

TEACHERS RECRUITMENT BOARD, CHENNAI - 6

**WRITTEN COMPETITIVE EXAMINATION FOR DIRECT RECRUITMENT OF
LECTURERS IN GOVERNMENT POLYTECHNIC COLLEGES - 2012**

CIVIL ENGINEERING

Time Allowed : 3 Hours]

[Maximum Marks : 190

**Each question carries four options namely A, B, C and D.
Choose one correct option and mark in appropriate place in the
OMR Answer Sheet.**

SECTION - A

(1 mark each)

1. Static equilibrium implies that the
 - ☒ A) forces have zero resultant
 - B) forces have zero resultant and zero moment
 - C) forces are stationary
 - D) forces are equal.
2. Working stress of mild steel is determined from the
 - A) upper yield stress
 - B) ultimate stress
 - C) fracture stress
 - ☒ D) lower yield stress.
3. Compatibility conditions are essentially required to solve
 - A) substitute frame
 - B) complex truss
 - ☒ C) redundant frame
 - D) compound truss.

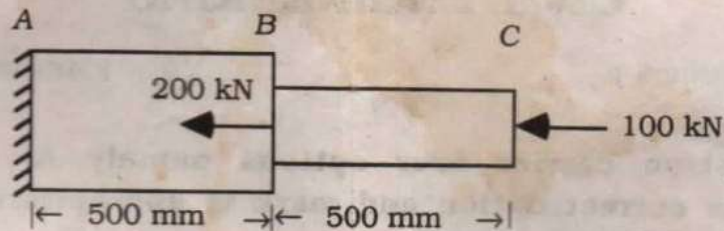
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4. The maximum number of unknown forces that can be determined in a concurrent force system under equilibrium is

A) zero ☒ B) 2
C) 3 D) 6.

5. The portion AB is subjected to a force equal to



A) 200 kN ☒ B) 300 kN
C) 100 kN D) 400 kN.

6. If the Poisson's ratio is 0.3 for a material, the ratio of Young modulus to shear modulus is

A) 1.3 ☒ B) 2.6
C) 3.9 D) 5.2.

7. If the ratio of Young's modulus to bulk modulus is 1.8, the Poisson's ratio is

A) 0.3 B) 0.25
☒ C) 0.2 D) 0.275.

8. The radius of a Mohr's circle for stresses at a point in a body to $\sigma_x = -160 \text{ N/mm}^2$, $\sigma_y = 350 \text{ N/mm}^2$, $\tau_{xy} = 0$ is

☒ A) 255 B) 190
C) 350 D) 160.

Handwritten calculations for question 8:

$$R = \frac{1}{2} \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau_{xy}^2}$$

$$R = \frac{1}{2} \sqrt{(-160 - 350)^2 + 4(0)^2}$$

$$R = \frac{1}{2} \sqrt{(-510)^2}$$

$$R = \frac{1}{2} \times 510$$

$$R = 255$$

Handwritten formula for maximum shear stress:

$$\tau_{max} = \frac{1}{2} \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau_{xy}^2}$$

9. For a beam carrying a UDL, the strain energy will be maximum in case the beam is

A) cantilever $= \frac{(wL^2)^2}{2}$ B) simply supported $R_A \times L - \frac{wL^2}{2}$
C) propped cantilever D) fixed at both ends. $\frac{wL^2}{8}$

10. Two uniform steel rods A and B of same length having diameters d and $2d$ are subjected to tensile forces P and $2P$ respectively. Then the strain energy in both rods will be

A) equal B) rod A has more $\frac{PL}{2E \pi d^2}$
C) rod B has more D) zero in both. $\frac{PL}{2E \pi (2d)^2}$

11. If the hinged end of a propped cantilever of span L and flexural rigidity EI undergoes a rotation, then the shear force in the beam will be

A) $\frac{EI}{L^2} \theta$ B) $\frac{2EI}{L^2} \theta$ C) $\frac{3EI}{L^2} \theta$ D) $\frac{6EI}{L^2} \theta$

12. Clockwise moments M are acting at both the ends of a uniform simply supported beam. The ratio of slope at the end to the slope at centre will be

A) 0.5 B) 1 C) 2 D) 3

13. If a moment M is applied to the hinged end of a prismatic propped cantilever, then the moment at the fixed end will be

A) M B) $\frac{M}{2}$ C) $\frac{M}{3}$ D) $\frac{M}{4}$

14. The moment capacity of a section at plastic hinge is

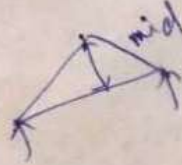
A) zero B) yield moment C) twice of yield moment D) fully plastic moment.

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15. The maximum bending moment under a particular load moving among the several moving loads on a simply supported beam occurs when that point load is placed

- A) at mid-span
B) at one third-point
C) at quarter point
✓ D) at a point when CG of all loads and particular load are equidistant from mid-span.



16. A uniformly distributed load of length 8 m passes over a simply supported beam of 20 m span. If there is a maximum bending moment at the left quarter point then the distance between the CG of load and centre of span will be

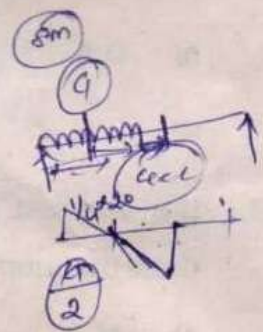
- A) 0
B) 2 m
✓ C) 3 m
D) 4 m.

17. The simply supported bending moment at the central hinge of a three hinged arch is 36 kN-m. The span and rise at the hinge are 12 m and 3 m respectively. The horizontal thrust in the arch is

- A) 3 kN
B) 6 kN
C) 9 kN
✓ D) 12 kN.

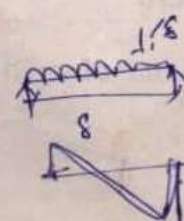
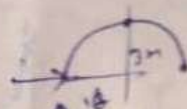
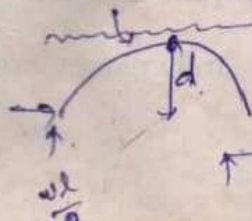
18. The shape of the cable under horizontal UDL is

- ✓ A) parabolic
B) catenary
C) circular
D) triangular.



19. A cable of span l and central dip d is subjected to uniform load w per unit horizontal length. The horizontal component of tension in the cable is

- ✓ A) $\frac{wl^2}{4d}$
B) $\frac{wl^2}{8d}$
C) $\frac{wl^2}{12d}$
D) $\frac{wl^2}{16d}$



$$\frac{wl}{2} \times \frac{l}{2} = H \times d$$

$$\frac{wl^2}{8} = Hd$$

$$H = \frac{wl^2}{8d}$$

20. A compression member has one end hinged and other end rigidly fixed against rotation and sway. Its Euler's buckling load is 120 kN. What will be its buckling load if its both ends are fixed against sway and rotation?

