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SPACE FOR ROUGH WORK

1. $\lim_{x \rightarrow 0} \left(\frac{2x+1}{x+1} \right)^{1/x}$ is

- (1) one (2) e
(3) does not exist (4) none of the above

2. If a matrix $A = \begin{bmatrix} 1 & -2 & 3 \\ 0 & -1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$ then the Eigen values of $A^2 + A^{-1} + 3\text{adj}A$ are

- (1) 1, 3, 1 (2) -1, 3, 1 (3) -1, -3, 1 (4) -1, 3, -1

3. Laplace transform of $\frac{d}{dt} \left(\frac{\sin t}{t} \right)$ is

- (1) $1 - s \cot^{-1} s$ (2) $1 - s \tan^{-1} s$
(3) $s \cot^{-1} s - 1$ (4) $s \tan^{-1} s - 1$

4. If $\vec{F} = (xy^2)\mathbf{i} + (yz^2)\mathbf{j} + (zx^2)\mathbf{k}$ and S is the surface of the sphere $x^2 + y^2 + z^2 = 4$ then the value of $\oiint_S \vec{F} \cdot d\vec{s}$ is

- (1) $\frac{16\pi}{5}$ (2) $\frac{128\pi}{5}$ (3) $\frac{64\pi}{5}$ (4) $\frac{32\pi}{5}$

5. General solution of wave equation $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$ s.t. $y(0, t) = 0 = y(l, t)$ is

- (1) $\sum_{n=1}^{\infty} \left[A_n \cos \frac{n\pi c x}{l} + B_n \sin \frac{n\pi c x}{l} \right] \sin \frac{n\pi t}{l}$
(2) $\sum_{n=1}^{\infty} \left[A_n \cos \frac{n\pi c t}{l} + B_n \sin \frac{n\pi c t}{l} \right] \sin \frac{n\pi x}{l}$
(3) $\sum_{n=1}^{\infty} \left[A_n \cos \frac{n\pi t}{l} + B_n \sin \frac{n\pi t}{l} \right] e^{\frac{n\pi c x}{l}}$
(4) $\sum_{n=1}^{\infty} A_n \sin \frac{n\pi x}{l} e^{-c^2 n^2 \pi^2 t / l^2}$

6. If A is 37×37 matrix with $A^2 = I$ then rank of A is

- (1) 0 (2) i
 (3) 37 (4) such a matrix is not possible

7. If \bar{a} is a non-zero constant vector with magnitude $a \neq \frac{1}{\sqrt{2}}$ and $\bar{r} = x\hat{i} + y\hat{j} + z\hat{k}$ then $\text{div}[\bar{a} \times (\bar{r} \times \bar{a})]$ is

- (1) 0 (2) 1 (3) $2a^2$ (4) a^2

8. The velocity 'V' of particle at distance 'D' from a point on its path given by below table

D (in metre)	0	10	20	30	40	50	60
V (m/sec)	47	58	64	65	61	52	38

The time taken to travel 60 meters by using Simpson's one third rule is

- (1) 1.0445166 sec (2) 1.0635166 sec
 (3) 1.0534166 sec (4) 1.0746166 sec

9. If bulk modulus and modulus of rigidity for a material are K and G respectively, then what will be Poisson's ratio

- (1) $\frac{3K + 4G}{6K - 4G}$ (2) $\frac{3K - 4G}{6K + 4G}$ (3) $\frac{3K - 2G}{6K + 2G}$ (4) $\frac{3K + 2G}{6K - 2G}$

10. A bar of steel ($E = 2.1 \times 10^6 \text{ kg/cm}^2$) 70 cm long varies in its cross section with 2.5 cm dia for the first 20 cm, 2 cm dia for next 30 cm and 1.5 cm dia for the rest of the length. Find the elongation if the bar is subjected to a tensile load of 15 tonnes.

