

## TEST BOOKLET

**DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO**

Test Booklet Series

**B**

Serial No. 905962

**BAC-31**

**CIVIL ENGINEERING**

Time Allowed : 2 Hours

Maximum Marks : 300

### INSTRUCTIONS TO CANDIDATE

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. ENCODE YOUR OPTIONAL SUBJECT CODE AS MENTIONED ON THE BODY OF YOUR ADMISSION CERTIFICATE AND ADVERTISEMENT AT APPROPRIATE PLACES ON THE ANSWER SHEET.
3. ENCODE CLEARLY THE TEST BOOKLET SERIES A, B, C OR D AS THE CASE MAY BE IN THE APPROPRIATE PLACES IN THE ANSWER SHEET USING HB PENCIL.
4. You have to enter your Roll No. on the Test Booklet in the Box provided along side. DO NOT write anything else on the Test Booklet.
5. This Test Booklet contains 120 items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.
6. You have to mark all your responses **ONLY** on the separate Answer Sheet provided by using HB pencil. See instruction in the Answer Sheet.
7. All items carry equal marks. All items are compulsory. Your total marks will depend only on the number of correct responses marked by you in the Answer Sheet. For each question for which a wrong answer is given by you, **one fifth (0.20) of the marks assigned to that question will be deducted as penalty.**
8. Before you proceed to mark in the Answer Sheet the responses to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your **Admission Certificate.**
9. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator the Answer Sheet, the Test Booklet issued to you.

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1. A steep flow curve indicates soil of
  - (a) low shear strength
  - (b) high shear strength
  - (c) low compressibility
  - (d) low permeability
  
2. A flat grain size distribution curve shows a
  - (a) narrow range of grain sizes.
  - (b) wide range of grain sizes.
  - (c) uniform grain sizes.
  - (d) certain range of missing grain sizes.
  
3. Which of the following describes a soil compacted dry of optimum relative to the same soil compacted wet of optimum ?
  - (a) Dispersed structure, higher strength, higher swelling.
  - (b) Flocculated structure, higher strength, lower swelling.
  - (c) Dispersed structure, lower strength, less permeability.
  - (d) Higher permeability, higher strength, higher swelling.
  
4. The value of compression index ( $C_c$ ) for a remoulded sample whose liquid limit is 40% is
  - (a) 0.21
  - (b) 0.28
  - (c) 0.021
  - (d) 0.028
  
5. The only stress of Boussinesq suitable for computation of stress in soils is
  - (a) vertical stress
  - (b) horizontal stress
  - (c) tangential stress
  - (d) shear stress
  
6. For piping phenomenon to occur in soils the most important condition to be satisfied is that the
  - (a) specific gravity of soil solids is more than 2.8.
  - (b) void ratio is more than 2.0.
  - (c) hydraulic gradient is nearly unity.
  - (d) soil is fine grained.
  
7. For stability analysis of an earth dam for steady seepage case, the most appropriate test would be the
  - (a) unconsolidated undrained test
  - (b) consolidated undrained test
  - (c) unconsolidated drained test
  - (d) consolidated drained test
  
8. Negative skin friction on a pile
  - (a) acts downward and decreases the load carrying capacity of the pile.
  - (b) acts downward and increases the load carrying capacity of the pile.
  - (c) acts upward and decreases the load carrying capacity of the pile.
  - (d) acts upward and increases the load carrying capacity of the pile.

9. A normally consolidated clay settled 10 mm when effective stress was increased from 50 kN/m<sup>2</sup>. If the effective stress is further increased from 100 kN/m<sup>2</sup>, then further settlement of the clay shall be
- (a) 10 mm (b) 20 mm  
(c) 30 mm (d) 40 mm
10. The correct increasing order of specific surface i.e. surface area per mass of the given soils is
- (a) silt, sand, colloids, clay (b) sand, silt, colloids, clay  
(c) sand, silt, clay, colloids (d) clay, silt, sand, colloids
11. For stability analysis of an earth dam for steady seepage case, the most appropriate test
- (a) unconsolidated undrained test (b) consolidated undrained test  
(c) unconsolidated drained test (d) consolidated drained test
12. While designing the abutments of a bridge, the lateral earth pressure to be considered is
- (a) active earth pressure.  
(b) earth pressure at rest with value of  $K_0$  for loose back fill.  
(c) earth pressure at rest with value of  $K_0$  for dense back fill.  
(d) none of them.
13. The rise of water table below the foundation influences the bearing capacity of soil mainly by reducing
- (a) cohesion and effective unit weight of soil.  
(b) cohesion and effective unit weight of soil.  
(c) effective unit weight of soil and effective angle of shearing resistance.  
(d) effective angle of shearing resistance.
14. Newton's law of viscosity is given by the relation
- (a)  $\tau = \mu^2 \frac{du}{dy}$  (b)  $\tau = \sqrt{\mu} \frac{du}{dy}$   
(c)  $\tau = \mu \frac{du}{dy}$  (d)  $\tau = (\mu)^{3/2} \frac{du}{dy}$
15. Surface tension is expressed in
- (a) N/m (b) N/m<sup>2</sup>  
(c) N<sup>2</sup>/m (d) N/m<sup>3</sup>
16. Gauge pressure is defined as
- (a) pressure measured with respect to atmospheric pressure.  
(b) pressure measured from zero pressure.  
(c) absolute pressure plus atmospheric pressure.  
(d) pressure given by a gauge.
17. The pressure intensity at a point in water is given by 49.05 kN/m<sup>2</sup>. The depth to that point below surface is
- (a) 0.198 m (b) 481.2 m  
(c) 5 m (d) 10 m