A) 60 kN
B) 120 kN
C) 240 kN
D) $120\sqrt{2}$ kN.

Handwritten notes for Q20:
 $P_{cr} = \frac{\pi^2 EI}{L^2}$
 $P_{cr} = 120$
 $P_{cr} = \frac{\pi^2 EI}{4L^2}$
 $P_{cr} = \frac{120 \times 4}{1} = 480$

21. A horizontal semi-circular beam of radius R is fixed at the ends and carries a UDL 'W' over entire length. The bending moment at the fixed support is

A) $\frac{WR^2}{4}$
B) $\frac{WR^2}{3}$
C) $\frac{WR^2}{2}$
D) WR^2

Handwritten notes for Q21:
 $\frac{W \times \pi R}{2}$
 $\frac{W \times \pi R^2}{2}$
 $\frac{W \times \pi R^2}{2}$

22. A cantilever beam of span l and flexural rigidity EI is subjected to a concentrated load W at mid-span. The slope at the free end is

A) $\frac{Wl^2}{2EI}$
B) $\frac{Wl^2}{4EI}$
C) $\frac{Wl^2}{8EI}$
D) $\frac{Wl^2}{3EI}$



23. A column of rectangular cross-section d units \times 1 unit at top is subjected to a load P in addition to its self weight. Then the profile for uniform stress along its length is (ρ = density, σ = stress)

A) $de \left(\frac{\rho x}{\sigma} \right)$
B) $de \left(\frac{\sigma}{\rho x} \right)$
C) $de \left(\frac{x}{\sigma} \right)$
D) $de \left(\frac{\rho}{\sigma} \right)$

Handwritten notes for Q23:
 $\frac{P}{A} = \frac{W}{A}$
 $\frac{W \times l^2}{4} - Wd - \frac{Wl^2}{4}$

24. A threaded rod is placed inside a tube and fastened by nuts at both ends. The pitch of the thread is p . For quarter turn what is the advancement of the nut?

A) p
B) $p/2$
C) $p/4$
D) $p/3$



Handwritten notes for Q24:
 $M = -H \times 3 + V \times 6 = 0$
 $-3H = \frac{36}{12}$

Handwritten notes for Q24:
 $V \times 12 = 0$
 $V \times 12 - H \times d - W \times \frac{12}{4}$

Handwritten notes for Q24:
 $V \times X = W \times \frac{12}{2}$
 $V = \frac{W \times 12}{2}$

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25. In a reinforced concrete beam the stress in the concrete at the level of steel is measured as 6 N/mm^2 . The modular ratio between steel and concrete is 18. What is the stress in steel?

A) 118 N/mm^2

B) 108 N/mm^2

C) 180 N/mm^2

D) 60 N/mm^2

$$\frac{f_s}{f_c} = \frac{m}{1} = \frac{b}{m}$$

$$f_s = \frac{f_c}{m} = \frac{6}{18} = 0.33$$

26. A square bar of size $20 \text{ mm} \times 20 \text{ mm}$ is subjected to direct tensile force. What is the largest tensile force the bar can sustain if its shear strength is 100 MPa ?

A) 100 MPa

B) 50 MPa

C) 200 MPa

D) 150 MPa

$$\sigma = \frac{P}{A}$$

$$\tau = \frac{P}{A}$$

$$\frac{P}{A}$$

27. For a overhanging beam the expression for Bending moment is given as $2.5x - \frac{3x^2}{2} \text{ kNm}$. Then the location of maximum bending moment is

A) $\frac{5}{3}$

B) $\frac{2.5}{3}$

C) $\frac{3}{2.5}$

D) $\frac{3}{5}$

$$10 \times 20 \times 20$$

28. The sum of the moment of inertias of two mutually perpendicular arbitrary axis is

A) varies directly as the square of smaller value

B) zero

C) always constant

D) different for different orientations.

$$I_{xx} + I_{yy} = I_z$$

$$I_{xx} = \frac{bd^3}{12}$$

$$I_{yy} = \frac{bd^3}{12}$$

$$I_z = \frac{bd^3}{12} + \frac{bd^3}{12} = \frac{bd^3}{6}$$

$$\frac{bd^3}{12}$$

29. Radius of curvature is

$$\frac{d^2y}{dx^2}$$

$$\frac{M}{E}$$

$$\frac{M}{I}$$

$$\frac{My}{EI}$$

$$EI \frac{d^2y}{dx^2} = M$$

$$\frac{d^2y}{dx^2} = \frac{M}{EI}$$

$$\frac{EI}{M} \cdot 2.5 - \frac{3x^2}{2} = 0$$

$$3x = 2.5$$

$$x = \frac{2.5}{3}$$

$$\frac{M}{EI} = \frac{1}{R}$$

$$R = \frac{EI}{M}$$

30. The angular twist of a shaft of radius R mm and length l mm subjected to a torque of 70 kN mm ($G = 70$ GPa) is

A) $\frac{10 l}{\pi R^4}$

B) $\frac{2l}{\pi R^4}$

C) $\frac{4l}{\pi R^4}$

D) $\frac{15l}{\pi R^4}$

31. In an elastic system, the external work done by a force p_i during the deformations caused by another force p_j is equal to the external work done by the force p_j during the deformations caused by p_i is stated by

A) Maxwell

B) Betti

C) Maxwell-Betti

D) Euler.

32. A simply supported beam of span 24 m is to be designed to carry a central concentrated load of 200 kN. If 40 cm is the dip of the cable at the loading point from the neutral axis, the effective prestress is

A) 300 kN

B) 3000 kN

C) 200 kN

D) 2000 kN.

33. The batten plates used to connect the components of built-up column are designed to resist

A) longitudinal shear only

B) transverse shear only

C) longitudinal shear and moment arising from transverse shear

D) vertical shear only.

