MEGA MOCK CHALLENGE

BYJU'S EXAM PREP

JKSSB JE

Civil Engineering

Mega Mock Challenge

(October 20th - October 21st 2021)

Questions & Solutions

1. In transit theodolite, the line of the sight can be reversed by revolving the telescope through _____.

A. 90 ° in horizontal plane
B. 90 ° in vertical plane
C. 180 ° in horizontal plane
D. 180 ° in vertical plane

Ans. D

Sol. Transit theodolite is theodolite the telescope of which can be rotated completely about its horizontal axis.

Transiting of theodolite is also known as reversing. It is the process of turning gthe telescope about its horizontal axis through 180 in vertical plane.

2. The following table gives data of consecutive coordinates in respect of closed theodolite traverse ABCDA. The magnitude and direction of error of closure in whole circle bearing are

Station	Northing (m)	Southing (m)	Easting (m)	Westing (m)
A	400.75			300.5
B	100.25		199.25	
C		199.0	399.75	
D		300.0		300.5

A. 2 m and 45°
B. 2 m and 315°
C. 2√2 m and 315°
D. 3√2 m and 45°

Ans. C

Sol. ∑Latitude = ∑Northing - ∑Southing

= 501 – 499

= 2

∑Departure = ∑Easting - ∑Westing

= 599 – 601

= -2

Hence error of closure, $e = \sqrt{(\sum \text{Latitude})^2 + (\sum \text{Departure})^2}$

$e = \sqrt{2^2 + (-2)^2}$

$e = 2\sqrt{2}$

$$\tan\theta = \frac{\sum \text{Departure}}{\sum \text{Latitude}} = \frac{-2}{2} = -1$$

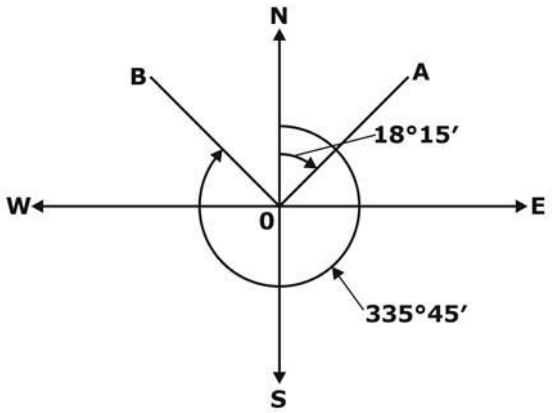
Since $\sum \text{Departure}$ has a negative value and $\sum \text{Latitude}$ has a positive value then direction of error of closure lies in 4th quadrant of whole circle bearing.

So without calculating the angle, we can match the options as which option is having angle that lies in 4th quadrant with $2\sqrt{2}$ as error of closure

Since, $\tan\theta = -1$

Therefore, $\theta = 315^\circ$

3. The whole circle bearings of line OA and OB are 18°15′ and 335°45′ respectively. What is the value of included angle AOB?



A. 42°30′ B. 132°15′

C. 354°30′ D. 177°15′

Ans. A

Sol. Included angle AOB = 360°- 335°45′ + 18°15′ = 42°30′

4. If the fore bearing of a line is observed to be AB 12° 24′, the back bearing of line AB should be?

A. 167°36′ B. 192°24′

C. 102°24′ D. 77°36′

Ans. B

Sol. Fore bearing ± Back bearing = 180°

Back bearing = 180° + 12°24′ = 192°24′

5. The distance between two **brass** rings in a surveyor's chain is:

A. 2 m B. 1 m

C. 20 cm D. 75 cm

Ans. A

Sol. **Metric chains** are made in lengths 20m and 30m. Tallies are fixed at every five-meter length and brass rings are provided at every meter length except where tallies are attached.

- The **Surveyor's chain** or **Guntur's chain** is 66ft, each link being 7.92 inches(divided into 100 links) i.e 20 cm
- The 66-foot (~20.117 m) chain is divided into **100 links**, usually marked off into **groups of 10 by brass rings** (@20 x 10/100 m = 2 m)or tags which simplify intermediate measurement.

6. Which of the following contour represents either hills or ponds?

A. Contour having concentric circles B. Closely placed contour

C. Distant contour D. Parallel contour

Ans. A

Sol. Contours having concentric circles represent either **hills** or **ponds**. If contour interval increases toward inside then it represent Hill if it decreases inside then it represent Pond.

7. How high should a helicopter pilot rise at a point A just to see the horizon at point B, if the distance AB is 100 km?

A. 763 m
B. 673 m
C. 664 m
D. 873 m

Ans. B

Sol. Distance between point A and B, d = 100 km

Required height, $h = 0.0673d^2$

$h = 0.0673 \times 100^2 = 673$ m

8. With an increase in the denominator of the representative fraction, the scale of the map will _____.

A. decrease
B. either decrease or increase
C. increase
D. remain same

Ans. A

Sol. Representative factor= $\frac{Map\ length}{Actual\ Length}$, With an increase in denominator keeping numerator same the scale will be decreased.

9. The survey done to locate boundaries of a field and to determine its area is called

A. Traverse survey
B. Cadastral Survey
C. Plane Table survey
D. Tachometric survey

Ans. B

Sol. Cadastral Survey is done to locate the boundaries of a field and to determine its area. A chain line is run through the centre of the area which is divided into a number of triangles and trapezoids. The offsets to the boundary are taken in order of their chainages. The instruments required for cross staff survey are chain, tape, arrows, and a cross staff. After the field work is over the survey is plotted to a suitable scale.

10. The weight of an angle θ is 3, then weight of angle 2θ is:

A. $\frac{3}{2^2}$
B. 3×2^2
C. $\frac{3}{2}$
D. $\frac{3^2}{2^2}$

Ans. A

Sol. Using the principle of weight concept,

If weight of a quantity is A, then weight of quantity kA is $\frac{A}{k^2}$

Similarly in our case, the weight of the quantity 2θ is $\frac{3}{2^2}$

11. Two bars of different materials and same size are subjected to the same tensile force. If the bars have elongation in the ratio of 3:7, then the ratio of modulus of elasticity of the two materials will be

A. 3:7
B. 7:3
C. 7:4
D. 4:7

Ans. B

Sol. Elongation in a bar is given by, $\delta l = \frac{PL}{AE}$

Where P is the axial force acting on the bar

L is the length of the bar

A is area of cross section of the bar

E is modulus of elasticity of bar

The above equation suggest that $\delta l \propto \frac{1}{E}$

If ratio of the elongation in two bars is 3/7

Ratio of the modulus of elasticity is inverse of the ratio of elongation in two bars,

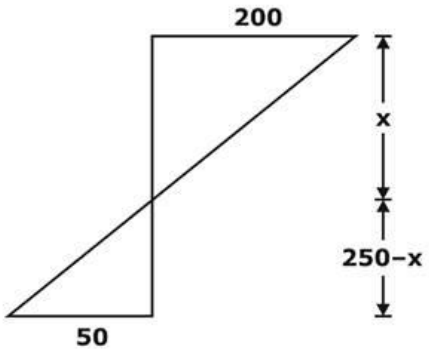
i.e. 7/3

12. A mild steel structural beam has cross section, which is an unsymmetrical I-section. The overall depth of the beam is 250 mm. The flange stresses at the top and bottom are 200 N/mm^2 and 50 N/mm^2 respectively. What is the depth of the neutral axis from the top of the beam?

A. 50 mm
B. 100 mm
C. 150 mm
D. 200 mm

Ans. D

Sol.



As per similar triangles concept,

$$\frac{200}{x} = \frac{50}{250 - x}$$

X = 200 mm

13. A closed coil helical spring is subjected to a torque about its axis. The spring wire would experience a _____.

A. Bending stress
B. Direct tensile stress of uniform intensity at its cross section
C. Direct shear stress
D. Torsional shearing stress

Ans. D

Sol.