18. The total pressure on a vertical plate 2 m wide and 4 m depth when held normal to the free surface in water with its one width on the free surface is
- (a) 16 kN (b) 16,000 kN  
(c) 78.48 kN (d) 32 kN
19. A submerged body is supposed to be in stable equilibrium when
- (a) center of buoyancy coincides with center of gravity.  
(b) center of gravity lies above center of buoyancy.  
(c) center of buoyancy lies above center of gravity.  
(d) when buoyant force is less than the gravitational force.
20. If the position of metacenter M lies below c.g. of the floating body G, the body will remain in a state of
- (a) stable equilibrium (b) unstable equilibrium  
(c) neutral equilibrium (d) none of the above
21. The type of flow in which the velocity at any given time does not change with respect to space is called
- (a) steady flow (b) unsteady flow  
(c) rotational flow (d) uniform flow
22. The path followed by a fluid particle in motion is called a
- (a) stream line (b) path line  
(c) streak line (d) equipotential line
23. In fluid mechanics, the continuity equation is a mathematical statement embodying the principle of
- (a) conservation of momentum (b) conservation of mass  
(c) conservation of energy (d) none of the above
24. \_\_\_\_\_ is defined as a scalar function of space and time such that its negative derivative with respect to any direction gives the fluid velocity in that direction.
- (a) velocity potential function (b) stream function  
(c) circulation (d) vorticity
25. The streamlines and equipotential lines are
- (a) normal to each other  
(b) parallel to each other  
(c) always intersecting at acute angles  
(d) lie one over the other
26. A stagnation point in a fluid flow is a point at which
- (a) pressure is zero (b) total energy is zero  
(c) pressure and velocity are zero (d) velocity is zero
27. A stream function is given by  $\Psi = x^2 + y^2$ . The velocity component in the x direction at point (1, 3) will be
- (a) 6 (b) 2  
(c) -6 (d)  $\sqrt{40}$

28. Euler's equation (in differential form) is written as
- (a)  $\frac{dp}{\rho} + v^2 \cdot dv + g \cdot dz = 0$       (b)  $\frac{dp}{\rho} + v \cdot dv + g \cdot dz = 0$   
(c)  $\frac{dp}{\rho} + v \cdot dv + g^2 \cdot dz = 0$       (d)  $\frac{dp}{\rho^2} + v^2 \cdot dv + g \cdot dz = 0$
29. The piezometric head is the summation of
- (a) velocity head and pressure head.  
(b) pressure head and elevation head.  
(c) velocity head and elevation head.  
(d) total head.
30. A Venturimeter is used for measuring
- (a) pressure.      (b) piezometric head.  
(c) total energy.      (d) flow rate.
31. Dynamic similarity between the model and prototype is the
- (a) similarity of motion.      (b) similarity of lengths.  
(c) similarity of forces.      (d) similarity of flow.
32. The boundary layer separation occurs when
- (a)  $\frac{dp}{dx} < 0$       (b)  $\left(\frac{\partial u}{\partial y}\right)_{y=0} = 0$   
(c)  $\left(\frac{\partial u}{\partial y}\right)_{y=0} > 0$       (d)  $\left(\frac{\partial u}{\partial y}\right)_{y=0} < 0$
33. Loss of head due to sudden enlargement is given as
- (a)  $\frac{(V_1 - V_2)^3}{2g}$       (b)  $\frac{(V_1 - V_2)^2}{2g}$   
(c)  $\frac{V_1^2 - V_2^2}{2g}$       (d)  $\frac{\sqrt{V_1 - V_2}}{2g}$
- Where  $V_1$  and  $V_2$  are respectively velocities before and after the enlargement and  $g$  is the acceleration due to gravity.
34. In a laminar flow, Reynolds number is
- (a) less than 4000.  
(b) more than 2000.  
(c) more than 2000 but less than 4000.  
(d) less than 2000.
35. The main function of a surge tank is
- (a) to regulate the flow in penstock.  
(b) to increase the storage capacity of the reservoir.  
(c) to absorb water hammer pressures.  
(d) to create water hammer action.