- (1) 0.118 cms (2) 0.25 cms (3) 0.178 cms (4) 0.354 cms

11. A solid circular shaft of diameter 100 mm is subjected to a torque of 25 kNm. The angle of twist over a length of 3 m is observed to be 0.09 rad. The modulus of rigidity of material is

- (1) $7.64 \times 10^{-5} \text{ N/mm}^2$ (2) $8.49 \times 10^4 \text{ N/mm}^2$
 (3) $2.1 \times 10^5 \text{ N/mm}^2$ (4) $6.74 \times 10^4 \text{ N/mm}^2$

12. A propped cantilever of span 'L' is carrying a point load 'P' acting at midspan. The plastic moment of the section is M_p . The magnitude of collapse load is

- (1) $6 M_p/L$ (2) $8 M_p/L$ (3) $2 M_p/L$ (4) $4 M_p/L$

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13. Find the Euler's crippling load for a hollow cylinder column ($E = 205 \text{ GPa}$) of 38 mm external diameter and 2.5 mm thick, with a length of 2.3 m and fixed at both of its ends.
(1) 17.16 kN (2) 14.29 kN (3) 16.88 kN (4) 21.49 kN
-
14. A bar of 400 mm length and of uniform cross-section 20 mm diameter is subjected to tensile load of 50 kN, assuming $E = 200 \text{ GPa}$ the elongation of bar is
(1) 2.481 mm (2) 3.203 mm
(3) 0.318 mm (4) 0.187 mm
-
15. Reaction at a prop in a propped cantilever when it is subjected to UDL of 'w/m' over a entire span 'L' is equal to
(1) $\frac{3wL}{8}$ (2) $\frac{5wL}{8}$ (3) $wL^2/8$ (4) $\frac{wL^4}{8EI}$
-
16. The curved geometry of masonry arches allows its load carrying capability only in the form of
(1) Compressive forces (2) Tensile forces
(3) Bending forces (4) Torsional forces
-
17. The slope of cantilever beam having span 'L', at the free end due to concentrated load 'P' applied at free end is
(1) PL^2/EI (2) $PL^2/2EI$ (3) $PL^3/3EI$ (4) $PL^3/2EI$
-
18. In moment distribution method the sum of distribution factors for all the members meeting at a joint is always
(1) Equal to zero (2) Equal to one
(3) Greater than one (4) Smaller than one
-
19. If the Young's Modulus and Poisson's ratio of a material is $2 \times 10^6 \text{ kg/cm}^2$ and 0.25 respectively. Find the Bulk Modulus.
(1) $\frac{6}{5} \times 10^6 \text{ kg/cm}^2$ (2) $\frac{3}{4} \times 10^6 \text{ kg/cm}^2$
(3) $\frac{5}{6} \times 10^6 \text{ kg/cm}^2$ (4) $\frac{4}{3} \times 10^6 \text{ kg/cm}^2$
-
20. A continuous beam ABCDE has four simple supports A, B, C and D. DE is overhang. Hinge 'F' is provided along span BC. The degree of static indeterminacy is
(1) 4 (2) 1 (3) 2 (4) 3

21. Shear stress at the centre of shaft having 200 mm radius and subjected to twisting moment of 300 N.m. is

- (1) 0.19 N/mm² (2) Zero (3) 0.38 N/mm² (4) 0.095 N/mm²

22. Using limit state method, find the area of steel required for a beam 300 mm × 600 mm effective, if concrete M₂₀ and steel Fe 415 are used

- (1) 1019 mm² (2) 1728 mm² (3) 1256 mm² (4) 958 mm²

23. For a rectangular beam section the limiting value of $\frac{x_u, \max}{d} = 0.479$. However, for

the beam data $\frac{x_u}{d} = 0.504$. Following statement is true for the beam

- (1) The beam is under-reinforced and failure shall be with warning
 (2) The beam is over-reinforced and failure shall be sudden and without warning
 (3) The beam is under-reinforced and failure shall be sudden and without warning
 (4) The beam is balanced section

24. Flexural strength of M₂₅ concrete is

- (1) 3.00 N/mm² (2) 3.5 N/mm² (3) 5.00 N/mm² (4) 17.5 N/mm²

25. The sudden failure of a prestressed member without any warning is generally due to

- (1) Fracture of steel in compression zone
 (2) Fracture of steel in tension zone
 (3) Crushing of concrete
 (4) Web shear cracks