- When an axial load is applied to the spring, stresses are developed due to Torsion, Direct Shear due to axial load and bending stresses.
- The stresses due to the direct shear and bending are very small and may be neglected in comparison to the torsion.
- And for light springs direct shear also can be neglected.

Hence, finally shear stress due to torsion dominates which is given by

$16T/\Pi d^3$

14. In a rigid jointed frame, the joints are considered _____.

A. to rotate only as a whole

B. not to rotate at all.

C. that 50% of members rotate in clockwise direction and 50% in anti-clockwise direction.

D. None of these

Ans. A

Sol. Pin joints do not allow the transfer of moments and hence members at the joints are free to rotate relative to each other, i.e. each member has a different amount of rotation. Rigid Joints transfer moment from one member to another, thus restrict the relative rotation of members. All the members will have the same angle of rotation.

So the joint as a whole rotates.

15. A support is said to be non yielding if _____.

A. It can take any type of reaction

B. It is frictionless

C. settlement occurs

D. The beam has zero slope at the support

Ans. D

Sol. Fixed support is also known as non-yielding support.

16. A body is subjected to a tensile stress of 1000 MPa on one plane and another tensile stress of 400 MPa on a plane at right angles to the former. It is subjected to a shear stress of 400 MPa on the same planes. The maximum normal stress will be

A. 400 MPa

B. 500 MPa

C. 900 MPa

D. 1200 MPa

Ans. D

Sol. Let the stress in x direction, $\sigma_x = 1000\ \text{MPa}$

Stress in y direction, $\sigma_y = 400\ \text{MPa}$

Shear stress, $\tau_{xy} = 400\ \text{MPa}$

Maximum normal stress is given by,

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

$$(\sigma_n)_{max} = \frac{1000 + 400}{2} + \sqrt{(\frac{1000 - 400}{2})^2 + 400^2}$$

$$(\sigma_n)_{max} = 700 + \sqrt{300^2 + 400^2} = 1200\ \text{MPa}$$

17. A thin cylindrical pressure pipe with both ends closed has diameter 1000 mm. The pipe is subjected to an internal pressure of 4 N/mm^2. The permissible tensile stress in the material is 100 N/mm^2. What is the minimum required thickness of the pipe?

A. 5 mm
B. 10 mm
C. 40 mm
D. 20 mm

Ans. D

Sol. $\sigma_t = \frac{pd}{2t}$ (in case of cylindrical pipe)

$100 = \frac{pd}{2t}$

$100 = \frac{4 \times 1000}{2t}$

t = 20 mm

18. Beams composed of more than one material, rigidly connected together so as to behave as one piece, are known as

A. Compound beams
B. Indeterminate beams
C. Determinate beams
D. Composite beams

Ans. D

Sol. A structural member composed of two or more dissimilar materials joined together to act as a unit.

19. A 6 meter long uniform cantilever beam carries a load of 8 tonnes uniformly distributed over its whole length. If the free end of the cantilever is to be propped up to the level of the fixed end, then the force (in tonnes) required at the prop will be:

A. 3
B. 4
C. 6
D. 8

Ans. A

Sol. When an UDL runs over a propped cantilever beam, then the propped reaction is given as $\frac{3wl}{8}$, Where w is the intensity of udl in KN/m and l is the length of the cantilever beam.

Force required = $\frac{3wl}{8} = \frac{3 \times 8}{8}$ = 3 tonnes

20. Which of the following statements is true?

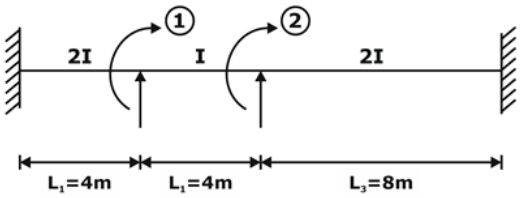
A) A roller is provided at end of a bridge truss to allow thermal expansion.
B) A roller provides freedom of deformation in horizontal plane in case of thermal expansion.

A. Only A
B. Only B
C. Both A and B
D. None of these

Ans. C

Sol. Providing hinged at one-end and have roller supports on the other end to allow for movements usually occur due to thermal contraction and expansion. Stresses occur due to movement being resisted, so if you resist the expansion/ contraction movement, say by pinning the roller support, additional thermal stresses will be induced in the members accordingly.

21. For the beam shown in figure, find the component of stiffness matrix at co-ordinate 1 due to unit moment at co-ordinate 1.



A. 0.5EI
B. EI
C. 2EI
D. 3EI

Ans. D

Sol. For the given beam when unit moment is applied at co-ordinate 1, we can consider the other end at co-ordinate 2 behaves like a fixed support as the far end support is fixed.

Here $I_1 = 2I$, $I_2 = I$ and $I_3 = 2I$

$L_1 = 4\ m$, $L_2 = 4\ m$ and $L_3 = 8\ m$

$$K_{11} = \frac{4EI_1}{L_1} + \frac{4EI_2}{L_2}$$

$$K_{11} = \frac{4E(2I)}{4} + \frac{4EI}{4}$$

K_{11} = 3EI

22. The moment required to rotate the near end of a prismatic beam through unit angle, without translation, the far end being fixed is

A. EI/L
B. 2 EI/L
C. 3 EI/L
D. 4 EI/L

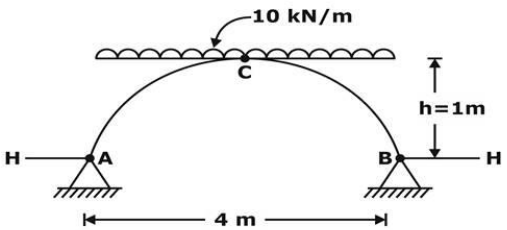
Ans. D

Sol. for end being fixed,

Then from moment distribution method,

Moment required to rotate the near end of a prismatic beam = 4EI/L

23. A three hinged parabolic arch of span length 4 m and rise of 1 m carrying a uniform distributed load over the whole span of intensity 10 kN/m. The horizontal thrust and vertical reaction at support A will be



A. 40 kN and 20 kN
B. 20 kN and 20 kN
C. 78 kN and 10 kN
D. 78 kN and 20 kN

Ans. B

Sol. UDL on the three hinged arch, w = 10 kN/m

Length of span, L = 4 m

Rise at mid of arch, h = 1 m

Horizontal thrust of three hinged parabolic arch at support A, $H = \frac{wL^2}{8h}$

$$H = \frac{10x4^2}{8x1}$$

H= 20 kN

Vertical reaction at support, $R_A = \frac{wL}{2}$

$$R_A = \frac{10 \text{ x } 4}{2}$$

$$R_A = 20 \text{ kN}$$

24. Maximum strain theory for the failure of a material at the elastic limit is known as

A. Guest 's or Tresca's theory
B. St. Venant's theory
C. Rankine's theory
D. Haigh's theory

Ans. B

Sol. St. Venant's theory is also known as maximum principle strain theory.

According to this theory, material subjected to complex stresses fail in simple tensile test, when maximum principle strain reaches the value of strain at yield point.

25. Pick up the correct statement from the following: The torsional stiffness of a shaft is inversely proportional to

A. modulus of rigidity
B. angle of twist
C. the length of the shaft
D. moment of inertia of the shaft section.

Ans. C

Sol. Torsional stiffness = GJ/L

G = Modulus of rigidity of the material of the shaft

J = Polar moment of inertia

L= length of shaft

26. In a beam M20 Grade of concrete and fe415 HYSD deformed bars has development length 720 mm, if 16 mm diameter bars are used as main reinforcement then the length of lap of reinforcement bars in tension is

A. 480 mm
B. 960 mm
C. 720 mm
D. 1080 mm

Ans. C

Sol. The lap length for tension member is equal to greater of development length or 30Φ.

The lap length for compression member is equal to greater of development length or 24Φ.

For beams or flexural member or tension member lap length, $L = L_d \text{ or } 30\phi$

L = 720 mm or 30 x 16 = 480 mm

Therefore lap length is equal to development length as it has higher value i.e. 720 mm.