36. When the depth of flow changes abruptly over a short distance in a free surface flow, the flow is known as
- (a) uniform flow (b) spatially varied flow  
(c) gradually varied flow (d) rapidly varied flow
37. For flow in open channels, uniform flow is characterized by
- (a) a constant slope of channel bottom.  
(b) a constant depth of flow.  
(c) a changing depth of flow.  
(d) none of the above.
38. The hydraulic mean depth is given by
- (a)  $\frac{P}{A}$  (b)  $\frac{P^2}{A}$   
(c)  $\frac{A}{P}$  (d)  $\sqrt{\frac{A}{P}}$
39. For the best rectangular section
- (a)  $y = b/3$  (b)  $y = b$   
(c)  $y = b/4$  (d)  $y = b/2$
40. The hydraulic jump occurs when
- (a) the bed slope is steep.  
(b) the flow changes from super critical to sub critical.  
(c) the flow changes from sub-critical to super critical.  
(d) the flow is critical.
41. Cipolletti weir is a trapezoidal weir having side slope of
- (a) 1 horizontal to 2 vertical (b) 4 horizontal to 1 vertical  
(c) 1 horizontal to 4 vertical (d) 1 horizontal to 3 vertical
42. The surface profile lying in zone 1 of a channel with mild slope is called
- (a)  $C_1$  profile (b) draw down  
(c)  $M_2$  profile (d)  $M_1$  profile
43. A surge with an advancing front moving in the upstream direction with increased depth is called a
- (a) hydraulic bore (b) negative surge  
(c) positive surge (d) hydraulic jump
44. The present population of a community is 28000 with an average water demand of 150 lpcd. The existing water treatment plant has a design capacity of 6000 m<sup>3</sup>/d. It is expected that the population will increase to 44000 during the next 20 years. The number of years from now when the plant will reach its design capacity, assuming an arithmetic rate of population growth, will be
- (a) 5.5 years (b) 8.6 years  
(c) 15.0 years (d) 16.5 years

45. Water samples ( $S_1$  and  $S_2$ ) from two different sources were collected for the measurement of dissolved oxygen (DO) using modified Winkler method. Samples were transferred to 300 mL BOD bottles. 2 mL of  $MnSO_4$  solution and 2 mL of alkali-iodide-azide reagents were added to each bottle containing the sample and mixed. Sample  $S_1$  developed a white precipitate, whereas sample  $S_2$  developed a brown precipitate. In reference to these observations, the correct statement is
- Both the samples were devoid of DO
  - Sample  $S_1$  was devoid of DO while sample  $S_2$  contained DO
  - Sample  $S_1$  contained DO while sample  $S_2$  was devoid of DO
  - Both the samples contained DO
46. The turbidity of surface water is measured with the help of a turbidity meter – an instrument measuring the intensity of light scattered by suspended material present in water. The turbidity value so obtained is expressed in the units of
- CFU
  - FTU
  - JTU
  - NTU
47. Hardness of water is measured by titration with ethylene-di-amine-tetra-acetic acid (EDTA) method using
- Eriochrome black T indicator
  - Ferroun indicator
  - Methyl orange indicator
  - Phenolphthalein indicator
48. The design parameter of a flocculation unit is given by a dimensionless number  $Gt$ , where  $G$  is the velocity gradient and  $t$  is the detention time. Values of  $Gt$  ranging from  $10^4$  to  $10^5$  are commonly used, with  $t$  ranging from 10 to 30 minutes. The most preferred combination of  $G$  and  $t$  to produce smaller and denser flocs is
- large  $G$  values with short  $t$
  - large  $G$  values with long  $t$
  - small  $G$  values with short  $t$
  - small  $G$  values with long  $t$
49. Particles whose surface properties are such that they aggregate, or coalesce, with other particles upon contact, thus changing size, shape and perhaps specific gravity with each contact, are called
- colloidal particles
  - discrete particles
  - flocculating particles
  - suspended particles
50. Two particles are released in water at the same time. Particle A has a diameter  $d_A$  of 0.45 mm. Particle B has a diameter  $d_B$  of 0.90 mm. Assuming equal densities for both the particles and laminar flow conditions, the ratio of the terminal settling velocity of particle A to that of particle B will be
- 4.00
  - 2.00
  - 0.50
  - 0.25

51. **Assertion (A)** : A discrete particle (having diameter  $d_0$ ) settling in a circular sedimentation tank follows a parabolic path.

