt that can be used, when the bolts are subjected to reversal of stresses.
- (A) Ordinary unfinished bolt
  - (B) Flange bolt
  - (C) Turned and fitted bolt
  - (D) High strength bolt
18. Horizontal stiffener is provided in a plate girder to safe guard against
- (A) Shear buckling of web plate
  - (B) Compression buckling of web plate
  - (C) Yielding
  - (D) All of the above
19. The main function of alumina in brick earth is
- (A) To impart plasticity
  - (B) To make the brick durable
  - (C) To prevent shrinkage
  - (D) To make the brick impermeable
20. Le-Chateliers equipment is used for determining the
- (A) Setting time of cement
  - (B) Soundness of cement
  - (C) Tensile strength of cement
  - (D) Compressive strength of cement
21. A crack is formed in a RCC beam, when the material exceeds
- (A) modulus of elasticity
  - (B) compressive stress
  - (C) modulus of rupture
  - (D) None of the above

22. The type of pile recommended in places where the soil is soft and that reduces the risk of liquefaction
- (A) Friction pile (B) Pedestal pile  
(C) Pressure pile (D) Vibro pile
23. Which one of the following represents an event ?
- (A) Fixing of door (B) Concrete cured  
(C) Selecting sites (D) Plastering of walls
24. The time by which a particular activity can be delayed without affecting the preceding and succeeding activities is known as
- (A) Total float (B) Interfloating float  
(C) Free float (D) Independent float
25. Pick up the incorrect statement from the following.
- (A) No deduction is made for the volume occupied for reinforcement.  
(B) No deduction is made for the openings up to 0.1 sq.m.  
(C) No deduction is made for the volumes occupied by pipes, not exceeding 100 sq.cm in cross-section.  
(D) None of the above.
26. Consistency of cohesive soils is related to its
- (A) Density (B) Moisture content  
(C) Shear strength (D) Porosity
27. Sheep foot rollers are best suited for compacting which type of soil ?
- (A) Granular soils (B) Cohesive soils  
(C) Hard rock (D) Any type of soil
28. In Mohr's circle, a point located above Mohr's envelope shows
- (A) Imaginary condition (B) Safe condition  
(C) Imminent failure condition (D) Condition of maximum obliquity
29. A wall is acted upon by a pressure due to water on one of its sides. If  $w$  = Specific weight of liquid, and  $H$  = Height of liquid, total pressure on the wall per unit length is
- (A)  $wH$  (B)  $wH/2$   
(C)  $wH^2/2$  (D)  $wH^2/3$
30. The use of a surge tank is
- (A) to control the pressure variations due to rapid changes in the pipe line flow.  
(B) to eliminate water hammer possibilities.  
(C) to regulate flow of water to turbines by providing necessary retarding head of water  
(D) All of the above

31. A standard Cipoletti weir is \_\_\_\_\_ in shape.  
(A) Rectangular (B) Triangular  
(C) Trapezoidal (D) Circular
32. For highway capacity design, what are the studies needed ?  
(A) Origin and destination studies (B) Parking and accident studies  
(C) Speed and volume studies (D) Accident studies
33. In concrete pavements, tie bars are used in which joints ?  
(A) Expansion joints (B) Contraction joints  
(C) Warping joints (D) Longitudinal joints
34. Mention the test done to find the extent of weathering of aggregates in a lab.  
(A) Soundness test (B) Crushing test  
(C) Impact test (D) Abrasion test
35. The central location of bubble in a levelling instrument means the axis of the bubble tube is parallel to  
(A) Line of sight (B) Line of collimation  
(C) Axis of the telescope (D) None of these
36. Which method is used to locate the position of a station with reference to three known points ?  
(A) Intersection method (B) Radiation method  
(C) Resection method (D) Three-point problem
37. Solution of Three point problems can be obtained by  
(A) mechanical method (B) graphical method  
(C) trial and error method (D) All of the above
38. Infiltration capacity depends upon  
(A) rainfall intensity  
(B) initial moisture condition of soil  
(C) soil characteristics and ground slope  
(D) All the above.
39. The rim of a standard rain gauge is \_\_\_ above ground level.  
(A) 10 cm (B) 20 cm  
(C) 30 cm (D) 50 cm
40. The ratio of the volume of water retained by the formation after it has been drained under gravity to the total volume of formation is known as  
(A) yield (B) porosity  
(C) specific yield (D) specific retention