27. If f_{ck} is the characteristic strength of concrete cube then design strength of concrete is:

A. 0.67 f_{ck} B. 0.447 f_{ck}

C. f_{ck} D. 0.5 f_{ck}

Ans. B

Sol. Strength of concrete taken for actual structure = $\frac{fck}{1.5}$ = 0.67 f_{ck}

Design strength of concrete = $\frac{0.67 f_{ck}}{FOS} = \frac{0.67 f_{ck}}{1.5}$ = 0.446 f_{ck}

28. An axially loaded column of square cross section with dimension 450 × 450 mm is subjected to an axial service load of 300 KN. If grade of concrete is M25, design shear strength of concrete shall be increased by what factor as per recommendation of IS 456:200

A. 1.18 B. 1.27

C. 1.36 D. 1.50

Ans. B

Sol. As per IS 456:2000, for an axially loaded column, increases in design shear strength is made by a factor

$S = 1 + \frac{3 P_u}{A_g \cdot f_{dk}}$ or 1.5 whichever is less

Pu = 1.5 × 300 = 450 KN

$S = 1 + \frac{3 \times 450 \times 10^3}{450 \times 450 \times 25}$ =1.27 (or 1.5 whichever is less)

SO S= 1.27

29. A square column of 350 mm × 350 mm is reinforced with 4 Nos of 25 mm dia bars. The maximum spacing of lateral ties should be:

A. 250 mm c/c B. 300 mm c/c

C. 350 mm c/c D. 400 mm c/c

Ans. B

Sol. Spacing of lateral ties = $min\begin{cases} least lat. dim. = 350mm \\ 16 \times dia of bar = 16 \times 25 = 400mm \end{cases}$

= 300 mm

30. Assertion [A]: RCC section is generally design as cracked section.

Reason [R]: RCC section is generally design as uncracked section.

A. A is correct, R is correct, and R is correct explanation of A

B. A is correct, R is correct, and R is incorrect explanation of A

C. A is correct, R is incorrect

D. A is incorrect, R is correct

Ans. C

Sol. Generally, we design R.C.C. section as cracked section

Reason → (i) In cracked section

Stress generated ≥ permissible stress

Proper utilization of strength of concrete hence economical section design is possible.

(ii) In uncracked section the stress generated will be less than permissible stress. It means for same load we need to increase the strength so that permissible stress limit increases. This leads to uneconomical design.

31. A continuous beam of rectangular cross section and effective span 13 m is subjected to uniformly distributed load. Calculated minimum effective depth required to check defection of this beam, when modification factors for tension and compression reinforcement are 0.80 and 1.20 respectively

A. 60 cm
B. 68 cm
C. 75 cm
D. 88 cm

Ans. B

Sol. For continuous beam, basic $\frac{\text{span}}{\text{depth}} = 26$

$\because$ span > 10 m

so, $\frac{\text{span}}{\text{depth}} \nmid 26 \times \frac{10}{13} \times 0.80 \times 1.20 = 19.20$

$\Rightarrow$ depth > $\frac{\text{span}}{19.20} = \frac{13}{19.20} = 0.6770$ m

= 67.70 cm ≈ 68 cm

32. An RCC is subjected to following loading

Dead load = 26 kN/m

Live load = 45 kN/m

Wind load = 28 kN/m

The factored load which should be considered to satisfy the serviceability criteria is

A. 54 kN
B. 71 kN
C. 84.4 kN
D. 99 kN

Ans. C

Sol. The maximum load is taken as the largest of the following values to satisfy serviceability criteria:

(i) DL + LL = 26 + 45 = 71 kN/m

(ii) DL + WL = 26 + 28 = 54 kN/m

(iii) DL + 0.8 (LL + WL) = 26 + 0.8(45 + 28) = 84.4 kN/m

33. An RCC column of circular cross-section and length L runs along two stories. The ends of the column is restrained in position and direction. The effective length of the column is

A. L
B. 0.8 L
C. 0.65 L
D. 2 L

Ans. C

Sol. For a column that is effectively held in position and restrained against rotation at both ends the effective length recommended is 0.65L.

For columns effectively held in position at both ends but restrained against rotation only at one end, the effective length recommended is 0.8L.

For columns held in position at both ends but not retrained against rotation at both ends, the recommended value for effective length is L.

For columns that are effectively held in position and restrained against rotation only at one end and the other end remaining free, the effective length recommended is 2L.

34. A simply supported beam has a span of 10m. The minimum effective depth to satisfy the vertical deflection limit is:

A. 650 mm
B. 500 mm
C. 350 mm
D. 100 mm

Ans. B

Sol. As per limit state of serviceability of IS 456:2000, the span to effective depth ratio of beams of span upto 10 m is 20.

$$\frac{\text{Span}}{\text{Effective depth}} = 20$$

$$\text{Effective depth} = \frac{\text{span}}{20} = \frac{10000}{20} = 500 \text{ mm}$$

35. A RC beam is subjected to a bending moment of 200 KNm, shear force of 20 KN and a torque of 9 KNm. The size of the beam is 300 mm width x 425 mm depth. The effective cover is 25 mm. The equivalent moment is?

A. 200 KNm
B. 250 KNm
C. 213 KNm
D. 400 KNm

Ans. C

Sol. $M_e = M + \frac{T}{1.7}\left(1 + \frac{D}{B}\right)$

$$M_e = 200 + \frac{9}{1.7}\left(1 + \frac{425}{300}\right)$$

$M_e = 213$ KNm

36. Match the following-

Type of shear failure:

P) Diagonal tension failure

Q) Flexural shear failure

R) Diagonal compression failure

Cause of failure:

1) Due large bending moment and less shear force

2) Due to large shear force

3) Due large shear force and less bending moment

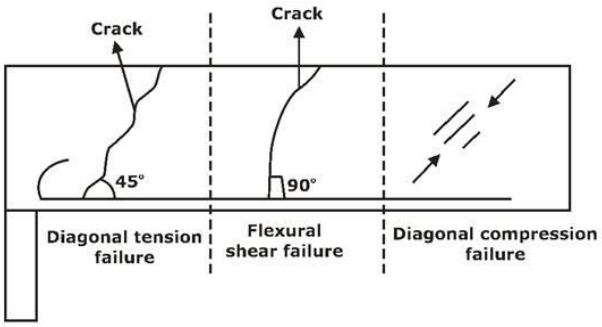
A. P-1, Q-3, R-2
B. P-3, Q-1, R-2
C. P-2, Q-3, R-1
D. P-2, Q-1, R-3

Ans. B

Sol. → Diagonal shear failure occurs under large shear force and less bending moment. Such cracks are normally at 45 with horizontal.

→ Flexural shear failure occur under large bending and less shear force. Such crack are 90° with horizontal.

→ Diagonal compressive failure occurs under large shear force. It is characterized by crushing of concrete.



37. Consider the following statements in the light of IS: 456 - 2000:

1) There is an upper limit on the nominal shear stress in beams (even with shear reinforcement) due to the possibility of crushing of concrete in diagonal compression.

2) A rectangular concrete slab whose length is equal to its width may not be a two-way slab for certain definable support conditions.

Which of the above statements is/are correct?

A. 1 only
B. 2 only
C. Both 1 and 2
D. Neither 1 nor 2

Ans. C

Sol. (i) General l y concrete is strong in compression but under shear there is a chance of crushing of concrete due to diagonal compression hence an upper limit τ_{max} is defined for nominal shear stress in diagonal compression.

(ii) A rectangular concrete slab whose length is equal to its width may not be a two way slab when there is absence of supports in two parallel edges. In this case it would be one way slab.

38. For two way action, i.e. punching shear, the calculated shear stress, τ_v, should satisfy the following relation $\tau_v \leq k_s\tau_c$, where τ_c according to working stress method is expressed as

A. $0.1\sqrt{f_{ck}}$
B. $0.16\sqrt{f_{ck}}$
C. $0.25\sqrt{f_{ck}}$
D. $0.4\sqrt{f_{ck}}$

Ans. B

Sol. when shear reinforcement is not provided,

The calculated shear at the critical section shall not exeed $k_s\tau_c$

Where, k_s is not greater than 1 & τ is shear strength of coloumn.