**Reason (R)** : The downward settling velocity ( $v_0$ ) of the discrete particle (having diameter  $d_0$ ) in the circular sedimentation tank do not change with time.

**Codes :**

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true but (R) is NOT a correct explanation of (A).
- (c) (A) is true, but (R) is false.
- (d) (A) is false, but (R) is true.

52. **Assertion (A)** : A small quantity of ammonia is added to water before carrying out disinfection using chlorine.

**Reason (R)** : Chloramines are persistent disinfectant, which provides continued protection against regrowth of microorganisms in the water distribution system.

**Codes :**

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true but (R) is NOT a correct explanation of (A).
- (c) (A) is true, but (R) is false.
- (d) (A) is false, but (R) is true.

53. Match List-I (Equation/method) with List-II (Application) and select the correct answer using the codes given below the lists :

List-I (Equation/Method)	List-II (Application)
A. Manning's Equation	1. Frictional head loss estimation in pipe flow
B. Darcy-Weisbach Equation	2. Domestic sewer design
C. Hardy Cross Method	3. Storm water sewer design
D. Rational Method	4. Water distribution system design

**Codes :**

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 1 | 4 | 3 |
| (b) | 1 | 4 | 3 | 2 |
| (c) | 4 | 3 | 2 | 1 |
| (d) | 3 | 4 | 1 | 2 |



**54. Assertion (A) :** Inverted siphons normally include multiple pipes and an entrance structure designed to divide the sewage flow among them so that the velocity (at least 0.9 m/s) in those pipes in use will be adequate to prevent deposition of solids.

**Reason (R) :** A single pipe of smaller diameter may be enough to maintain the required velocity at the minimum flow, but the velocity at peak flow will produce very high head losses leading to damage of the pipe itself.

**Codes :**

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true but (R) is NOT a correct explanation of (A).
- (c) (A) is true, but (R) is false.
- (d) (A) is false, but (R) is true.

**55.** A combined sewerage system is designed to carry

- (a) domestic sewage and industrial wastewaters together.
- (b) storm water and domestic sewage together.
- (c) industrial wastewaters and storm water together.
- (d) domestic sewage only.

**56.** In a circular sewer of diameter  $D$ , if the wetted perimeter is  $\frac{\pi D}{3}$ , the depth of flow will be equal to

- (a) 0.25  $D$
- (b) 0.50  $D$
- (c) 0.75  $D$
- (d) 1.00  $D$

**57.** 3 mL of wastewater containing no dissolved oxygen is mixed with 297 mL of dilution water containing 8.6 mg/L of dissolved oxygen in a 300 mL BOD bottle. After a 5-day incubation at 20 °C, the dissolved oxygen content of the mixture is 5.4 mg/L. The  $BOD_5$  of the wastewater is

- (a) 317 mg/L
- (b) 320 mg/L
- (c) 950 mg/L
- (d) 960 mg/L

**58.** An analysis for determination of solids in the domestic sewage was carried out as follows :

- (1) A crucible was dried to a constant mass of 62.485 g.
  - (2) 50 mL of a well-mixed sample was taken in the crucible.
  - (3) The crucible with the sample was dried to a constant mass of 65.020 g in drying oven at 104 °C.
  - (4) The crucible with the dried sample was placed in a muffle furnace at 600 °C for an hour. After cooling, the mass of the crucible with residues was 63.145 g. The concentration of organic fraction of solids present in the sewage sample is
- (a) 13200 mg/L
  - (b) 33800 mg/L
  - (c) 37500 mg/L
  - (d) 50700 mg/L

59. Chemical Oxygen Demand (COD) of a wastewater containing organic matters is estimated by dichromate method titrating with ferrous ammonium sulphate solution using
- (a) Eriochrome black T indicator      (b) Ferroin indicator  
(c) Methyl orange indicator          (d) Phenolphthalein indicator

60. It is important to control and maintain the horizontal velocity at approximately 0.3 m/s in a channel type horizontal-flow grit chamber irrespective of variations in flow rate through the chamber. The controlled horizontal velocity is achieved by providing a velocity control section at the end of the channel. The shape of velocity control section is dependent on the section of the channel. If the channel is made of a rectangular section, the velocity control section should be

- (a) a sharp-crested weir                      (b) an inboard weir  
(c) a proportioning weir                      (d) an ogee weir

61. Activated sludge process is designed for operation in

- (a) endogenous growth phase of microorganism.  
(b) lag growth phase of microorganism.  
(c) log growth phase of microorganism.  
(d) stationary growth phase of microorganism.