34. A steel plate is 300 mm wide and 40 mm thick is connected using 24 mm dia bolts of 3 numbers. The net sectional area of the plate is

A) 9840 mm²

B) 8940 mm²

C) 9480 mm²

D) 8490 mm²

$$\frac{M}{I} = \frac{E}{R} = \frac{M}{EI} = \frac{1}{R}$$

$$\frac{d^2y}{dx^2} = \frac{M}{EI}$$

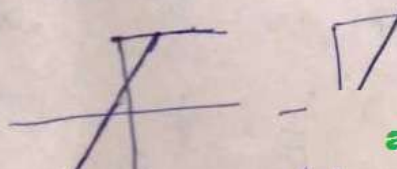
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35. The use of concordant cables in prestressed continuous beams induces
- A) initial support reactions B) no initial support reactions
☒ C) excess cracking D) excess deflection.
36. Losses in prestress in pretensioned beams are more than the losses in post-tensioned beams due to the
- ☒ A) effect of elastic shortening B) frictional force through bonding
 C) excess shrinkage D) anchorage slip.
37. A steel beam is replaced by a corresponding aluminum beam of same cross-sectional shape and dimension and is subjected to same loading. The maximum bending stress now will be
- A) unaltered
 B) increase
 C) decrease
☒ D) vary in proportion to their modulus of elasticity.
38. The base plate of a roof truss is attached to the concrete pier with the help of 16 mm dia anchor bolts of grade Fe 250 MPa. What is the maximum pull the base can be subjected to if the root dia is 0.75 times the shank dia ?
- A) 67.5 kN B) 28.3 kN
☒ C) 56.55 kN D) 33.75 kN.
39. The behaviour of an overreinforced beam is more ductile than that of under-reinforced beam because overreinforced beam contains
- A) more steel and steel is more ductile than concrete
☒ B) concrete is brittle
 C) both concrete and steel stressed simultaneously
 D) statement is wrong.

$x_a < x_c$



40. The load carrying capacity of a column designed by working stress method is 500 kN. The ultimate load of the column is

A) 500 kN

B) 662.5 kN

☒ C) 750 kN

D) 1100 kN.

$$\frac{500 \times 1.5}{1.5 \times 1.5} = 225$$

41. As per IS 3370 (part 2) : 2009 concrete structures for storage of liquids (RCC) the permissible stresses in steel reinforcement for strength for high strength deformed bars is

A) 115 N/mm²

B) 130 N/mm²

☒ C) 125 N/mm²

D) 140 N/mm².

$$\frac{125 \times 1.5}{1.5 \times 1.5} = 225$$

42. The torsional reinforcements for corners held down in the slabs are provided at

A) continuous edges

B) discontinuous edges

☒ C) fixed boundaries

D) for all boundaries.

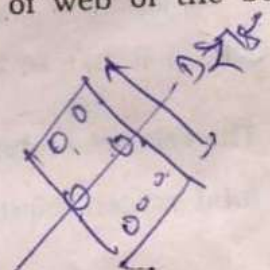
43. Side face reinforcements is provided when the depth of web of the beam exceeds ✓

A) 500 mm

B) 650 mm

☒ C) 750 mm ✓

D) 1000 mm.



44. The depth of footing shall be calculated for

A) bending moment

B) bending moment and checked for shear

C) shear and checked for bending moment

☒ D) shear.

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45. As per IS 1172-1993 in the design of a water supply scheme for a town with full flushing system minimum water supply for domestic water demand is
- A) 135 lpcd B) 200 lpcd
C) 240 lpcd D) 27 lpcd.
46. The safe permissible limit of nitrates in domestic water supplies is
- A) 15 ppm B) 25 ppm
C) 45 ppm D) 100 ppm.
47. The settling velocity of inorganic particles in a sedimentation tank of a water treatment plant is governed by
- A) Darcy's law B) Stokes law
C) Dupuit's law D) Pascal's law.
48. The self cleaning velocity for all sewers in India is
- A) 1.0 m/s to 1.2 m/s B) less than 1 m/s
C) 1.5 m/s to 2.0 m/s D) 3.0 m/s to 3.5 m/s.
49. The relative stability of a sewage sample whose dissolved oxygen is same as the total oxygen required to satisfy BOD is
- A) zero B) 1%
C) 100% D) infinity.
50. If a sewer carrying a discharge of 3 cumec outfalls into a river having a discharge of 10 cumec and DO equal to 9.1 mg/l, the resultant DO of the mix is

A) 7 mg/l

B) 5 mg/l

C) 6 mg/l

D) 8 mg/l

$$\frac{13 \times 9.1}{10 + 3} = 9.1$$

$$\frac{10 \times 9.1 + 3 \times 0}{10 + 3} = 9.1$$

$$\frac{9.1}{13}$$

$$\frac{Q_1 D_1 + Q_2 D_2}{Q_1 + Q_2} = \frac{10 \times 9.1 + 3 \times 0}{10 + 3} = 9.1$$

51. A given sludge with 98% moisture is x times more bulky than with 95% moisture, then x is

A) 3.5

B) 2.5

☒ C) 3

D) 2.

Handwritten notes for Q51:

$$98 - 95$$

$$a \rightarrow 98\%$$

$$b \rightarrow 95\%$$

Handwritten calculation for Q51:

$$98 \times x = 95$$

$$x = \frac{95}{98}$$

52. Electrostatic precipitators remove

☒ A) particulate matter

B) sulphur dioxide

C) methane

D) carbon monoxide.

53. The process of heating solidwaste under controlled condition is

A) composting

☒ B) pyrolysis

C) sanitary land fill

D) dumping.

54. The threshold of hearing for normal healthy ear is

☒ A) 0.00002 N/m²

B) 0.0002 N/m²

C) 0.002 N/m²

D) 0.02 N/m².

Handwritten notes for Q54:

$$20 \times 10^{-6}$$

$$20 \times 10^{-6}$$

$$0.0002$$

55. When the fluid is at rest, the shear stress is

A) maximum

☒ B) zero

C) unpredictable

D) higher.

Handwritten note for Q55:

$$\tau = 0$$

56. A current meter is a device used for measuring

☒ A) velocity

B) viscosity

C) current

D) pressure.

57. For the laminar flow through a circular pipe the ratio of maximum velocity to average velocity is

A) 1.5

B) 2.5

C) 2.0

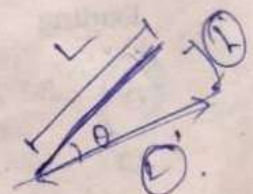
☒ D) 1.0.