For working stress method, $\tau_c = .16\sqrt{f_{ck}}$

39. In a prestressed beam carrying an external load 500 kN with a bent tendon is having angle of inclination 30° and prestressed load 200 kN. The net downward load at the centre is

A. 200 kN
B. 300 kN
C. 400 kN
D. 500 kN

Ans. B

Sol. External load, W = 500 kN

Prestressed load, P = 200 kN

Angle of inclination, $\theta = 30°$

Net Downward load at centre, $N = W - 2P\sin\theta$ (General Results)

$$N = 500 - 2x200\sin 30 = 300\ kN$$

40. Limit state of serviceability of prestressed concrete sections should satisfy _____.

A. Cracking, deflection and maximum compression
B. Cracking only
C. Deflection and cracking
D. Deflection and maximum compression

Ans. C

Sol. limit state of serviceability-

1) Cracking or flexure check.(which depends on % of reinforcement)
2) Deflection check.($(l/d)_{provided}$ should be less than $(l/d)_{max}$)
3) limit state of vibration

41. Coefficient of permeability of soil varies approximately as

A. $(D_{10})^2$
B. $(D_{10})^{1/2}$
C. $(D_{10})^3$
D. $(D_{10})^{3/2}$

Ans. A

Sol. Coefficient of permeability of soil varies

$$K = C \times D_{10}^2$$

K in cm/s

D in cm.

42. The property of a soil due to which the loss in shear strength caused by remoulding can be regained with the time is known as:

A. Thixotropy
B. Activity
C. Sensitivity
D. Consistency regain

Ans. A

Sol. Thixotropy is the property of a soil due to which the loss in shear strength caused by remoulding can be regained with the time.

43. The exit gradient of the seepage water through a soil is

A. slope of flow line
B. slope of equipotential line
C. ratio of total head to the length of seepage
D. ratio of the head loss to the length of seepage

Ans. D

Sol. The loss of head per unit length of flow through the soil i8 equal to the exit gradient(i), i = h/L

44. Given that coefficient of curvature = 1.5, $D_{30} = 3mm, D_{10} = 0.6\ mm.$ Based on this information of particle size distribution for use as subgrade, this soil will to be

A. Uniformly Graded sand
B. Well graded sand
C. Very fine sand
D. Poorly graded sand

Ans. B

Sol. Coefficient of curvature, $C_c = 1.5$

$$D_{30} = 3mm$$

$$D_{10} = 0.6\ mm$$

$$C_c = \frac{(D_{30})^2}{D_{10}.D_{60}}$$

$$1.5 = \frac{3^2}{0.6\ x\ D_{60}}$$

$$D_{60} = 10$$

$$C_u = \frac{D_{60}}{D_{10}} = \frac{10}{0.6} = 16.6$$

$$Since, C_u \geq 6\ ;\ C_c = 1 - 3$$

Hence, well graded

45. A soil has a bulk density of 24 kN/m^3 and water content of 20% . The dry density of soil in kN/m^3 is

A. 18
B. 19
C. 20
D. 21

Ans. C

Sol. The dry density is given by,

$$\gamma_d = \frac{\gamma}{1+w} = \frac{24}{1.2} = 20$$

Hence it is determinate and stable

46. The Mohr's straight theory is based on the following fact.

A. Material fails essentially by shear
B. Ultimate strength of the material is determined by the stress in the plane of slip
C. Failure criterion is independent of the intermediate principal stress
D. all options are correct

Ans. D

Sol. The Mohr–Coulomb failure criterion is a set of linear equations in principal stress space describing the conditions for which an isotropic material will fail, with any effect from the intermediate principal stress being neglected. MC can be written as a function of major and minor principal stresses, or normal stress r and shear stress s on the failure plane.

47. The maximum dry density and optimum moisture content of a soil is given by 1.65 gm/cc and 20.5% respectively. What is the percentage of air content of soil at OMC, if the specific gravity of particles is given by 2.65?

A. 10.4 B. 15.5

C. 26.8 D. 35.7

Ans. A

Sol. $\rho_d = \frac{(1-n_a)G\rho_w}{1+wG}$,

Hence n_a =.039

$Percentage\ air\ void, n_a = n \times a_c, Here\ a_c = Air\ content$

$To\ get\ the\ value\ of\ n, \rho_d = \frac{G\rho_w}{1+e}, e = .61$

$We\ know, n = \frac{e}{1+e} = .377$

$Now, a_c = \frac{n_a}{n} \times 100 = 10.34\%$

48. The initial and final void ratios of a clay sample in a consolidation test are 1.0 and 0.5 respectively. If the initial thickness of the sample is 2.4 cm, then its final thickness will be

A. 1.3 cm B. 1.8 cm

C. 1.9 cm D. 2.2 cm

Ans. B

Sol. $\Delta H = H_\circ \frac{\Delta e}{1+e_\circ}$

$= 2.4 \times \frac{1-0.5}{1+1} = 0.6$

Hence the final thickness= 2.4-0.6=1.8cm

49. The shear strength in plastic undrained clay, is due to _____.

A. inter-granular friction B. internal friction

C. cohesion D. none of these

Ans. C

Sol. This makes the shear vane most reliable in clays which when nearly 100% saturated have no angle of internal friction and in which all of the shearing strength is due to cohesion.

50. In a typical deposit of submerged soil, the approximate depth at which the inter-granular pressure is equal to 50 KN/m^2 is (γ_{sat} = 20 KN/m^3)

A. 2.5m B. 5m

C. 7.5m D. 10m

Ans. B

Sol. Intergranular pressure means effective pressure

γ_{sat} = 20 KN/m^2

$\gamma_w = 10\ KN/m^2$

$\gamma_{sub} = \gamma_{sat} - \gamma_w$

$\gamma_{sub} = 20 - 10 = 10\ KN/m^2$

γ_{sub} x d = effective pressure

10 x d = 50

d = 5m.

51. Match List I with List II and select the correct answer using the codes given below the lists.

List I

A) Dynamic viscosity

B) Moment of momentum

C) Power

D) Volume modules of elasticity

List II

1. $[ML^2T^{-3}]$
2. $[ML^{-1}T^{-2}]$
3. $[ML^{-1}T^{-1}]$
4. $[ML^2T^{-2}]$
5. $[ML^2T^{-1}]$

A. A-1; B-4; C-2; D-3

B. A-3; B-5; C-1; D-2

C. A-1; B-5; C-2; D-3

D. A-3; B-4; C-1; D-2

Ans. B

Sol. Volume modulus of elasticity $[ML^{-1}T^{-2}]$

Dynamic viscosity	$[ML^{-1}T^{-1}]$
Moment of momentum	$[ML^2T^{-1}]$
Power	$[ML^2T^{-3}]$

Volume modulus of elasticity $[ML^{-1}T^{-2}]$

52. What is the dynamic viscosity of a liquid having kinematic viscosity of 5 stokes and a specific gravity of 2.1.

A. 1.5 Ns/m^2

B. 1.2 Ns/m^2

C. 1.15 Ns/m^2

D. None of these

Ans. D

Sol. Given,

Kinematic viscosity (v) = 5stokes = $5cm^2/s$

$v = 5 \times 10^{-4}\ m^2/s$

Specific Gravity, S = 2.1

Density (ρ) = $2100\ kg/m^3$

Dynamic viscosity (μ) = $v \times \rho$

$\mu = 5 \times 10^{-4} \times 2100 = 1.05\ Ns/m^2$

53. A _____ is a device used for measuring pressure at a point in a fluid.

A. manometer
B. hygrometer
C. thermometer
D. ammeter

Ans. A

Sol. A manometer is one of the most accurate devices for measuring pressure in the lower ranges. A manometer is a device used for measuring pressure at a point in a fluid.