26. For gravity retaining wall earth pressure exerted by back-fill is resisted by

- (1) Bending action of stem and bottom slab
 (2) Tension in the counterfort
 (3) Dead weight of wall
 (4) None of the above

27. A concrete rectangular beam of size 180 mm × 300 mm is prestressed with a straight tendon to an effective force of 200 kN at an eccentricity of 50 mm below the centroidal axis. The stresses at top and bottom fibre of structure are

- | | |
|--|--|
| (1) 3.70 N/mm ² (Compression) | (2) 3.70 N/mm ² (Compression) |
| 3.70 N/mm ² (Compression) | 7.40 N/mm ² (Compression) |
| (3) 7.40 N/mm ² (Tension) | (4) 0 N/mm ² |
| 0 N/mm ² | 7.40 N/mm ² (Compression) |

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28. When the steel plates are placed end to end and flushed with each other and are joined by means of cover plates on either side such a joint is known as

- (1) Zig-Zag rivet lap joint (2) Chain riveted lap joint
(3) Double cover butt joint (4) Flushed rivet joint

29. The shape factor for a rectangular beam of width 100 mm and depth 300 mm is

- (1) 2.00 (2) 1.50 (3) 1.00 (4) 1.25

30. The ratio of plastic moment to yield moment is called as

- (1) Modulus of rupture (2) Proof resilience
(3) Plastic section modulus (4) Shape factor

31. Find the effective length of a compression steel column of length 'L' which is effectively held in position at both ends and restrained against rotation at one end.

- (1) 1.00 L (2) 0.80 L (3) 0.65 L (4) 1.5 L

32. A beam is subjected to bending moment of 148.2 kN m. Assume $\gamma_{mo} = 1.10$ and yield stress $f_y = 250$ MPa. The plastic section modulus Z_p for the section is

- (1) $538.91 \times 10^3 \text{ mm}^3$ (2) $652.08 \times 10^3 \text{ mm}^3$
(3) 1.856 mm^3 (4) $40.755 \times 10^3 \text{ mm}^3$

33. What is the coefficient for calculating net effective c/s area of a single 'T' section connected to Gusset plate through its flange by rivet ?

- (1) $\frac{3A_1}{3A_1 + A_2}$ (2) $\frac{5A_1}{5A_1 + A_2}$ (3) $A_g - ndt$ (4) $\frac{5A_1}{5A_1 - A_2}$

34. Residual soil is a soil

- (1) Which stays at the place of its formation
(2) Which deposits at a place away from place of its origin
(3) Both 1 and 2
(4) Neither 1 nor 2

35. For compacted soil, maximum dry density is obtained corresponding to

- (1) Minimum water content (2) Optimum water content
(3) Maximum water content (4) None of the above

36. A silty soil gives positive reaction in

- (1) Dry strength test (2) Toughness test
(3) Dilatancy test (4) None of the above

37. In a cohesionless soil, quick sand condition occurs when effective pressure is

- (1) High (2) Zero (3) Less (4) None of the above

38. The seismic refraction methods cannot be used if the wave velocity is

- (1) Greater than the velocity in the upper layer
(2) Less than the velocity in the lower layer
(3) More than four times
(4) More than thrice

39. Submergence of foundation due to rise of water table causes

- (1) Increase in bearing capacity (2) Decrease in bearing capacity
(3) No change in bearing capacity (4) None of the above

40. The radius of friction circle is equal to

- (1) $R \sin \phi$ (2) $R \cos \phi$ (3) $R \tan \phi$ (4) $R \phi$

41. To resist heavy lateral loads which type of piles are used ?

- (1) Friction and bearing piles (2) Displacement piles
(3) Under reamed piles (4) Batter piles

42. A shallow foundation is defined as foundation which has

- (1) Depth less than 0.6 m (2) Depth less than its width
(3) Depth less than 1 m (4) None of the above

43. Allowable soil pressure for foundation in cohesive soils is generally controlled by

- (1) Settlements (2) Bearing capacity
(3) Both 1 and 2 (4) Neither 1 nor 2

44. Sample procured in a sandy soil by split spoon sampler is

- (1) Disturbed sample (2) Undisturbed sample
(3) Representative sample (4) Wash sample