Handwritten note for Q57:

$$= \frac{v_{max}}{v_{avg}} = 2$$

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65. In water bound roads binding material is
- A) sand ☒ B) stone dust
- C) cement D) brick dust.
66. If L is the length of a moving vehicle and R is the radius of curvature the extra mechanical widening to be provided on horizontal curves for single lane is
- A) $\frac{L}{2R}$ ☒ B) $\frac{L^2}{2R}$
- C) $\frac{L^3}{2R}$ D) $\frac{2L}{R^2}$
67. According to IRC the maximum super elevation in rolling terrain in plains is limited to
- A) 4% ☒ B) 7%
- C) 10% D) 5%.
68. In which of the following traffic signal systems, cycle lengths and cycle division automatically varied ?
- A) Simultaneous system B) Alternate system
- C) Simple progressive system ☒ D) Flexible progressive system.
69. The drain which is provided parallel to loading to intercept and divert the water from hill slopes is called
- ☒ A) slope drain B) catch water drain
- C) side drain D) cross-drain.
70. If θ is the angle of slope, L is the length of slope and h is the difference in elevation between two ends of the line, then slope correction will be
- ☒ A) $L \sin \theta$ B) $2L \sin^2 \left(\frac{\theta}{2} \right)$
- C) $L \sin \left(\frac{\theta}{2} \right)$ D) $2L \sin 2\theta$.



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58. If the Froude number in open channel flow is equal to 1.0, the flow is called
- A) streaming flow B) tranquil flow
- C) shooting flow D) critical flow.
59. Specific energy of a flowing fluid per unit weight is equal to
- A) $\frac{P}{W} + \frac{V^2}{2g}$ B) $\frac{P}{W} + h$
- C) $h + \frac{V^2}{2g}$ D) $\frac{P}{W} + \frac{V^2}{2g} + h.$
60. The dimension for specific weight is
- A) $ML^{-2} T^{-2}$ B) $ML^{-1} T$
- C) MLT^2 D) $ML^{-1} T^{-2}.$
61. An isohyet is a line joining points of
- A) equal rainfall intensity B) equal storm durations
- C) equal rainfall excess D) equal rainfall depth.
62. Dicken's formula for flood peak is given by
- A) $Q = CA^{1/3}$ B) $Q = CA^{3/4}$
- C) $Q = CA^{1/4}$ D) $Q = CA^{2/3}.$
63. Khosla's safe exit gradient for design of weirs will be the lowest for which of following soil types ?
- A) Coarse sand B) Gravels
- C) Fine sand D) Shingles.
64. There is minimum wastage of water in
- A) sprinkler irrigation B) furrow irrigation
- C) check basin irrigation D) border method.

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71. Isogonic lines are lines passing through

- ☒ A) points having same declination B) points of zero declination
C) points having same dip D) points having zero dip.

72. Spire test is used for adjustment of

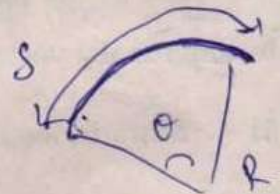
- A) line of sight B) horizontal axis
C) vertical axis ☒ D) adjustments of altitude bubble

73. Size of a theodolite is specified by

- ☒ A) diameter of lower plate B) diameter of upper plate
C) length of telescope D) diameter of vertical circle.

74. If Δ is angle of deflection of a simple curve of radius R , the length of the curve is

- A) $\frac{\pi R \Delta}{90}$ B) $\frac{\pi R \Delta}{180}$
C) $\frac{\pi R \Delta}{270}$ ☒ D) $\frac{\pi R \Delta}{360}$



75. In order to obtain a good quality of undisturbed soil sample the area ratio of sampling tube should be

- ☒ A) 8% B) 16%
C) 24% D) 32%.

$$r = R \times D$$

$$\frac{\pi R}{360}$$

76. A 0.3 m square bearing plate settles by 10 mm in the plate load test cohesionless soil, when the intensity of load is 200 kN/m². Estimate settlement of a shallow foundation of 2 m square under the same intensity loading

- ☒ A) 30.25 mm B) 3.31 mm
C) 17.39 mm ☒ D) 5.75 mm

77. In the passive state of cohesionless soil, minor stress is

- A) horizontal
B) vertical
C) 45° to horizontal
D) 30° to horizontal.

78. For a sandy soil having an angle of internal friction 30°, the ratio of passive and active lateral earth pressure will be

- A) 2
B) 4
C) 3
D) 9.

79. In stability analysis of slopes, factor of safety with respect to height is given by

- A) $F_H = \frac{H_C}{H}$
B) $F_H = \frac{H}{H_C}$
C) $F_H = \frac{2H}{H_C}$
D) $F_H = \frac{H_C}{2H}$

80. Stability analysis by Swedish method of slices gave following values per meter run of 10 m high embankment (i) total shearing force = 480 kN (ii) total normal force = 1950 kN (iii) total neutral force (iv) length of arc = 22 m, if $C = 24 \text{ kN/m}^2$, $\phi = 6^\circ$, then the factor of safety with respect to shear strength is

- A) 1.57
B) 1.67
C) 1.47
D) 1.75.

81. In which mode of shear failure, all the three zones of failure develops fully

- A) local shear failure
B) punching shear failure
C) general shear failure
D) vertical shear.

82. Immediate settlement of cohesionless soils are given by

- A) $S_i = qB \left(\frac{1 - \mu^2}{E_s} \right) I$
B) $S_i = \frac{H}{C} \log_e \frac{\bar{\sigma}_0 + \Delta \bar{\sigma}}{\bar{\sigma}_0}$
C) $S_i = \frac{E_s (1 - \mu^2) I}{qB}$
D) $S_i = \frac{C}{H} \log_e \frac{\bar{\sigma}_0 + \Delta \bar{\sigma}}{\bar{\sigma}_0}$

89. A flownet is drawn to obtain

- A) seepage, coefficient of permeability and uplift pressure
- B) coefficient of permeability, uplift pressure and exit gradient
- ☒ C) exit gradient, uplift pressure and seepage quantity
- D) exit gradient, seepage and coefficient of permeability.

90. Which one of the following planes is not most likely to be the failure plane in Sandy soil ?

- ☒ A) Maximum shear stress plane
- B) Planes carrying maximum normal stress
- C) Principal plane
- D) Planes with maximum angle of obliquity.


91. When consolidation of a saturated soil sample occurs, degree of saturation

- A) increases
- B) decreases ☒
- C) zero
- ☒ D) remains constant.

92. The degree of compaction obtained in the field is measured by

- ☒ A) relative compaction
- B) maximum density
- C) optimum moisture content
- D) bulk density.

93. Newmarks influence chart is used to determine the vertical stress at any point under a uniformly loaded

-  A) circular area only
- B) rectangular area only
- C) trapezoidal area only
- ☒ D) any shape.

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83. For the pile group shown in the figure, the efficiency of pile group determined by Feld's rule is



(4x)

A) 80%

B) 85%

C) 88%

☒ D) 90%.

84. The piles which are used to protect water front structures against impacts from floating objects is

A) Batterpile

B) Anchor pile

☒ C) Fender pile

D) Sheet pile.