54. An oil of specific gravity 0.7 is stored in a closed tank up to a height of 2 m. What will be the gauge pressure at the bottom of the tank?

A. 0.14 MPa
B. 1.4 MPa
C. 0.014 MPa
D. 14 MPa

Ans. C

Sol. Specific gravity: S = 0.7

Height: h = 2 m

$$S = \frac{\rho}{\rho_{water}} \Rightarrow \rho = 0.7 \times 1000 = 700 \text{ kg / m}^3$$

Pressure (P) is given by:

P = ρgh

$$P = 700 \times 10 \times 2 = 14000 \text{ Pa} = 0.014 \text{ MPa}$$

55. Stream and velocity potential functions for a two-dimensional flow field given by u = 2x and v = – 2y are

(A) $\psi = 2xy, \varphi = x^2 - y^2$

(B) $\psi = x^2 - y^2 \varphi = 2xy$

(C) $\psi = x^2\, y^2 \varphi = x^2 + y^2$

(D) $\psi = x^2 + y^2 \varphi = x^2\, y^2$

A. (A) Only
B. (B) Only
C. (C)Only
D. (D) Only

Ans. A

Sol. Given,

u = 2x, v = –2y

Potential function

$$u = -\frac{\partial \varphi}{\partial x}, \quad v = -\frac{\partial \varphi}{\partial y}$$

$$-\frac{\partial \phi}{\partial x} = 2x$$

$\int \partial \varphi = -2x \int \partial x$

$$\phi = -\frac{2x^2}{2} + f(y)$$

$$\phi = -x^2 + f(y)$$

$$\because -\frac{\partial \phi}{\partial y} = v \Rightarrow \frac{\partial \phi}{\partial y} = 2y = f'(y)$$

$\Rightarrow f'(y) = 2y$

Integrate function

$$\Rightarrow f(y) = \frac{2y^2}{2} + c = y^2 + c$$

So potential function $\varphi = -x^2 + y^2 + c$

56. In an orifice the coefficient of contraction is defined as the ratio of:

A. area of orifice to area of jet at vena-contracta

B. velocity of jet at vena-contracta to area of orifice

C. area of jet at vena-contracta to area of orifice

D. theoretical velocity to area of jet at vena-contracta

Ans. C

Sol. Area of vena contracta

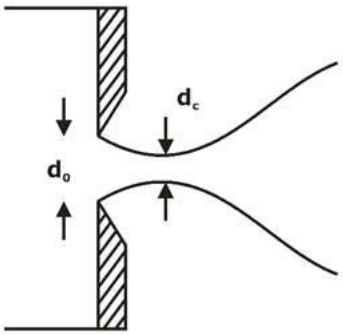
$= a_v$

Area of orifice

$= a_0$

Coefficient of contraction

$$c_c = \frac{a_v}{a_0}$$



57. A stone weights 250 N in air and 150 N in water. If the unit weight of water is 10000 N/m^3, the volume of the stone is :

A. 0.02 m^3 B. 0.01 m^3

C. 0.025 m^3 D. 0.015 m^3

Ans. B

Sol. Buoyant force, F_B

$= r_w \times$ volume of stone

Weight, w = 250 N

$\Rightarrow$ weight in water = $w - F_B$

$\Rightarrow 150 = 250 - r_w \times V$

$$\Rightarrow V = \frac{250 - 150}{r_w} = \frac{100}{10000} = 0.01\ m^3$$

58. Which notch is preferred for measuring the low discharges?

A. Triangular notch
B. Rectangular notch
C. Trapezoidal notch
D. parabolic notch

Ans. A

Sol. Triangular notch is preferred for measuring low discharges because

(i) C_d is fairly constant with depth in triangular weir.

(ii) In triangular weir, head is large even for small discharge.

(iii) For small discharge. V notch gives more accurate result.

59. Which phenomenon will occur when the value at the discharge end of a pipe connected to a reservoir is suddenly closed?

A. Cavitation
B. Erosion
C. Hammering
D. Surging

Ans. C

Sol. Water hammering: when a fluid is flowing in a pipe and valve is open completely. If now the valve is suddenly closed than a high pressure wave developed in the pipe setup, this high pressure wave create a noise known as knocking also this wave of high pressure has the effect of hammering action on the walls of the pipe and hence it is also known as water hammer.

60. In turbulent flow, losses are more because

A. Separation of flow
B. Formation of Eddies
C. Friction
D. All of the above

Ans. C

Sol. In turbulent flow losses are more because of friction.

61. If the coefficient of discharge is 0.6, then the discharge over a right angled notch is

A. 1.417 $H^{5/2}$
B. 0.417 $H^{5/2}$
C. 4.171 $H^{5/2}$
D. 3.417 $H^{5/2}$

Ans. A

Sol. $Q = \frac{8}{15} C_d \tan(\theta/2)\sqrt{2g}\ H^{5/2}$

$= \frac{8}{15} \times 0.6 \times \tan\left(\frac{90}{2}\right)\sqrt{2 \times 9.81}\ H^{5/2}$

Â 1.417 $^{5/2}$

62. A 7.5 m wide rectangular channel conveys 12 m^3/s of water with a velocity of 1.5 m/s. The specific energy head of the flow is

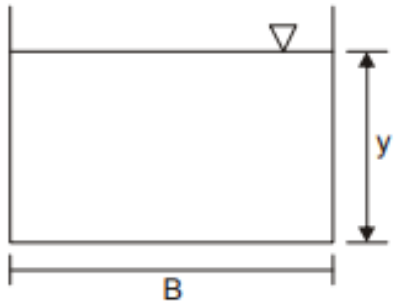
A. 1.18m
B. 1.78m
C. 2.18m
D. 2.78m

Ans. A

Sol. Q = 12 m^3/s

B = 7.5 m

V = 1.5 m/s



Area, A =

$$\frac{Q}{V}=\frac{12}{1.5}=8m^2$$

$$By=8m^2$$

$$y=\frac{8}{7.5}=1.06m$$

Specific energy =

$$=y+\frac{U^2}{2g}$$

$$=1.06+\frac{(1.5)^2}{19.62}$$

$$=1.18m$$

63. What will be the carrying capacity of a horizontal rectangular channel 4 m wide, conveying a discharge of 1 cumecs per meter width of channel?

A. 2.085 m^3/s B. 8.000 m^3/s

C. 1.000 m^3/s D. 4.000 m^3/s

Ans. D

Sol. Given discharge per on width,

$q = \frac{Q}{B}$ = 1 $(m^3/s)/m$ width

width, B = 4 m

⇒ Discharge, Q = qB = 1 × 4 = 4 m^3/s

64. Two geometrically similar pumps are running at the same speed of 150 rpm and lifting water against the heads of 36.0 m and 49.0 m respectively. First pump is having an impeller diameter of 240 mm. The impeller diameter of second pump shall be

A. 280 mm B. 240 mm

C. 120 mm D. None of these

Ans A

Sol. $\frac{H_1}{D_1^2\ N_1^2}=\frac{H_2}{D_2^2\ N_2^2}$

$$\frac{36}{240^2}=\frac{49}{D^2}$$

D = 280 mm

65. Hydraulic efficiency of Francis turbine is

A. Directly proportional to velocity of whirl at inlet and inversely proportional to net head on turbine

B. Directly proportional to velocity of whirl at inlet and net head on turbine

C. Inversely proportional to velocity of whirl at inlet and net hear on turbine

D. Inversely proportional to velocity of whirl at inlet and directly proportional to net head on turbine

Ans. A

Sol. Hydraulic efficiency of a Francis turbine

$$(\eta_h) = \frac{V_{w_1} u_1}{gH}$$

$$\eta_n \propto V_{w_1} \text{ and } \eta_n \propto \frac{1}{H}$$

66. A canal irrigates a portion of a culturable command area to grow sugarcane and wheat. The average discharge required to grow sugarcane and wheat are 1 cumec and 0.6 cumec respectively. The time factor is 0.8. The required design capacity of the canal is

A. 0.5 cumec B. 1 cumec

C. 1.5 cumec D. 2 cumec

Ans. D

Sol. Sugarcane is perennial crop and Wheat is a Rabi crop.