62. Match List-I (Terms) with List-II (Definitions) and select the correct answer using the codes given below the lists

<b>List-I</b>		<b>List-II</b>	
<b>(Terms)</b>		<b>(Definitions)</b>	
A. Concentrated Suspension	1.	1.	Whose size, shape and specific gravity do not change with time.
B. Flocculating Particles	2.	2.	Concentration of particles is not sufficient to cause significant displacement of water as they settle.
C. Dilute Suspension	3.	3.	Whose surface properties are such that they aggregate or coalesce with other particles upon contact.
D. Discrete Particles	4.	4.	Particles are close enough together so that their velocity field overlaps with those of neighbouring particles.

**Codes :**

	A	B	C	D
(a)	2	1	4	3
(b)	4	3	2	1
(c)	2	3	4	1
(d)	4	1	2	3

- 63. Assertion (A) :** A sewage lagoon is a suspended-culture biological system consisting of a large, shallow earthen basin in which sewage is retained long enough for natural purification processes to provide the necessary degree of treatment.
- Reason (R) :** The natural purification occurs in the presence of oxygen, which is largely provided by artificial aeration.
- Codes :**
- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).  
 (b) Both (A) and (R) are true but (R) is NOT a correct explanation of (A).  
 (c) (A) is true, but (R) is false.  
 (d) (A) is false, but (R) is true.
- 64. The highest power-to-weight ratio amongst the following vehicles :**
- (a) Car (b) Truck  
 (c) Motorcycle (d) Bicycle
- 65. The standard lane width in multi-lane roads as per IRC in highways**
- (a) 3.6 m (b) 5.75 m  
 (c) 7.0 m (d) 3.5 m
- 66. Extra widening on the horizontal curves is provided for**
- (a) Accommodating off-tracking.  
 (b) To counter various forces at sharp turns.  
 (c) For extra safety.  
 (d) None of these.
- 67. The stopping sight distance (270 m) in a sag vertical curve (with tangent slopes +0.5% and + 3.5%) is greater than the curve length. The curve length when the rest other factors are taken as per IRC standard, is**
- (a) 266 m (b) 200 m  
 (c) 175 m (d) None of these
- 68. In a flexible pavement the layer below the top surface is**
- (a) Sub-grade (b) Sub-base  
 (c) Base (d) None of these
- 69. Bitumen is obtained from**
- (a) Destructive distillation of coke  
 (b) Distillation of petroleum  
 (c) Fractional distillation of petroleum  
 (d) Mixing solvents in tar
- 70. In a flexible pavement, the following four materials with the CBR values given are available : 80%, 60%, 15% and 4%. Indicate the order (top to bottom) in which the materials are to be placed for making a good pavement**
- (a) 4%, 15%, 60% 80% (b) 4%, 80%, 15%, 60%  
 (c) 80%, 60%, 15%, 4% (d) 4%, 60%, 80%, 15%

71. Ideally a permanent way comprises of
- rails, sleepers, ballast cushion and sub ballast murum.
  - rails, sleepers and ballast cushion.
  - rails, sleepers, ballast cushion and sub grade.
  - rails, sleepers, sub ballast murum and subgrade.
72. The gauge widths (in m) for broad, standard and narrow gauges respectively are
- 1.767, 1.650, 0.760
  - 1.676, 1.500, 0.676
  - 1.676, 1.435, 0.762
  - 1.876, 1.656, 0.800
73. The gauge width (in m) for a metre gauge
- 0.760
  - 1.00
  - 1.656
  - None of these
74. The number of crossing indicates the
- number of rails that criss-cross a joint.
  - angle between main rail and crossing rail.
  - number of sleepers all through the crossing.
  - number of sleepers all through the crossing plus a number depending on the connecting rail length.
75. In a broad gauge track with 1 in 8 turnout the curve lead (in m) is
- 17.00
  - 34.00
  - 14.25
  - 28.49
76. The component in the airport system where the aircrafts land/take off
- Apron
  - Taxiway
  - Runway
  - None of these
77. The external aid for en route overwater navigation of aircraft
- Doppler navigation
  - Inertial Navigation
  - Celestial navigation
  - Long range navigation
78. A circuit/loop in a construction network represents
- cyclic pattern of activities
  - illogical interpretation of activities
  - Routine maintenance activities
  - None of these
79. A dummy activity is introduced to
- for getting logical dependencies
  - make the network diagram look elegant
  - make network efficient
  - None of these