85. When the natural state of the cohesionless soil is in its loosest form then the relative density will be equal to

A) one

☒ B) zero

C) two

D) less than one.

86. Lacustrine soils are the soils

A) transported by rivers and streams

B) transported by glaciers

C) deposited in sea beds

☒ D) deposited in lake beds.

87. Consistency as applied to cohesive soils is an indicator of its

A) density

☒ B) moisture content

C) shear strength

D) porosity.

88. Specific surface of a soil particle having particle size D is given by

A) $\frac{D}{2}$

B) $\frac{2}{D}$

C) $\frac{6}{D}$

☒ D) $\frac{D}{6}$.

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83. For the pile group shown in the figure, the efficiency of pile group determined by Feld's rule is



4x

- A) 80%
 B) 85%
 C) 88%
 D) 90%
84. The piles which are used to protect water front structures against impacts from floating objects is
- A) Batterpile
 B) Anchor pile
 C) Fender pile
 D) Sheet pile.
85. When the natural state of the cohesionless soil is in its loosest form then its relative density will be equal to
- A) one
 B) zero
 C) two
 D) less than one.
86. Lacustrine soils are the soils
- A) transported by rivers and streams
 B) transported by glaciers
 C) deposited in sea beds
 D) deposited in lake beds.
87. Consistency as applied to cohesive soils is an indicator of its
- A) density
 B) moisture content
 C) shear strength
 D) porosity.
88. Specific surface of a soil particle having particle size D is given by
- A) $\frac{D}{2}$
 B) $\frac{2}{D}$
 C) $\frac{6}{D}$
 D) $\frac{D}{6}$

$$e_{\text{ref}} = e_{\text{max}}$$

$\frac{e m_0 - e m_0 \gamma}{e \gamma - e}$

89. A flownet is drawn to obtain

- A) seepage, coefficient of permeability and uplift pressure
- B) coefficient of permeability, uplift pressure and exit gradient
- ☒ C) exit gradient, uplift pressure and seepage quantity
- D) exit gradient, seepage and coefficient of permeability.

90. Which one of the following planes is not most likely to be the failure plane in Sandy soil ?

- ☒ A) Maximum shear stress plane
- B) Planes carrying maximum normal stress
- C) Principal plane
- D) Planes with maximum angle of obliquity.

91. When consolidation of a saturated soil sample occurs, degree of saturation

- A) increases
- B) decreases ☒
- C) zero
- ☒ D) remains constant.

92. The degree of compaction obtained in the field is measured by

- ☒ A) relative compaction
- B) maximum density
- C) optimum moisture content
- D) bulk density.

93. Newmarks influence chart is used to determine the vertical stress at any point under a uniformly loaded

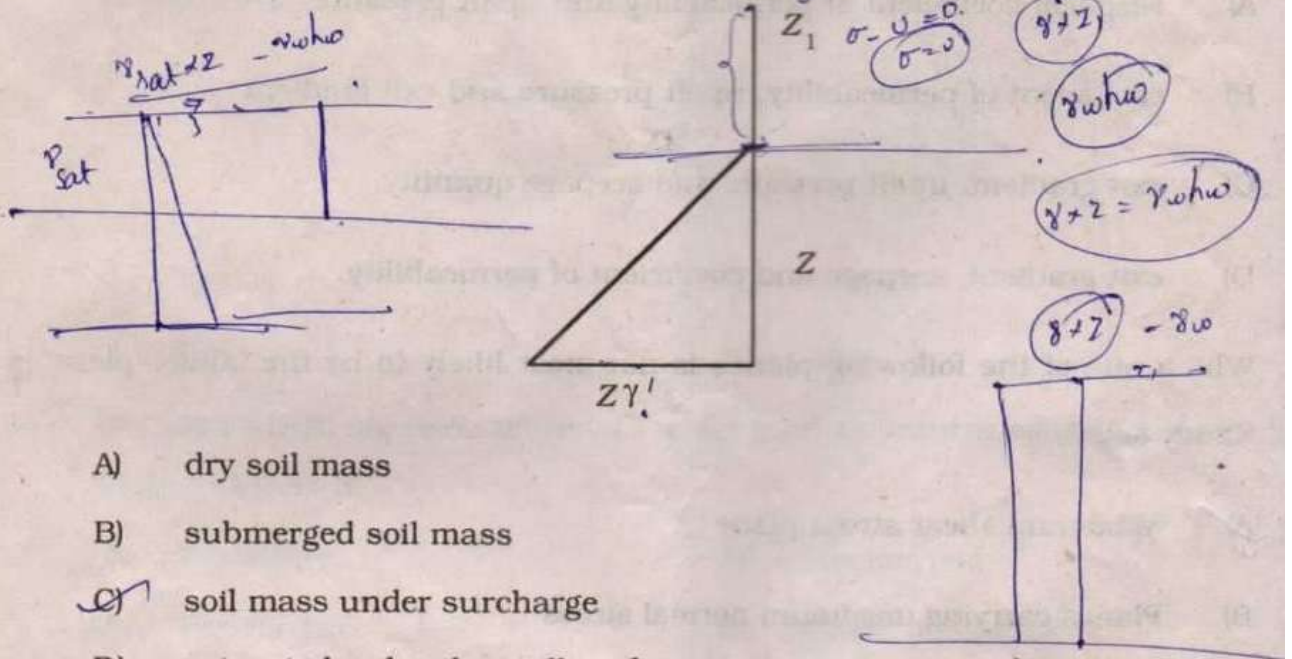


- A) circular area only
- B) rectangular area only
- C) trapezoidal area only
- ☒ D) any shape.

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94. Following diagram is the effective stress distribution diagram for



- A) dry soil mass
- B) submerged soil mass
- ☒ C) soil mass under surcharge
- D) saturated soil with capillary fringe.

95. The fixed point at the transformation

$$W = Z + a$$

- A) 0
- B) 1
- C) i
- ☒ D) ∞

96. Evaluate $\oint_c \frac{Z+2}{Z} dz$ where c is $|Z-2| = 1$

- A) π
- ☒ B) $2\pi i$
- C) πi
- D) 0.

97. The residues of $f(z) = \frac{z^2}{(z-1)(z+2)^2}$ at $z=1$ is

- A) $-\frac{1}{9}$
- B) $\frac{1}{9}$
- C) $\frac{1}{8}$
- ☒ D) 0.