Time factor = 0.8

Average discharge required for sugarcane, Q_S = 1 cumec

Average discharge required for wheat, Q_W = 0.6 cumec

Total average discharge required during Rabi season, $Q = Q_S + Q_S = 1 + 0.6 = 1.6$ cumec

Required design capacity of the canal, $Q_0 = \frac{\text{Total average discharge}}{\text{Time factor}}$

$$Q_0 = \frac{1.6}{0.8} = 2 \text{ cumec}$$

67. The method of growing crops on rides, running on the sides of water ditches, is known as

A. Flood irrigation B. Furrow irrigation

C. Check irrigation D. None of them

Ans. B

Sol. Flood irrigation is the method in which soil is submerged and thoroughly flooded with water, so as to cause through saturation of the land.

Furrow irrigation is a type of surface irrigation in which trenches or "furrows" are dug between crop rows in a field.

68. Critical velocity ratio for use in Kennedy's theory is:

A. Less than 1 B. More than 1

C. Equal to 1 D. All of the above

Ans. D

Sol. Kennedy introduced a factor to account for the type of soil through which the canal has to pass. This factor is known as Critical velocity Ration (CVR)

Equation for modified critical velocity = $V_0 = 0.55\ m\ d^{0.64}$

d = depth of water in channel

m = critical velocity ratio

Sand coarser than standard were assigned value of m between 1.1 and 1.2

Sand finer than standard were assigned value of m between 0.9 and 0.8.

69. Which of the following is not a type of fish ladder?

A. Pool type
B. Steep channel type
C. Inverted filter type
D. Fish lock

Ans. C

Sol. Inverted filter is a protection work, provided at both the u/s and the d/s ends of the impervious floor to safeguard against the piping failure.

70. The meander pattern of a river is developed by

A. Dominant discharge
B. Maximum discharge
C. Average discharge
D. Critical discharge

Ans. A

Sol. For natural rivers, the discharge which determines the meander belt, is called as dominant discharge.

Meandering length, $M_L = 65.8\sqrt{Q_{dominant}}$

71. Pick up the correct sequence of the part of a canal system from the following.

A. Head work-distributary canal-minor
B. Head work-main canal-branch canal-distributary-minor
C. Head work-main canal-branch canal-minor- distributary
D. Head work-branch canal-main canal-distributary-minor

Ans. B

Sol. TYPES OF CANAL

(BASED ON DISCHARGE)

- MAIN CANAL
- BRANCH CANAL
- MAJOR DISTRIBUTARY
- WATER COURSE OR FIELD CHANNEL

72. The water which can be utilized by the crops from the soil is called

A. Field capacity water
B. Hygroscopic water
C. Capillary water
D. None of the above

Ans. C

Sol. Hygroscopic water is in general not available for plant use.

Field capacity is defined as the maximum amount of moisture which can be held by a soil against gravity.

Capillary water induce greater water holding capacity which can be utilized by crops from the soil.

73. For a culturable command area of 800 hectare with intensity of 75%, the duty on the field for a certain crop is 1000 hectare/cumec. The design discharge of water course required will be.

A. 0.4 cumec
B. 0.6 cumec
C. 0.8 cumec
D. 1.25 cumec

Ans. B

Sol. Total culturable command area = 800 hectare

Intensity of irrigation = 75%

Area actually irrigated, A = 800 x 0.75 = 600 hectare

Duty of on the field, D = 1000 hectare/cumec

Design discharge required, $Q = \frac{A}{D}$

$$Q = \frac{600}{1000} = 0.6 \text{ cumec}$$

74. The angle of inclination of repelling groyne with the bank varies from

A. 10° to 30°
B. 20° to 40°
C. 40° to 60°
D. 60° to 80°

Ans. D

Sol. The angle of inclination of repelling groyne with the bank varies from 60° to 80°, or with a line perpendicular to the bank varies from 10° to 30°.

75. According to Bligh's creep theory, for safety against piping

A. $L_{req} \leq CH$
B. $L_{req} \geq CH$
C. $L_{req} \geq \frac{C}{H}$
D. $L_{req} \leq \frac{C}{H}$

Ans. B

Sol. According to Bligh's creep theory if the hydraulic gradient $\leq \left(\frac{1}{C}\right)$ there will be no danger of piping.

So, $L_{req} \geq CH$

76. Activated sludge is the:

A. Resultant sludge removable from the aeration unit
B. Sludge settled in the humus tank
C. Sludge in the secondary tank post aeration, rich in microbial mass
D. Sludge in the secondary tank post aeration, rich in nutrients

Ans. C

Sol. Activated sludge contained a large concentration of highly active micro-organism. It gets settled in the secondary sedimentation tank of activated sludge plant.

77. One litre of sewage, when allowed to settle for 30 minutes gives a sludge volume of 30 cm^3. If the dry weight of this sludge is 6 grams, then its sludge volume index is:

A. 3 ml/gm
B. 5 ml/gm
C. 6 ml/gm
D. 9 ml/gm

Ans. B

Sol. The settled sludge volume V_{ob} = 30 cm^3/lit = 30 ml/lit

The concentration of suspended solids in mixed liquor X_{ob} = 6 gm/lit

SVI = $\frac{V_{ob}}{X_{ob}} = \frac{30}{6}$ = 5 ml/gm

78. What is the concentration of H+ ions in moles/L in water if the pOH value is 5?

A. 10^{-6}
B. 10^{-7}
C. 10^{-8}
D. 10^{-9}

Ans. D

Sol. pH + pOH = 14

pOH = 5, so pH = 14-5 = 9

$H^+ = 10^{-pH} = 10^{-9}$ moles/L

79. Calculate the total 5 days BOD of sewage in kg per day, if the average sewage from the city is $100x10^6$ litre per day and the average 5 day is 300 mg/litre.

A. 30000 kg/day
B. 15000 kg/day
C. 7500 kg/day
D. 60000 kg/day

Ans. A

Sol. $\text{The average sewage} = 100 \times 10^6 \text{ litre/day}$

$\text{BOD}_5 = 300 \text{ mg/l}$

$\text{Total BOD}_5 \text{ sewage} = \text{average sewage} \times \text{BOD}_5$

$\text{Total BOD}_5 \text{ sewage} = 300 \times 100 \times 10^6 = 30000 \times 10^6 \text{ mg/day}$

$= 30000 \text{ kg/day}$

80. Determine the maximum upper limit of BOD of a glucose solution of concentration 540 mg/l.

$$\frac{C_6H_{12}O_6}{180 \text{ gm}} + \frac{6O_2}{192 \text{ gm}} \rightarrow 6CO_2 + 6H_2O + \text{Energy}$$

A. 360 mg/l
B. 384 mg/l
C. 576 mg/l
D. 192 mg/l

Ans. C

Sol. Concentration of oxygen in reaction = 192 gm

Concentration of Glucose in reaction = 180 gm

Theoretical oxygen demand per 360 mg of glucose

$$= \frac{\text{Concentration of oxygen}}{\text{Concentration of Glucose}} \times 360 = \frac{192}{180} \times 540 = 576 \text{ mg/l}$$

Theoretical oxygen demand is equal to maximum upper limit of BOD.