41. Coliforms which are the indicator organisms for microbiological pollution are  
 (A) Gram +ve bacilli (B) Gram – ve bacilli  
 (C) Gram +ve cocci (D) Gram – ve cocci
42. Kjeldahl Nitrogen is a measure of  
 (A) Ammonia & Organic Nitrogen (B) Nitrate & Nitrite  
 (C) Ammonia & Nitrite (D) Nitrate & Organic Nitrogen
43. 30 ml of sample is pipetted directly to 300 ml incubation bottle. The initial DO of the diluted sample is 8 mg/L and final DO is 1 mg/L. The initial DO of the dilution water is 9 mg/L and final DO is 8 mg/L. The temperature of incubation is 20°C for 5 days. What is the 5 day BOD of the sample ?  
 (A) 180 mg/L (B) 600 mg/L  
 (C) 61 mg/L (D) 80 mg/L
44. For slow sand filters the effective size of the sand ranges from  
 (A) 0.45 mm – 0.55 mm (B) 0.5 mm – 0.6 mm  
 (C) 0.09 mm – 1.0 mm (D) 0.25 mm – 0.35 mm
45. Colloids become destabilized when  
 (A) Repulsive force > Van der Waals force  
 (B) Van der Waals force > Repulsive force  
 (C) Gravitational force > Viscous force  
 (D) Viscous Force > Gravitational force
46. On analysis for coliform group using 3 samples of 10 mL, 50 mL and 500 mL by membrane filter technique the results obtained are: 10 mL portion- 5, 6, 7, 8, 9; 50 mL portion- 30, 35, 26, 36, 38; and 500 mL portion- 300, 380, 340, 360, 320. The number of coliforms per 100 mL is  
 (A) 100 (B) 66  
 (C) 320 (D) 35
47. Oxidation of nitrites to nitrates is done by  
 (A) Nitrobacter (B) Nitrosomonas  
 (C) Pseudomonas (D) Azetobacter
48. Form of chlorine, which can prevent the formation of disinfection by products (DBP) some of which are carcinogens, is  
 (A) Bleaching powder (B) Chlorine tablets  
 (C) Gaseous Chlorine (D) Chloramines
49. Determination of chemical elements that compose the solid waste is known as  
 (A) Proximate analysis (B) Energy analysis  
 (C) Ultimate analysis (D) Inert value analysis



50. Type 2 settling is also known as  
(A) Discrete settling (B) Compressed settling  
(C) Stage settling (D) Flocculent settling
51. Maximum runoff will be obtained for a rain having duration equal to  
(A) Time of concentration (B) Overland flow time  
(C) Channel flow time (D) Gutter flow time
52. A city has a population of 20000 with an area of 1000000 Square metres. The average runoff coefficient is 0.72 and time of concentration 30 minutes. The maximum storm water discharge is  
(A) 1 Cumec (B) 10 Cumecs  
(C) 40 Cumecs (D) 4 Cumecs
53. Streeter-Phelps equation gives  
(A) Total organic content (B) Biochemical oxygen demand  
(C) Dissolved oxygen deficit (D) Chemical oxygen demand
54. Dairy wastes are mainly treated by  
(A) Photocatalysis (B) Chemical oxidation  
(C) Activated sludge process (D) Phytoremediation
55. Major component contributing to total solids in Sulfite waste liquor is  
(A) Calcium (B) Sulphur  
(C) Sugar (D) Lignin
56. The atmosphere is said to be unstable when  
(A) Environmental lapse rate < Adiabatic lapse rate  
(B) Environmental lapse rate = Adiabatic lapse rate  
(C) Environmental lapse rate > Adiabatic lapse rate  
(D) Environmental lapse rate does not have any relation with Adiabatic lapse rate
57. "Fanning" the spreading of plume horizontally occurs when the lapse rate is  
(A) Negative (B) Positive  
(C) Neutral (D) Adiabatic
58. Which among the following control device has the maximum particulate removal efficiency?  
(A) Cyclone separator (B) Spray Tower  
(C) Fabric Filter (D) Cyclone scrubber