98. The partial differential equation by eliminating the arbitrary constants a and b from $z = (x^2 + a)(y^2 + b)$ is

- A) $4xyz = pq$
- ☒ B) $xyz = pq$
- C) $x = yzp$
- D) $x^2 + y^2 = 4pz$

99. The iteration formula to find the reciprocal of a given number N by Newton's method is

A) $x_{i+1} = x_i (2 - Nx_i)$

☒ B) $x_{i+1} = x_i - Nx_i^2$

C) $x_{i+1} = 2 - Nx_i$

D) $x_{i+1} = x_i (2 + Nx_i)$

100. The error in the trapezoidal rule is

A) of the order h^3

B) of the order h^2

C) of the order h^4

☒ D) of the order h

101. Which work is known as an encyclopaedia of social life in the Eleventh Century ?

A) Dasakumaracharita by Dandin

☒ B) Kathasaritsagara by Somadeva

C) Karpuramanjari by Rajasekhara

D) Rajatarangini by Kalhana.

102. Who led the French forces during the battle of Waterloo ?

A) Duke of Wellington

B) Duke of Cornwall

☒ C) Napoleon Bonaparte

D) Duke of Scotland.

103. In which district is Adichanallur which had been the habitat of human race during 1000-2000 BC located ?

☒ A) Ariyalur

B) Ramanathapuram

C) Tirunelveli

D) Virudhunagar.

104. Which of the following is measured on the Richter scale ?

A) Density of liquids

☒ B) Intensity of earthquakes

C) Velocity of tornadoes

D) Height of mountains.

[Turn over

SECTION - B

(2 marks each)

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111. A bar of cross-sectional area 2 cm^2 and length 100 cm fixed to rigid supports at both ends at a temperature of 25°C . The bar is subjected to an increase in temperature of 30°C . If the coefficient of linear thermal expansion of the material is $10 \times 10^{-6}/^\circ\text{C}$ and Young's modulus $2 \times 10^5 \text{ N/mm}^2$ the stress in the bar is

A) 10 N/mm^2 comp

B) 20 N/mm^2 comp

C) 50 N/mm^2 comp

D) 50 N/mm^2 tension

112. The maximum permissible load on a steelbar of 20 mm dia when the factor of safety is 1.8 and the ultimate stress is 495 MPa is

A) 863.9 kN

B) 86.39 kN

C) 8.639 kN

D) 0.86 kN

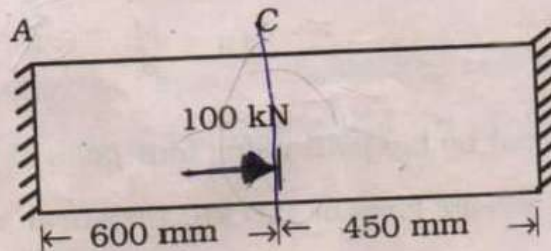
113. If two forces each equal to p act at right angles, their effect may be neutralized by a third force acting along their bisector in opposite direction whose magnitude is equal to

A) $\frac{p}{2}$

B) $2p$

D) $3p$

114. In the bar shown below the force in the part AC is



A) $\frac{600}{7} \text{ kN}$

B) $\frac{300}{7} \text{ kN}$

C) $\frac{450}{7} \text{ kN}$

D) 100 kN

[Turn over

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105. What is zero hour ?

- A) When matters of utmost importance are raised
- ☒ B) When money bill is introduced in the Lok Sabha
- C) When proposals of opposition are considered
- D) Interval between morning and evening sessions.

106. Which of the following is a direct tax ?

- A) Excise duty
- ☒ B) Sales tax
- C) Income tax
- D) Both (B) & (C).

107. Who got the Nobel Prize for Peace in the year 2011 ?

- A) Thomas Sargent
- B) Christopher Sims
- ☒ C) Ellen Johnson Sirleaf, Leymah Gbowee and Tawakkol Karman
- D) Domas Transtroma.

108. Which country won the Kabaddi World Cup, 2011 ?

- A) United Kingdom
- ☒ B) India
- C) Canada
- D) Germany.

109. The Raman effect is used in the study of

- A) X-rays
- B) Cells
- C) Chromosomes
- ☒ D) Molecular energy.

110. Green India Programme is the National Action plan on

- A) Pollution
- ☒ B) Climate change
- C) Rainfall
- D) Environment.

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115. A two dimensional stress system has like stresses $\sigma_x = 100 \text{ N/mm}^2$ and $\sigma_y = 200 \text{ N/mm}^2$ in two mutually perpendicular directions. The xy coordinates of the centre of the Mohr's circle are

A) 100, 50

B) -50, 0

C) 150, 0

D) 0, 150.

116. The force required to cause a rotation ' θ ' at the propped end of propped cantilever beam of span l , Young's modulus E , moment of inertia I is

A) $\frac{12 EI}{L^3} \theta$

B) $\frac{2 EI}{L} \theta$

C) $\frac{4 EI}{L} \theta$

D) $\frac{6 EI}{L^2} \theta$

117. The reaction of the prop of a propped cantilever beam of span l with UDL $W \text{ kN/m}$ is

A) $\frac{5}{8} Wl \text{ (kN)}$

B) $\frac{3}{8} Wl \text{ (kN)}$

C) $\frac{1}{8} Wl \text{ (kN)}$

D) $\frac{7}{8} Wl \text{ (kN)}$

118. A uniform simply supported beam is subjected to a clockwise moment M at the left end. The moment required at the right end of the beam so that the rotation of right end is zero is equal to

A) $2M$

B) M

C) $\frac{M}{2}$

D) $\frac{M}{3}$

119. Two plates are connected by lap joint using four bolts of 20 mm diameter. If the joint is subjected to a tensile force of 100 kN, the shear stress in the bolt is

A) 25 N/mm^2

B) 31.4 N/mm^2

C) 79.6 N/mm^2

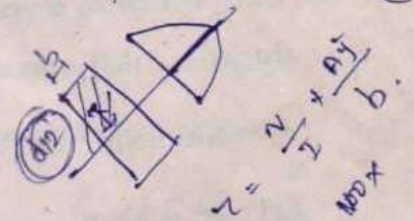
D) 50 N/mm^2

120. A timber beam of 150 mm width and 200 mm depth is flitched with two steel plates of 10 mm thickness and 150 mm width at top and bottom. The Young's moduli of steel is 210 GPa and of timber is 14 GPa. Then the equivalent width of the timber segment is

- A) 15 mm
B) 10 mm
C) 20 mm
D) 110 mm.