81. For a water sample the total hardness is 200 mg/l as $CaCO_3$ and alkalinity is 250 mg/l as $CaCO_3$. Then the carbonate hardness is

A. 200 B. 250

C. 450 D. 50

Ans. A

Sol. Total hardness = 200 mg/l

Alkalinity = 250 mg/l

Since, $\text{Alkalinity} \geq \text{total hardness}$

Therefore, Carbonate alkalinity = total hardness = 200 mg/l

82. Fresh sludge has moisture content of 99% and after thickening, its moisture content is reduced to 96%. The reduction in volume of sludge is:

A. 3% B. 5%

C. 75% D. 97%

Ans. C

Sol. $V_1(100 - P_1) = V(100 - P)$

$$\frac{V_1}{V} = \frac{100 - 99}{100 - 96} = \frac{1}{4} = 0.25$$

Volume reduction = $\frac{V - V_1}{V} \times 100$ = 75 %

83. The following data pertain to a waste water sample

Initial Dissolved oxygen = 10 mg/l

Final Dissolved oxygen = 3 mg/l

Dilution = 2 %

The Biochemical oxygen demand of the given wastewater sample is:

A. 250 mg/l B. 500 mg/l

C. 300 mg/l D. 350 mg/l

Ans. D

Sol. Biochemical oxygen demand (B.O.D) = (DO_i – DO_f) x Dilution Ratio

B.O.D = (10 – 3) x $\frac{100}{2}$

B.O.D = 350 mg/l

84. An ideal settling basin is designed with the surface overflow rate (SOR) of $1m^3/m^2$/hour. Particles have their discrete settling velocities and concentration as follows:

Particle type	settling velocity (m/h)	Initial concentration (mg/l)
(a)	1	100
(b)	0.5	100
(c)	0.1	100
(d)	0.05	100

Which one of the following give the correct estimate of the overall removal of particles per hour?

A. 65 mg/l
B. 165 mg/l
C. 265 mg/l
D. 365 mg/l

Ans. B

Sol. Particles with velocity above or equal to Surface absorption rate (S.O.R) will be completely removed and those with settling velocity below S.O.R are removed in proportion of $\frac{V}{SOR}$

Thus, overall removal = 100 + 0.5 x 100 + 0.1 x 100 + 0.05 x 100 = 165 mg/l

85. Which is the best sewer material to resist hydrogen sulphide corrosion?

A. Glazed stoneware
B. Glazed earthenware
C. RCC
D. Brick masonry

Ans. A

Sol. Glazed stoneware or vitrified clay pipes have the advantage of being highly resistant to sulphide corrosion.

86. The Lucknow plan targeted to construct roads, giving a density of

A. 32 km/100 sq. km.
B. 82 km/ 100 sq. km.
C. 16 km/ 100 sq. km.
D. 48 km/ 100 sq. km.

Ans. B

Sol. The Bombay plan targeted to construct roads, giving a density of 32 km/100 sq. km.
The Nagpur plan targeted to construct roads, giving a density of 16 km/100 sq. km.

87. Right of way is the summation of the width of_____.

A. carriage way and shoulder
B. carriage way, shoulder and road margins
C. carriage way and road margins
D. road margins and shoulder

Ans. B

Sol. Right of way is the width of land acquired for road, along its alignment. Thus it includes carriage way, shoulder and road margins.

88. The recommended camber for cement concrete surfaced pavement is

A. 1/50
B. 1/40
C. 1/33
D. 1/25

Ans. A

Sol.

Type of surface	Camber range
1. Cement concrete and high type bitumen surface	(2.0 – 1.7) %
2. Thin bituminous surface	(2.5 – 2.0) %
3. Water bound macadam and gravel pavement	(3.0 – 2.5) %
4. Earth	(4.0 – 3.0) %

89. Consider the following statements:

Excessive camber is not provided on the roads because:

a) Transverse tilt causes discomfort

b) Of formation of cross ruts

c) Of likely toppling over of highly laden bullock carts

d) Of higher costs involved

Which of the statements given above are correct?

A. b, c and d only
B. a, c and d only
C. a, b and d only
D. a, b and c only

Ans. D

Sol. Too steep cross slope is not desirable because of the following reasons.

i) Transverse tilt of vehicles causes uncomfortable side thrust and a drag on the steering of automobile.

ii) Discomfort of passenger due to throw of vehicle when crossing the crown during overtaking

iii) Problems of toppling over of highly laden bullock carts and trucks

iv) Formation of cross ruts due to rapid flow of water

v) Tendency of most of vehicles to travel along the centre line

vi) Unequal wear of the tyres as well as road surface because the thrust on wheels along the pavement edges is more

90. If the traffic density on a highway is 100 veh/km, the average spacing /space headway (in m) is:

A. 10
B. 20
C. 50
D. 100

Ans. A

Sol. $S = \frac{1000}{k} = \frac{1000}{100} = 10\ m$

91. Pick up the correct option related to transition curve:

A. Deflection angle = 3 x spiral angle

B. Deflection angle = 2 x spiral angle

C. Deflection angle = 1/3 x spiral angle

D. Deflection angle = 1/2 x spiral angle

Ans. C

Sol. Spiral angle = $\frac{x^2}{2RL}$

Deflection = $\frac{x^2}{6RL}$

So, deflection angle = 1/3 x spiral angle

92. The purpose of Marshal test is:

A. Design of bitumen concrete mix
B. Overlay design
C. Gradation of asphalts
D. Determination of softening point

Ans. A

Sol. The Marshall process uses a series of laboratory tests and evaluation criteria for selecting materials and to progressively narrow in on optimum bitumen concrete mix design.

93. The consistency and flow resistance of a sample of bitumen can be determined through which of the following tests?

A. Viscosity test
B. Penetration test
C. Ductility test
D. Softening point test

Ans. A

Sol. Consistency and flow resistance of a sample of bitumen can be determined through "Viscosity test".

94. The penetration range at 25°C of VG 40 bitumen is

A. 80-100 mm
B. 60-80 mm
C. 50-70 mm
D. 40-60 mm

Ans. D

Sol. Range of penetration for various viscosity grading are

VG 10 = 80-100 mm

VG 20 = 60-80 mm

VG 30 = 50-70 mm

VG 40 = 40-60 mm

95. The CBR value of soil subgrade is 6%. Wheel load and tyre pressure are 3600 kg and 9 kg/cm^2 respectively. Total thickness of pavement will be:

A. 24 .7 cm
B. 33 .5 cm
C. 30.3 cm
D. 35 cm

Ans. C

Sol. Given, CBR = 6%, P = 3600 kg, p = 9 kg/cm^2

$$t = \sqrt{P}\left(\frac{1.75}{CBA} - \frac{1}{p \times \pi}\right)^{1/2}$$

$$t = \sqrt{3600}\left(\frac{1.75}{6} - \frac{1}{9 \times \pi}\right)^{1/2} = 30.3 \text{ cm}$$

96. Due to slipping of the wheels the rail forms _____.

A. Crushed head
B. Battered ends
C. Spilt head
D. Horizontal fissure

Ans. A

Sol. Due to slipping crushing head formed in the rails.

In rails there are fatigue and creep also form by cyclic and continuous loading respectively.

97. The value of the curve lead to be provided for a BG track with crossing number 8.5 is nearly,

A. 5.1 m
B. 14.25 m
C. 21.4 m
D. 28.5 m

Ans. D

Sol. Curve lead (CL) = 2GN

CL = 2 x 1.676 x 8.5 = 28.5 m

98. The shape of vertical curve used in Indian Railways is

A. Cubic parabola
B. Circular curve
C. Spiral
D. Lemniscates of Bernoulli

Ans. B

Sol. Shape of transition curve used in Indian Railways is cubic parabola.

Shape of vertical curve used in Indian Railways is circular curve.

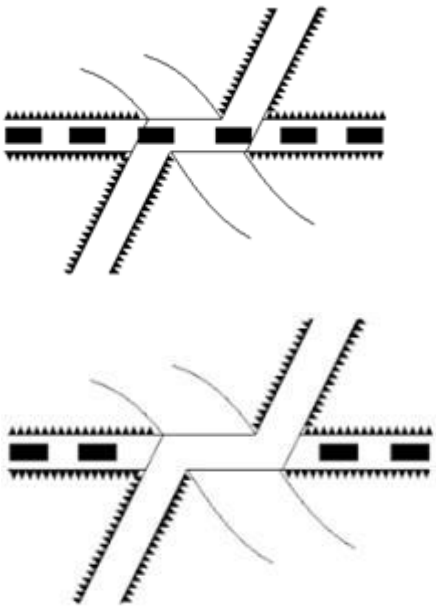
99. The conventional sign shown in the figure below represents a :-

A. Bridge carrying railway below road.
B. Bridge carrying road below railway
C. Bridge carrying road and railway at the same level.
D. A level crossing

Ans. B

Sol. The ABOVE diagram represents the bridge carrying road below railway

The below diagram shows Bridge carrying railway below road.