80. A critical path is essentially used to find .... of a project  
(a) total float (b) interfering float  
(c) free float (d) completion time
81. Critical Activities are those that have  
(a) zero float time (b) infinite float time  
(c) small but negligible float time (d) none of these
82. Program evaluation and review technique assumes that activity completion times are  
(a) deterministic (b) time dependent  
(c) Probabilistic (d) Fuzzy
83. For building a culvert across a road, the optimistic, pessimistic and most likely times for completion were given as 4, 5, 7, days respectively. The mean or expected value and variance time (in the same order) of completion of this activity in days are  
(a) 5, 4 (b) 5.17, 0.25  
(c) 5.33, 4 (d) 5.33, 0.50
84. Economy of scale exists when  
(a) Fixed and variable costs are nearly equal.  
(b) Fixed costs are high compared to variable costs.  
(c) Fixed costs are low compared to variable costs.  
(d) No specific relation between fixed and variable costs.
85. The worth of an infrastructural asset changes with time due to  
(a) inflation/deflation (b) utility it provides  
(c) Both (A) and (B) (d) None of these
86. The present worth of Rs. 100 cr asset valued 2 years ahead, with an annual interest rate of 10%  
(a) Rs. 121.00 cr (b) Rs. 82.64 cr  
(c) Rs. 100 cr (d) Rs. 110 cr
87. Variable costs refer to  
(a) cost incurred for use/operation.  
(b) fixed expenses irrespective of use/operation.  
(c) costs that vary with time.  
(d) none of these.

88. The base unit of length, mass and time in International system of units are
- metre, kilonewton and second
  - metre, kilogram and minute
  - metre, kilogram and second
  - milimetre, Newton and second
89. Varignon's theorem of moments states
- arithmetical sum of the moments of two forces about any point, is equal to the moments of their resultant about that point.
  - arithmetical sum of the moments of the forces about any point in their plane, is equal to the moment of their resultant about that point.
  - algebraic sum of the moments of the forces about any point in their plane, is equal to the moment of their resultant about that point
  - algebraic sum of the moments of two forces about any point, is equal to the moment of their resultant about that point.
90. A force of 800 N acts on a bracket as shown in Fig. Q. 3. The moment of the force about B is equal to

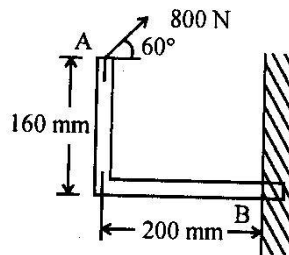


Fig. Q. 3

- 203 N-m
  - 230 N-m
  - 302 N-m
  - 320 N-m
91. Three loads are applied to the beam as shown in Fig. Q. 4. Neglecting the weight of the beam, the vertical reactions at A and B are

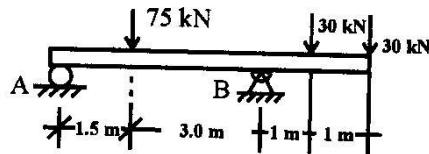
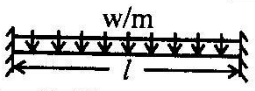
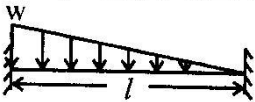
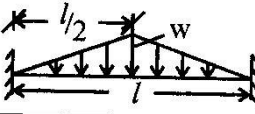
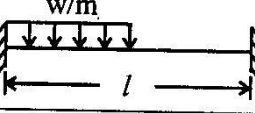


Fig. Q. 4

- 30 kN and 105 kN
- 35 kN and 100 kN
- 105 kN and 30 kN
- 100 kN and 30 kN

92. A 20-Mg rail road car moving at a speed of 0.50 m/s to the right collides with a 35-Mg car which is at rest. If after collision the 35-Mg car is observed to move to the right at a speed of 0.30 m/s, then the co-efficient of restitution between the two car is
- (a) 0.56 (b) 0.65  
(c) 0.55 (d) 0.66
93. The mass moment of inertia of a slender rod length ' $l$ ' and mass ' $m$ ' with respect to axis perpendicular to the rod and passing through one end of the rod is
- (a)  $ml^2/4$  (b)  $m^2l/3$   
(c)  $ml^2/3$  (d)  $m^2l^2/3$
94. In portal frame with columns of same height and section having fixed base, the sum of the displacement factors of column in Kani's method is
- (a) -2.0 (b) -1.5  
(c) -1.0 (d) -0.5

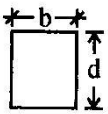
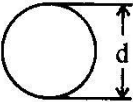
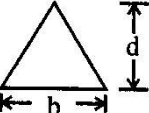
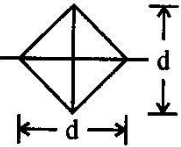
95. Match List-I with List-II and select the correct answer using codes given below :