121. The shear stress at the neutral axis of a rectangular beam of width $b = \frac{d}{\sum d^3}$ subjected to a shear force 100 kN is

- A) $\frac{300}{d^2}$
B) $\frac{150}{d^2}$
C) $\frac{75}{d^2}$
D) $\frac{100}{d^2}$



122. The maximum stress of a shaft of 100 mm diameter and 2.7 m length subjected to a torque of 125 kNm with shear modulus of 75 GPa is

- A) $\frac{2000}{\pi}$ MPa
B) $\frac{200}{\pi}$ MPa
C) $\frac{100}{\pi}$ MPa
D) $\frac{125}{\pi}$ MPa.

$V = 100 \text{ kN}$
 $I = \frac{bd^3}{12} = \frac{d^4}{24}$
 $b = d/2$
 $A = d^2 \times \frac{d}{2} = \frac{d^3}{2}$

123. If the wind pressure at a location is 1000 N/m^2 , wind directionality factor 0.9, area average factor 0.8, combination factor 1, the design wind pressure is

- A) 270 N/m^2
B) 720 N/m^2
C) 360 N/m^2
D) 410 N/m^2

124. A propped cantilever of span l is subjected to a concentrated load at mid-span. If M_p is the plastic moment capacity of the beam the value of collapse load will be

- A) $\frac{4 M_p}{l}$
B) $\frac{6 M_p}{l}$
C) $\frac{8 M_p}{l}$
D) $\frac{12 M_p}{l}$

$= \frac{100}{12} \times \frac{d^2 \times d}{4 \times \frac{d}{2}}$
 $= \frac{100}{12} \times \frac{d^2 \times d}{2}$
 $= \frac{100}{12} \times \frac{d^3}{2}$
 $= \frac{100}{24} \times d^3$

$\frac{T}{J} = \frac{\tau_{max}}{R}$

$\frac{125}{\frac{\pi}{32} \times 100^3}$

$\times 50$
 $\frac{125}{125 \times 10^3}$
 $\frac{1}{10^3}$

[Turn over

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☒ C) 150, 0

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D) $\frac{7}{8} Wl \text{ (kN)}$.

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B) M

☒ C) $\frac{M}{2}$

D) $\frac{M}{3}$.

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☒ C) 79.6 N/mm^2

D) 50 N/mm^2 .

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125. The base plate of a roof truss is attached to the concrete pier with the help of 16 mm dia mild steel anchor bolts of grade $F_y = 250$ MPa. The maximum pull the base can be subjected to if the roof area of bolt is 0.75 times shank area, is

- A) 28.3 kN
B) 67.5 kN
C) 120 kN
D) 90 kN.

126. A battened column subjected to an axial force of 1100 kN. Battens are placed at 1.25 m centre to centre. Depth of batten plate is 300 mm, length is 363 mm, thickness is 6 mm and on two planes. The bending moment in the batten is

- A) 9.6 kNm
B) 8.6 kNm
C) 10.6 kNm
D) 7.6 kNm.

127. For long shallow girders with low warping stiffness the critical moment is expressed as

- A) $\sqrt{EI_y GJ}$
B) $\frac{\pi}{L} \sqrt{EI_y GJ}$
C) $\frac{\pi}{L} (EI_y GJ)$
D) $EI_y GJ$.

128. A column with unsupported length of 3.5 m, cross-section 420 mm \times 420 mm subjected to an axial load 1000 kN to be checked for minimum eccentricity is

- A) 11 mm
B) 31 mm
C) 21 mm
D) 41 mm.

129. The stiffness matrix for a beam element is

$$k = \frac{EI}{63} \begin{bmatrix} 4 & -9 \\ -9 & 36 \end{bmatrix}. \text{ The corresponding flexibility matrix is}$$

- A) $\frac{63}{EI} \begin{bmatrix} 36 & 9 \\ 9 & 4 \end{bmatrix}$
B) $\frac{1}{EI} \begin{bmatrix} 36 & 9 \\ 9 & 4 \end{bmatrix}$
C) $\frac{63}{EI} \begin{bmatrix} -4 & 9 \\ 9 & -36 \end{bmatrix}$
D) $\frac{1}{EI} \begin{bmatrix} 4 & 9 \\ 9 & 36 \end{bmatrix}$

$$\frac{63}{EI} \begin{bmatrix} 36 & 9 \\ 9 & 4 \end{bmatrix}$$

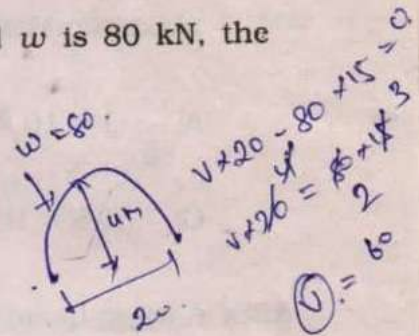
130. A three hinged parabolic arch subjected to a load w at $L/4$ distance from left support. The rise of the crown is 4 m, span is 20 m and w is 80 kN, the horizontal thrust at the supports is

A) 40 kN

B) 25 kN

C) 50 kN

D) 80 kN.



131. Water flows upward through a vertical pipe of diameter 5 cm and height 10 m. For a constant discharge, the pressure head at the lower end of the pipe is 20.4 m. If there is no loss, the pressure head at the upper end of the pipe is

A) 10.4 m

B) 104 m

C) 1.04 m

D) 101 m.

Handwritten calculation for Q131:
 $\frac{P_1}{\gamma} + \frac{V^2}{2g} + Z_1 = \frac{P_2}{\gamma} + \frac{V^2}{2g} + Z_2$
 $\frac{P_1}{\gamma} + 0 + 0 = \frac{P_2}{\gamma} + 0 + 10$
 $\frac{P_1}{\gamma} = \frac{P_2}{\gamma} + 10$
 $20.4 = \frac{P_2}{\gamma} + 10$
 $\frac{P_2}{\gamma} = 10.4$

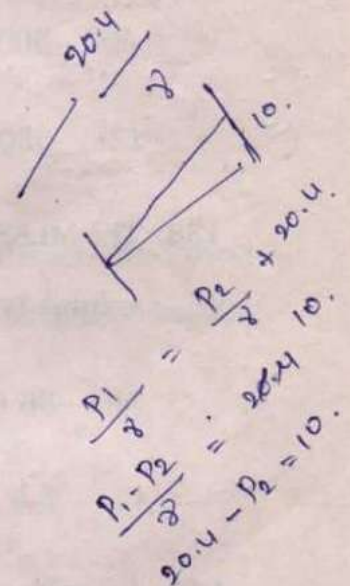
132. Modal analysis of free surface flows are based on

A) Reynolds number

B) Froude Number

C) Mach number

D) Euler number.