The above represents Bridge carrying road and railway at the same level.

100. The magnitude of super-elevation provided in Indian Railways on Broad gauge is _____ (in m)

A. 1.315 V^2/R B. 0.615 V^2/R

C. 0.81 V^2/R D. 0.415 V^2/R

Ans. A

Sol. The magnitude of super-elevation provided in Indian Railways on Broad gauge is 1.315 V^2/R

For meter gauge 1x V^2/R

For narrow gauge 0.676xV^2/R

101. A Pandrol clip is used in railways for:

A. Fixing tie bar with CI sleepers

B. Measurement of 'packing void' under the sleeper ends

C. Measurement of unevenness of rail top and rectification of alignment

D. Elastic rail fastening

Ans. D

Sol. A pandrol clip is used for elastic rail fastening. They are responsible for attaching the rail to the base plate so the rail cannot move vertically or horizontally with respect to the base plate.

102. In the layout of an MG track, the versine of a horizontal circular curve is measured over a 17 m chord length. What would be the value of the versine of curve? (Degree of curve is 2)

A. 4.2 cm B. 1.8 cm

C. 0.24 cm D. Data insufficient

Ans. A

Sol. V = Versine

$$V = \frac{C^2}{8 \times R}$$

D = Degree of curve = 2

R = 1720/D = 860 meter

$$V = \frac{17^2}{8 \times 860} = 4.2 \text{ cm}$$

103. Distance of outer signals in India for B.G. tracks and M.G. tracks is respectively:

A. 0.60 km, 0.50 km B. 0.52 km, 0.40 km

C. 0.60 km, 054 km D. 0.54 km, 0.40 km

Ans. D

Sol. Distance of outer signals:

B.G. track – 0.54 km

M.G. track – 0.40 km

104. Consider following statements regarding Ballast less tracks:

1. No sleepers are used in these tracks
2. These tracks are more durable; requires less maintenance
3. These tracks can not be used in tunnels
4. These tracks have been adopted in Delhi metro

Correct statement(s) is / are:

A. 1, 2, 3 only
B. 1, 3, 4 only
C. 2, 3, 4 only
D. 1, 2 and 4 only

Ans. D

Sol. 1. No Ballast and sleepers are used in Ballast less tracks → Correct
2. These tracks are more durable and requires less maintenance → Correct
3. These tracks are very effective in case of tunnels → Incorrect
4. These tracks are used in Delhi metro and other metros as well → Correct

105. Limiting value of cant deficiency and cant excess for meter gauge tracks recommended by Indian Railways are respectively:

A. 75 mm, 75 mm
B. 50 mm, 65 mm
C. 65 mm, 50 mm
D. 65 mm, 75 mm

Ans. B

Sol. Permissible value of cant deficiency
B.G. – 100 mm (V > 100 kmph)
– 75 mm
M.G. – 50 mm
N.G. – 38 mm
Permissible value of cant excess
B.G. – 75 mm
M.G. – 65 mm

106. Water cement ratio is generally expressed in volume of water required per _____.

A. 10 kg
B. 20 kg
C. 30 kg
D. 50 kg

Ans. D

Sol. Water cement ratio is generally expressed in volume of water required per 50 kg, it is generally due to the weight of one bag of cement 50 kg.

107. The Young's modulus of concrete (Ec) is given by _____.

A. 1000 f_{ck}
B. 5000 $\sqrt{f_{ck}}$
C. 5000 f_{ck}
D. 1000$\sqrt{f_{ck}}$

Ans. B

Sol. As per IS 456:2000
Modulus of elasticity of concrete is 5000$\sqrt{f_{ck}}$, in this effect of temperature and creep also considered .

108. In the process of the hydration of OPC, what is the water requirement (expressed as the percentage by weight of cement) to complete the chemical reactions?
A. 15 to 25%
B. 20 to 25%
C. 25 to 35%
D. 35 to 45%

Ans. B

Sol. To hydrate any cement completely, the amount of water you require is 20-25% the weight of the cement, but to account for workability and the loss of water you can probably take the weight of water to be around 40-45% to the weight of the cement.

109. The compressive strength of 100 mm cube as compared to 150 mm cube is always _____.
A. less
B. more
C. equal
D. None of these

Ans. B

Sol. Smaller size cubes have a more uniform distribution of stresses.

110. Which one of the following cement is best for the marine works?
A. Blast furnace slag cement
B. High alumina cement
C. Low heat Portland cement
D. Rapid hardening cement

Ans. A

Sol. Blast furnace slag cement is best for the marine work.

111. According to Le Chatelier Method for testing soundness of cement the unaerated ordinary rapid hardening and low heat Portland cement should not have an expansion of more than:
A. 15mm
B. 20mm
C. 10 mm
D. 5 mm

Ans. C

Sol. Soundness is the ability of cement to maintain a constant volume. The unaerated ordinary rapid hardening and low heat Portland cement should not have an expansion of more than 10mm.

112. Grading of sand causes great variation in
A. workability of concrete
B. strength of concrete
C. durability of concrete
D. All option are correct

Ans. D

Sol. All options are correct.

113. Low temperature during concrete laying _____ in the short term.
A. increases strength
B. decreases strength
C. has no effect on strength
D. depends on other factors

Ans. B

Sol. Low temperature decreases the strength of concrete in the short term because the hydration process slows down due to the low temperature.

114. The bar bending schedule is prepared to
A. i. calculate the quantity of reinforcing bars
B. ii. Calculate quantity of binders
C. iii. Calculate quantity of stirrup
D. Both i and iii

Ans. D

Sol. Bar bending schedule are prepared to estimate the quantity of steel work including reinforcing bars and stirrup.

115. Bending and binding of steel is measured in

A. cum B. sqm

C. Quintal D. Number

Ans. C

Sol. Bending and binding of steel is measured in quintal.

116. In the absence of detail design, the percentage of steel in concrete in the beams can be taken as

A. 0.7 to 1% B. 1 to 2%

C. 1 to 5% D. 0.5 to 0.8%

Ans. B

Sol. In the absence of detail drawing, the percentage of steel in concrete can be taken as 1 to 2% in case of beams.

117. In the estimation of plastering surface the deductions are not made for _____.

A. ends of beams B. ends of rafters

C. small openings upto 0.5 m^2 D. All of the above

Ans. D

Sol. In estimation of plastering surface the deduction are not made for small opening up to 0.5 m^2

118. For estimation of painting area of corrugated steel sheets, percentage increase in area above the plain area is _____.

A. 10% B. 14%

C. 20% D. 25%

Ans. A

Sol. The %increase over plain area for estimation of painting area is 10% for the corrugated steel sheets.

119. Calculate the primary estimate including contractor's profit in rupees for the building having a plinth area of 1,500 square meters and a rate of Rs.2,000 per square meter.

A. 30,00,000 B. 31,50,000

C. 33,00,000 D. 35,00,000

Ans. C

Sol. Primary estimate = plinth area * plinth area rate =1500*2000=3000000 Rs

Contractor profit is 10% of the primary estimate

Total estimate = 1.1*3000000= Rs. 3300000

120. Calculate the cost of the plastering required for a wall of 4 m long, 3.5 m high and 300 mm thick, if the rate of plastering is Rs. 12 per square meter. (Assume both side plastering is done)

A. 101 B. 168

C. 336 D. 423

Ans. C

Sol. $Cost\ of\ plastering(both\ sides\ of\ wall)$

$= 2 \times (Surface\ area \times rate\ of\ plastering)$

$= 2 \times (3.5 \times 4 \times 12)$

$= Rs.336$

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