List-I		List-II	
Type of beam with loading		Maximum support moment	
A		1	$\frac{5wl^2}{96}$
B		2	$\frac{11wl^2}{192}$
C		3	$\frac{wl^2}{12}$
D		4	$\frac{wl^2}{20}$

Codes :

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 4 | 3 | 1 | 2 |
| (b) | 4 | 1 | 2 | 3 |
| (c) | 3 | 4 | 1 | 2 |
| (d) | 3 | 4 | 2 | 1 |

96. Match List-I with List-II and select the correct answer using given codes :

List-I	List-II
Type of section on which shear force 'V' acting	Maximum shear stress across the section
A 	1 $\frac{3v}{bd}$
B 	2 $\frac{9v}{4d^2}$
C 	3 $\frac{16v}{3\pi d^2}$
D 	4 $\frac{3v}{2bd}$

Codes :

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 1 | 4 | 3 | 2 |
| (b) | 4 | 2 | 1 | 3 |
| (c) | 1 | 2 | 3 | 4 |
| (d) | 4 | 3 | 1 | 2 |

97. The cantilever beam AB with loading is shown in Fig. Q. 10. The deflection at the free end B, will be zero, if the value of R is

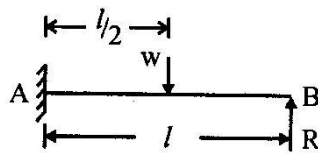


Fig. Q. 10

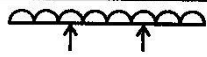

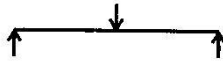

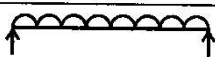

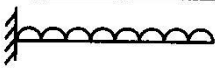
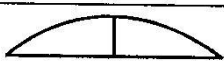
- |                      |                      |
|----------------------|----------------------|
| (a) $\frac{12w}{32}$ | (b) $\frac{8w}{32}$  |
| (c) $\frac{15w}{32}$ | (d) $\frac{10w}{32}$ |







105. Match List-I with List-II and select the correct answer using codes as given below :

List-I		List-II	
Type of beam with type of loading		B.M. diagram	
A		1	
B		2	
C		3	
D		4	

Codes :

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 4 | 3 | 1 |
| (b) | 3 | 4 | 1 | 2 |
| (c) | 4 | 2 | 3 | 1 |
| (d) | 2 | 3 | 4 | 1 |

106. The ratio of maximum deflection of beam 'P' to maximum deflection of beam 'Q' as shown in Fig. Q. 19 is

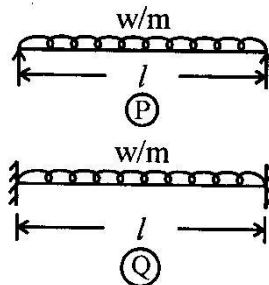


Fig. Q. 19

- |     |   |     |   |
|-----|---|-----|---|
| (a) | 2 | (b) | 3 |
| (c) | 5 | (d) | 7 |

107. The bending moment of the conjugate beam has the same value of the function of corresponding real beam known as

- |                    |                 |
|--------------------|-----------------|
| (a) slope          | (b) shear force |
| (c) bending moment | (d) deflection  |

108. The conjugate beam for the real beam shown in Fig. Q. 21 is

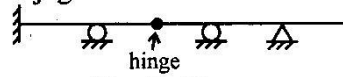


Fig. Q. 21

- (a) (b) (c) (d)

109. The ordinates of the influence line for support moment of a cantilever beam of length 'l' at free end and support are

- (a)  $l$  and  $-l$  respectively (b) zero and zero respectively  
(c) zero and  $l$  respectively (d) none of the above

110. The ratio of shear stress and shear strain of an elastic material is termed as

- (a) Modulus of Rigidity (b) Young's Modulus  
(c) Modulus of Elasticity (d) None of the above

111. Match List-I with the List-II and select the correct answer using given codes :

List-I

List-II

(Euler's Formula)

(End conditions of long column)

A  $P = \frac{2\pi^2 EI}{l^2}$

1. One end fixed other end free

B  $P = \frac{\pi^2 EI}{4l^2}$

2. Both ends fixed

C  $P = \frac{\pi^2 EI}{l^2}$

3. Both ends hinged

D  $P = \frac{4\pi^2 EI}{l^2}$

4. One end fixed, other end hinged

Codes :

	A	B	C	D
(a)	4	1	3	2
(b)	3	1	2	4
(c)	4	2	3	1
(d)	3	4	2	1

112. The magnitude of the concentrated load to be applied at the free end B of a cantilever beam show in Fig. Q. 25 to produce deflection ' $\Delta$ ' at that point (B) is