133. The specific speed of a turbine is given by

A) $N_S = \frac{N\sqrt{P}}{H^{3/4}}$

B) $N_S = \frac{N\sqrt{Q}}{H^{3/4}}$

C) $N_S = \frac{N\sqrt{P}}{H^{5/4}}$

D) $N_S = \frac{NP^{5/4}}{\sqrt{H}}$

134. The condition satisfied by the three routing coefficients of the Muskingum method is

A) $C_0 + C_1 + C_2 = 1$

B) $C_0 + C_1 + C_2 = 0$

C) $\frac{C_0}{C_1} = \frac{C_1}{C_2}$

D) $C_0 C_1 C_2 = 1$

Handwritten calculation for Q134:
 $C_1 + C_0 + C_2 = 1$

[Turn over

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135. If the average daily consumption of water of a city is $1 \times 10^5 \text{ m}^3$. Then the maximum daily consumption of water will be

A) $1 \times 10^5 \text{ m}^3$

B) $1.5 \times 10^5 \text{ m}^3$

C) $1.8 \times 10^5 \text{ m}^3$

D) $2.7 \times 10^5 \text{ m}^3$

136. A water having pH value equal to 9 will have hydrogen ion concentration equal to

A) 10^{-9} moles/litre

B) 10^9 moles/litre

C) 10^{-5} moles/litre

D) 10^5 moles/litre.

137. If the depletion of oxygen is found to be 2 mg/l after incubating 3 ml of sewage diluted to 300 ml at 20°C for 5 days, then the BOD_5 of the sewage is

A) 500 mg/l

B) 200 mg/l

C) 550 mg/l

D) 300 mg/l.

138. The MLSS concentration in an aeration tank is 2500 mg/l and the settled sludge volume is 215 ml, the sludge volume index is

A) 86 ml/g

B) 8.6 ml/g

C) 6.8 g/ml

D) 68 g/ml.

139. A source emitting 80 dB and another emitting 60 dB if put in the same location will produce a noise of

A) 140 dB

B) 80 dB

C) 20 dB

D) 60 dB.

140. If radius of horizontal curve is 80 mts, design speed is 40 kmph and design coefficient of lateral friction is 0.15, then rate of superelevation of full lateral friction will be

A) 0.30

B) 0.48

C) 0.60

D) 0.72.

141. An ascending gradient of 1 in 100 meets a descending gradient of 1 in 50. The length of summit curve required to provide over turning sight distance of 500 m will be

A) 938.25 m

B) 781.25 m

C) 470.25 m

D) 170.25 m.

142. In the abrasion test loss in weight is 27 gms, then coefficient of hardness will be

A) 11

B) 12

C) 13

D) 14.

143. The true bearing of a line is $34^{\circ} 20'$ and the magnetic declination at that place of observation is $2^{\circ} 20'$ west on the date of observation. The magnetic bearing of the line is

A) $36^{\circ} 40'$

B) $34^{\circ} 20'$

C) 32°

D) $32^{\circ} 40'$

144. A 30 m metric chain is found to be 0.1 m too short through out the measurement. If the distance measured is recorded as 300 m, then the actual distance will be

A) 300.1 m

B) 301.0 m

C) 299.0 m

D) 310.0 m.

[Turn over

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145. A sample of soil has the following properties liquid limit = 45%, plastic limit = 25%, shrinkage limit = 17%, natural moisture content = 30%. Then the consistency index of the soil is

$IL = 45$
 $PL = 25$
 $SL = 17$
 $w_{nat} = 30$
 $CI = 1 - IL$

A) $\frac{15}{20}$
 C) $\frac{8}{20}$

B) $\frac{13}{20}$
 D) $\frac{5}{20}$

$$\frac{30 - 95}{45 - 25} = \frac{5}{20}$$

$$\frac{20 - 5}{20} = \frac{15}{20} = \frac{3}{4}$$

146. An undrained triaxial compression test is carried out on saturated clay sample under a cell pressure of 100 kN/m^2 . The sample failed at a deviator stress of 200 kN/m^2 . The cohesion of the given sample of clay is

A) 100 kN/m^2
 C) 200 kN/m^2

B) 150 kN/m^2
 D) 50 kN/m^2

$$\sigma_1 = \sigma_3 + \sigma_d$$

$$\sigma_1 = 5 + 200 = 205$$

147. A stratum of soil consists of three layers of equal thickness. The permeabilities of top, middle and bottom layers are $k_1 = 10^{-4} \text{ cm/sec}$, $k_2 = 2 \times 10^{-4} \text{ cm/sec}$, $k_3 = 1.5 \times 10^{-4} \text{ cm/sec}$. Then the value of average k when flow perpendicular to the bedding plane is

A) $1.75 \times 10^{-4} \text{ cm/sec}$
 C) 10^{-4} cm/sec

B) $1.5 \times 10^{-4} \text{ cm/sec}$
 D) $1.38 \times 10^{-4} \text{ cm/sec}$

148. The general solution of $\frac{d^2 y}{dx^2} - 1 = 0$ is

A) $y = c_1 e^x + c_2 e^{-x}$
 C) $y = c_1 x + c_2 + \frac{x^2}{2}$

B) $y = c_1 \cos x + c_2 \sin x$
 D) $y = c_1 e^x + c_2 \cos x$

$$y'' - 1 = 0$$

$$m^2 - 1 = 0$$

$$m^2 = 1$$

$$m = \pm 1$$

149. If $A = \begin{bmatrix} 1 & 2 & -2 \\ 2 & 5 & -4 \\ 3 & 7 & -5 \end{bmatrix}$ then A^{-1} is

A) $A^2 - A + 5I$

B) $A^2 + A - 5I$

C) $A^3 - A^2 + 5A$

D) $A^2 - 2A + 5I$

150. If $\vec{F} = x\vec{i} + y\vec{j} + z\vec{k}$ and s is the closed surface of $x^2 + y^2 + z^2 = a^2$, then $\iiint_s \vec{F} \cdot \hat{n} ds$ is

A) $\frac{4}{3}\pi a^3$

B) πa^3

C) $4\pi a^3$

D) $\frac{1}{3}\pi a^3$

Your positive action combined with positive thinking results in Success.

$\sigma_1 = \sigma_3$

$3\omega = 100 \times 1$

$y = Ae^x + Be^{-x}$

$\frac{32}{\frac{2}{10^4} + \frac{2}{2 \times 10^6} + \frac{2}{1.5 \times 10^4}}$

$\frac{3}{\frac{1}{10^4} (1 + \frac{1}{2} + \frac{1}{1.5})}$

$\frac{3 + 1.5 + 2}{3} \times \frac{10}{6 \times 8}$

$\frac{6.5 \times 1.5}{6.5} = 2.50$