59. The process of heating the solid wastes in an oxygen free atmosphere splitting the organic substances through thermal cracking and condensation is  
(A) Incineration (B) Gasification  
(C) Spreader Stoking (D) Pyrolysis
60. According to IS 10500:2012, the acceptable limit of turbidity is  
(A) 1 NTU (B) 5 NTU  
(C) 10 NTU (D) 2 NTU
61. The most common disposal method for nuclear waste is:  
(A) Microbial uptake (B) Pyrolysis  
(C) Incineration (D) Burial in concrete containers
62. The unit of frequency of sound is:  
(A) Decibel (dB) (B) Hertz (Hz)  
(C) m/s (D) Lambda
63. Itai-Itai disease is caused by the heavy metal:  
(A) Cadmium (B) Mercury  
(C) Chromium (D) Lead
64. When the rate of deoxygenation is more than the rate of reaeration,  
(A) DO increases (B) DO deficit decreases  
(C) DO deficit increases (D) Ultimate BOD increases
65. Which of the following sets out the criteria for an environmental management system and can be certified to ?  
(A) ISO 18001 (B) ISO 14001  
(C) ISO 9000 (D) ISO 9001
66. The Kyoto Protocol is an international treaty that commits state parties to:  
(A) reduce greenhouse gas emissions (B) reduce ozone depleting substances  
(C) reduce acid rain (D) reduce photochemical smog
67. The Montreal Protocol is an international treaty designed to:  
(A) reduce greenhouse effect (B) protect ozone layer  
(C) reduce acid rain (D) reduce photochemical smog
68. What is the unit for Carbon footprint ?  
(A) tonnes of CO<sub>2</sub> equivalent (B) hectares of land  
(C) mg/litre of air (D) no unit

69. According to the environmental clearance process in India, Environmental Impact Assessment is not needed for projects which fall under:
- (A) Category A (B) Category B1  
(C) Category B2 (D) Schedule I
70. Which of the following Acts came into existence in India, to enact the decisions made in the United Nations Conference on the Human Environment held in Stockholm in June, 1972, in which India participated ?
- (A) The Water (Prevention and Control of Pollution) Act, 1974  
(B) The Air (Prevention and Control of Pollution) Act, 1981  
(C) Forest Conservation Act, 1980  
(D) The Environment (Protection) Act, 1986
71. The process of capturing and storing atmospheric carbon dioxide is called:
- (A) Global warming (B) Carbon foot-printing  
(C) Carbon crediting (D) Carbon sequestration
72. How many Sustainable Development Goals (SDGs) have been adopted as 2030 Agenda ?
- (A) 5 (B) 15  
(C) 17 (D) 20
73. Which of the following is a popular Green building rating system, developed in India ?
- (A) LEED (B) BREEAM  
(C) Green Globes (D) GRIHA
74. The permissible limit of lead (Pb) in drinking water as per IS 10500:2012 is:
- (A) 0.01 mg/l (B) 0.05 mg/l  
(C) 0.005 mg/l (D) 0.001 mg/l
75. Using of plants to clean up contaminated environments is called:
- (A) Bioremediation (B) Phytoremediation  
(C) Nanofiltration (D) Root zone filtration
76. Molarity of aqueous solution of acetic acid containing 30 weight percentage acid if density of solution is 1 g/cc is
- (A) 5 (B) 2.5  
(C) 2 (D) 0.05
77. Wet leather with moisture content 60% enters a drier and leaves with 10% moisture. If output from the drier is 100 kg/h, amount of water removed in kg/h is
- (A) 225 (B) 100  
(C) 200 (D) 125

78. Relative humidity of air can decrease in spite of increase in humidity if  
(A) pressure is increased (B) temperature is increased  
(C) temperature is decreased (D) cannot happen
79. At low concentration of a gas in a liquid, which of the following laws is most appropriate ?  
(A) Raoult's law (B) Henry's law  
(C) Dalton's law (D) Amagat's law
80. Heat required to raise temperature of 1 kg solution, with mean specific heat capacity 3.5 kJ/kgK, from 300 K to 400 K is \_\_\_\_\_  
(A) 700 kJ (B) 700 J  
(C) 350 J (D) 350 kJ
81. Boiling point of a heterogeneous mixture is  
(A) same as that of high boiling component  
(B) same as that of low boiling component  
(C) less than boiling point of all the components  
(D) more than boiling point of all the components
82. Temperature at which equilibrium vapour pressure of a liquid equals existing partial pressure of vapour in a mixture is the mixture's  
(A) dew point (B) boiling point  
(C) freezing point (D) sublimation point
83. Components A and B react to form product C, as per the reaction,  $A + B \rightarrow C$ . Heat of combustion for A, B and C are respectively 330 kcal, 200 kcal and 500 kcal. Standard heat of the reaction is  
(A) 30 kcal (B) - 30 kcal  
(C) - 530 kcal (D) 530 kcal
84. Adiabatic flame temperature of a fuel, attained by burning the fuel with theoretically required amount of pure Oxygen is 1215 K. If theoretically required amount of air is used instead of pure Oxygen, the flame temperature can be  
(A) 1215 K (B) more than 1215 K  
(C) less than 1215 K (D) cannot be predicted
85. Pressure drop in a packed bed for high Reynolds number is given by  
(A) Kozeny Carman equation (B) Burke Plummer equation  
(C) Bernoulli's equation (D) Hagen Poiseuille equation