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45. Slip circle method is used for determination of
(1) Stability of finite slope (2) Stability of infinite slope
(3) Stability of finite and infinite slope (4) None of the above
-
46. The precompression method is useful for compacting
(1) Silts (2) Organic soils (3) Clays (4) All the above
-
47. In situ vane shear test is used to measure shearing strength of
(1) Very soft and sensitive clays (2) Stiff and fissured clays
(3) Sandy soils (4) All of the above
-
48. Pile foundation is one of the type of
(1) Shallow foundation (2) Raft foundation
(3) Deep foundation (4) Machine foundation
-
49. Dynamic Viscosity (μ) has the dimensions as
(1) MLT^{-2} (2) $ML^{-1}T^{-1}$ (3) $ML^{-1}T^{-2}$ (4) $M^{-1}L^{-1}T^{-1}$
-
50. In a turbulent flow in a pipe, the shear stress is
(1) Maximum at the centre
(2) Maximum at the boundary and decreases linearly to zero at the centre
(3) Maximum at the boundary and decreases logarithmically towards the centre
(4) Maximum at a finite distance from the boundary
-
51. The critical depth is the depth of flow at which
(1) Discharge is maximum (2) Reynold number is unity
(3) The specific energy is minimum (4) Perimeter is minimum
-
52. Boundary layer on a flat plate is called laminar boundary layer if
(1) Reynold number is less than 2000 (2) Reynold number is less than 4000
(3) Reynold number is less than 5×10^5 (4) None of the above
-
53. The net or effective head at the turbine is
(1) The sum of gross head plus the head loss in the penstock
(2) Sum of gross head plus head loss in the penstock and velocity head at turbine exit
(3) The difference between gross head minus head loss in penstock
(4) The difference between gross head minus head loss in penstock and velocity head at turbine exit

54. The salinity in water
- (1) Reduces the evaporation (2) Increases the evaporation
(3) Does not affect evaporation (4) None of the above
-
55. A triangular DRH due to a 6-h storm in a catchment has a time base of 100 h and a peak flow of $40 \text{ m}^3/\text{s}$. The catchment area is 180 km^2 . The 6-h unit hydrograph for this catchment will have a peak flow in m^3/s of
- (1) 10 (2) 20 (3) 30 (4) 40
-
56. In a flow-mass curve the demand line drawn from a ridge in the curve did not intersect the mass curve again. This implies that
- (1) The reservoir was not full at the beginning
(2) The storage was not adequate
(3) The demand can not be met by the inflow as the reservoir will not refill
(4) The reservoir is wasting water by spill
-
57. The word unit in the unit hydrograph refers to the
- (1) Unit depth of runoff (2) Unit duration of the storm
(3) Unit base period of the hydrograph (4) Unit area of the basin
-
58. A rectangular plot having direction of overland flow parallel to its larger side, has time of concentration of 25 minutes. Following four rainfall patterns are considered for purpose of design of drainage
- A = 35 mm/h for 15 minutes
B = 45 mm/h for 10 minutes
C = 10 mm/h for 60 minutes
D = 15 mm/h for 25 minutes
- The greatest peak rate of runoff is expected in the storm
- (1) A (2) B (3) C (4) D
-
59. According to Khosla's theory, the exit gradient in the absence of a downstream cutoff is
- (1) zero (2) infinity (3) unity (4) very large
-
60. The eccentricity of the resultant permitted on either side of centre of base in gravity dam is given as
- (1) $e = 6B$ (2) $e = 6/B$ (3) $e = B/6$ (4) None of the above