Fig. Q. 25

(a)  $\frac{4EI \Delta}{l^3}$

(b)  $\frac{3EI \Delta}{l^3}$

(c)  $\frac{2EI \Delta}{l^2}$

(d)  $\frac{3EI \Delta}{l^3}$

113. A portal frame is shown in Fig. Q. 26. The deflected shape of the frame for constant EI will be as per

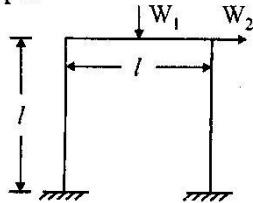
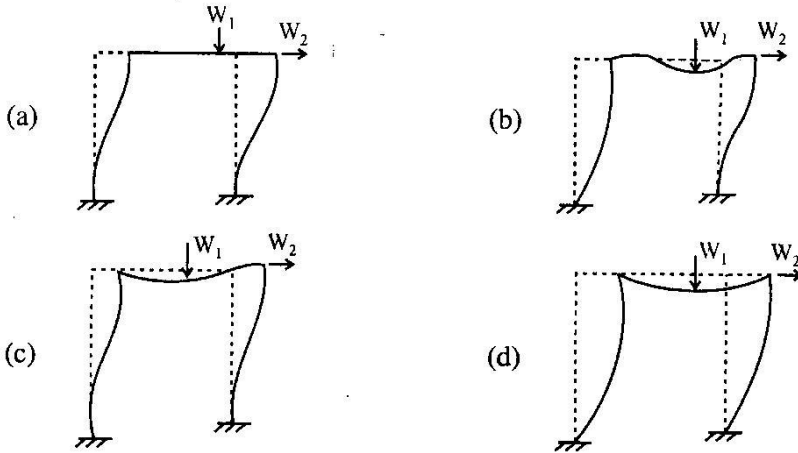


Fig. Q. 26



114. Match List-I with List-II and choose the correct answer from given codes :

**List-I**

- A Maximum/minimum principal stress reaches the elastic limit stress in simple tension/compression.
- B Maximum/minimum principal strain equal to the maximum / minimum strain at the elastic limit in simple tension/compression
- C Maximum shear stress must equal the maximum shear stress at elastic limit in simple tension.
- D Strain energy per unit volume in it equals the maximum strain energy per unit in the material at elastic limit in simple tension.

**List-II**

- 1. Coulomb's theory of elastic failure.
- 2. St. Venant's theory of elastic failure.
- 3. Rankine's theory of elastic failure.
- 4. Haigh's theory of elastic failure

Codes :

	A	B	C	D
(a)	2	3	4	1
(b)	4	3	2	1
(c)	1	2	4	3
(d)	3	2	1	4

115. For the given S.F. and B.M. diagrams as shown in Fig. Q. 28, the appropriate beam with loading is as in

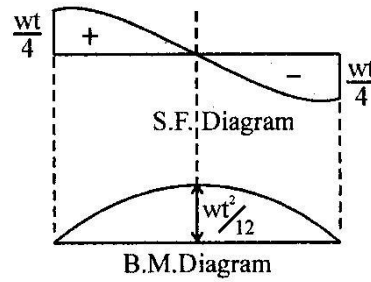


Fig. Q. 28

- (a) (b)
- (c) (d)

116. The inherent property of a body which offers reluctance to change its state of rest or uniform motion, is

- (a) momentum (b) inertia  
(c) mass (d) weight

117. Knowing  $M$ ,  $I$ ,  $R$ ,  $E$ ,  $F$  and  $Y$  are the bending moment, moment of inertia, radius of curvature, modulus of elasticity, stress and depth of neutral axis at a section in flexure, the

- (a)  $\frac{M}{I} = \frac{E}{R} = \frac{Y}{F}$  (b)  $\frac{M}{I} = \frac{R}{E} = \frac{F}{Y}$   
(c)  $\frac{I}{M} = \frac{R}{E} = \frac{F}{Y}$  (d)  $\frac{M}{I} = \frac{EE}{R} = \frac{F}{Y}$

118. A grading curve is

- (a) the results of a sieve analysis.  
(b) a plot of mass retained in each sieve against particle size.  
(c) the plot of cumulative fraction smaller than a given size against the logarithm of that size.  
(d) none of the above.

119. Aeolian soil is a

- (a) soil occurring in flood plain (b) glacial clayey soil  
(c) soil deposited in lake (d) wind-borne soil

120. A soil sample has a shrinkage limit of 10% and specific gravity of soil solids as 2.7. The porosity of the soil at shrinkage limit is

- (a) 21.2% (b) 27.0%  
(c) 73.0% (d) 78.8%

**Space For Rough Work**

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**Space For Rough Work**