86. Third law of thermodynamics states that
- All spontaneous processes are accompanied by degradation of energy
  - All spontaneous processes are to some extent irreversible
  - Energy can neither be created nor destroyed
  - At absolute zero, entropy of a pure crystalline substance is zero
87. If two Mixed Flow Reactors in series are used for a second order reaction, which of the following arrangements will perform better ?
- Smaller reactor first, followed by a larger reactor
  - Larger reactor first, followed by a smaller reactor
  - Two equal sized reactors in series
  - All the above give same performance
88. The reaction  $2A + B \rightarrow C$  is a zero order reaction. If  $C_A$  and  $C_B$  are concentrations of A and B respectively and k is rate constant, rate of this reaction can be given by the expression
- $-r_A = kC_A C_B$
  - $-r_A = kC_A^2 C_B$
  - $-r_A = kC_A^2$
  - $-r_A = k$
89. For a system at temperature T and pressure P, any movement away from equilibrium leads to
- $(\Delta G)_{T,P} < 0$
  - $(\Delta G)_{T,P} > 0$
  - Both (A) and (B)
  - $(\Delta G)_{T,P} = 0$
90. An isothermal gas phase reaction,  $R \rightarrow 4P$ , 50% inert is present in the system. Fractional change in volume,  $\varepsilon_A$  in this case is
- 3
  - 1.5
  - 3
  - 1.50
91. Pick out wrong statement.
- Maximum possible extent of a reaction is given by thermodynamics.
  - Factors influencing rate of reaction are obtained from chemical kinetics.
  - Heat liberated or absorbed during a reaction can be calculated from thermodynamic data.
  - For all reactions, thermodynamic information alone is sufficient for design.
92. Constant volume hydrometer is used to measure
- density
  - viscosity
  - pressure
  - composition

93. Pirani gauge is used for the measurement of  
 (A) atmospheric pressure (B) high vacuum  
 (C) very high pressure (D) moderate pressure
94. Which of the following cannot be used for composition analysis ?  
 (A) hydrometer (B) Mass spectrometer  
 (C) X-ray diffraction (D) Thermal conductivity cell
95. If a reaction proceeds with increase in number of moles, presence of inert in the system will  
 (A) increase equilibrium yield (B) decrease equilibrium yield  
 (C) not change equilibrium yield (D) cannot be predicted
96. Steps involved in a Carnot cycle are  
 (A) Two isothermals and two isobarics  
 (B) Two isothermal and two isentropics  
 (C) Two isobarics and two isochorics  
 (D) Two isentropics and two isobarics
97. Which of the following is an extensive property ?  
 (A) density (B) specific heat capacity  
 (C) entropy (D) molar entropy
98. For a system consisting of 'p' phases and 'c' components, if number of independent reactions involved are 'r', number of degrees of freedom is given by  
 (A)  $F = c - p + 2$  (B)  $F = c - p + r + 2$   
 (C)  $F = c - p - r - 2$  (D)  $F = c - p - r + 2$
99. Negative value of Joule -Thomson co-efficient indicates  
 (A) Decrease in temperature of gas on throttling  
 (B) Increase in temperature of gas on throttling  
 (C) Temperature of gas remains constant on throttling  
 (D) Joule -Thomson co-efficient is not related to temperature change
100. If 14 g of nitrogen and 4 g of hydrogen undergo reaction to produce ammonia, the product stream contains (assume complete conversion of limiting reactant)  
 (A) 2 g hydrogen and 17 g ammonia  
 (B) 7 g nitrogen and 17 g ammonia  
 (C) 1 g hydrogen and 17 g ammonia  
 (D) 17 g ammonia alone

**SPACE FOR ROUGH WORK**

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