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61. The spillway crest is located at
(1) Maximum water level of dam (2) Normal pool level
(3) Crest of dam (4) None of the above
-
62. In leaching process
(1) Land is flooded with adequate depth of water
(2) Land is provided with adequate drainage
(3) Land is provided with salt layer
(4) None of the above
-
63. Ozone layer in the stratosphere is being destroyed by
(1) Sulphur dioxide (2) Carbon dioxide
(3) Photochemical oxidants (4) Chlorofluro carbon
-
64. The surface area of a clarifier for $0.43 \text{ m}^3/\text{s}$ design flow, using surface overflow rate of $40 \text{ m}^3/\text{m}^2.\text{d}$ is
(1) 928.80 m^2 (2) 930.23 m^2 (3) 1720 m^2 (4) 172 m^2
-
65. Among the following, what is the best suitable range of pH for Ferrous Sulphate ($\text{Fe SO}_4 \cdot 7\text{H}_2\text{O}$) as a coagulant
(1) 5.5 – 8.0 (2) 5.5 – 11.0 (3) 4.5 – 9.5 (4) 8.5 – 11.0
-
66. The most desirable pH range for drinking water as per BIS is
(1) Less than 7.00 (2) More than 7.00
(3) 7.00 to 8.50 (4) 6.00 to 7.00
-
67. Acid rain is caused by increase in the atmospheric concentration of
(1) Ozone and dust
(2) Sulphur dioxide (SO_2) and nitrogen dioxide (NO_2)
(3) Sulphur trioxide (SO_3) and carbon monoxide (CO)
(4) Carbon dioxide (CO_2) and oxygen (O_2)
-
68. Speed of paddles rotation in mechanical flocculator ranges between
(1) 2-3 rpm (2) 5-10 rpm (3) 10-20 rpm (4) 100-200 rpm

69. The volumetric organic loading and aeration period of aeration tank, having influent BOD_5 of 200 mg/L, $\frac{\text{Food}}{\text{Microorganisms}}$ (F/M) ratio 0.2 and mixed liquor suspended solids concentration 3000 mg/L, respectively are

- (1) 0.6 Kg $BOD_5/m^3.d$ and 4 hrs. (2) 0.4 Kg $BOD_5/m^3.d$ and 8 hrs.
(3) 1.2 Kg $BOD_5/m^3.d$ and 8 hrs. (4) 0.6 Kg $BOD_5/m^3.d$ and 8 hrs.
-

70. The short circuiting occurring in sedimentation tank is represented by

- (1) Surface loading (2) Recirculation ratio
(3) Detention time (4) Displacement efficiency
-

71. The important gaseous pollutants contributing to acid rain are

- (1) SO_2 and NO_x (2) NO_x and O_3 (3) CO_2 and H_2S (4) None of these
-

72. The factors responsible for self purification of a polluted river when it flows on the down stream of point of disposal are

- (1) Dilution and dispersion, sedimentation, oxidation and reduction, effect of sunlight and turbulence
(2) Rainfall and surface runoff
(3) Sewage treatment by activated sludge process
(4) Evaporation, percolation etc.
-

73. Efficiency of conventional cyclones as air pollution control device for particle size range 5-20 μ lies between

- (1) 50 to 80% (2) Less than 50%
(3) 80 to 95% (4) 95 to 99%
-

74. The minimum per capita water demand for domestic use as recommended by BIS is.

- (1) 500 Lpcd (2) Less than 50 Lpcd
(3) 135 Lpcd (4) 1000 Lpcd
-

75. The average calorific value of the urban solid waste produced in India is about

- (1) 1000 Kcal/Kg (2) 1500 Kcal/Kg (3) 2000 Kcal/Kg (4) 2500 Kcal/Kg
-

76. The ambient air quality standards of noise in industrial area during day time and night time are respectively

- (1) 75 and 70 dB(A) Leq. (2) 70 to 75 dB(A) Leq.
(3) 65 to 55 dB(A) Leq. (4) 55 to 65 dB(A) Leq.
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77. Among the following which equipment can not be used for measurement of noise
- | | |
|-----------------------|--------------------------|
| (1) Sound Level Meter | (2) Octave Band Analyser |
| (3) Tintometer | (4) Cassette recorder |
-
78. As per IRC, maximum limit of superelevation for mixed traffic in plain and rolling terrain roads is
- | | | | |
|--------|---------|--------|--------|
| (1) 5% | (2) 10% | (3) 7% | (4) 4% |
|--------|---------|--------|--------|
-
79. Bituminous materials are commonly used in highway construction because of their good
- (1) tensile and compression properties
 - (2) binding and water proofing properties
 - (3) shear strength and tensile properties
 - (4) bond and tensile properties
-
80. A flexible pavement of 40 cm thickness is designed for a wheel load of 4100 kg and tyre pressure of 6 kg/cm². The required California Bearing Ratio (CBR) of subgrade soil is
- | | | | |
|-----------|--------|-----------|---------|
| (1) 2.95% | (2) 5% | (3) 3.95% | (4) 10% |
|-----------|--------|-----------|---------|
-
81. The cross slope for shoulders should be
- (1) Steeper than the cross slope of adjoining pavement
 - (2) Flatter than the cross slope of adjoining pavement
 - (3) Same as the cross slope of adjoining pavement
 - (4) None of the above
-
82. Maximum number of passenger cars that can pass a given point on a road during one hour under the most ideal roadway and traffic conditions is known as
- | | |
|---------------------------------------|------------------------------------|
| (1) traffic density | (2) basic capacity of traffic lane |
| (3) probable capacity of traffic lane | (4) all of the above |
-
83. It is generally satisfactory to design the highway facilities for the traffic volume corresponding to
- | | |
|---------------------------|----------------------------------|
| (1) Peak hour | (2) Annual average daily traffic |
| (3) 30 th hour | (4) 29 th hour |
-
84. Number of vehicles occupying a unit length of roadway at a given instant is called as
- | | |
|---------------------|-----------------------|
| (1) Traffic volume | (2) Traffic capacity |
| (3) Traffic density | (4) None of the above |

सूचना - (पृष्ठ 1 वरून पुढे....)

- (8) प्रश्नपुस्तिकेमध्ये विहित केलेल्या विशिष्ट जागीच कच्चे काम (रफ वर्क) करावे. प्रश्नपुस्तिकेव्यतिरिक्त उत्तरपत्रिकेवर वा इतर कागदावर कच्चे काम केल्यास ते काँपी करण्याच्या उद्देशाने केले आहे, असे मानले जाईल व त्यानुसार उमेदवारावर शासनाने जारी केलेल्या “परीक्षांमध्ये होणाऱ्या गैरप्रकारांना प्रतिबंध करण्याबाबतचे अधिनियम-82” यातील तरतुदीनुसार कारवाई करण्यात येईल व दोषी व्यक्ती कमाल एक वर्षाच्या कारावासाच्या आणि/किंवा रुपये एक हजार रकमेच्या दंडाच्या शिक्षेस पात्र होईल.
- (9) सदर प्रश्नपत्रिकेसाठी आयोगाने विहित केलेली वेळ संपल्यानंतर उमेदवाराला ही प्रश्नपुस्तिका स्वतः बरोबर परीक्षाकक्षाबाहेर घेऊन जाण्यास परवानगी आहे. मात्र परीक्षाकक्षाबाहेर जाण्यापूर्वी उमेदवाराने आपल्या उत्तरपत्रिकेचा भाग - 1 समवेक्षकाकडे न विसरता परत करणे आवश्यक आहे.

नमुना प्रश्न

Pick out the correct word to fill in the blank :

Q. No. 201. I congratulate you _____ your grand success.

- (1) for (2) at (3) on (4) about

ह्या प्रश्नाचे योग्य उत्तर “(3) on” असे आहे. त्यामुळे या प्रश्नाचे उत्तर “(3)” होईल. यास्तव खालीलप्रमाणे प्र. क्र. 201 समोरील उत्तर-क्रमांक “③” हे वर्तुळ पूर्णपणे छायांकित करून दाखविणे आवश्यक आहे.

प्रश्न क्र. 201. ① ② ● ④

अशा पद्धतीने प्रस्तुत प्रश्नपुस्तिकेतील प्रत्येक प्रश्नाचा तुमचा उत्तरक्रमांक हा तुम्हाला स्वतंत्ररीत्या पुरविलेल्या उत्तरपत्रिकेवरील त्या त्या प्रश्नक्रमांकासमोरील संबंधित वर्तुळ पूर्णपणे छायांकित करून दाखवावा. ह्याकरिता फक्त काळ्या शाईचे बॉलपेन वापरावे, पेन्सिल वा शाईचे पेन वापरू नये.

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