MEGA MOCK CHALLENGE

BYJU'S EXAM PREP

JKSSB JE

Civil Engineering

Mini Mock Challenge

(September 29th - September 30th 2021)

Questions & Solutions

1. Consider the following assumptions of Bowditch method:

1) Angular measurements are more precise than linear measurements

2) Linear measurements are more precise than angular measurements

3) Error in linear measurements are proportional to square root of its length.ga

4) Correction to latitude or departure of any side

= Total error in L (or) D × length of the line/perimeter of the traverse

Which of these statements are correct?

A. 3 and 4 B. 1, 2 and 3

C. 2, 3 and 4 D. 1 and 3

Ans. A

Sol. Assumptions of Bowditch method.

→ Angular & linear measurements taken as some precision.

→ Errors in linear measurement is directly proportional to $\sqrt{\ell}$.

→ Errors in angular measurement are inversely proportional to $\sqrt{\ell}$.

→ Correction to attitude or departure of any side

= Total error in L or D × $\left(\frac{\text{length of that side}}{\text{perimetor of traverse}}\right)$

So, option (A) is correct

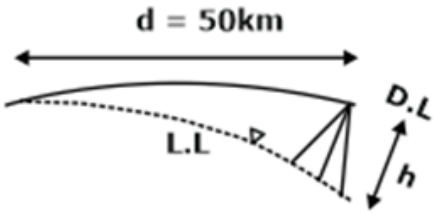
2. A lighthouse is visible just above the horizon at a certain station at the sea level. The distance between the station and the lighthouse is .

A. 168.25 m B. 33 .65 m

C. 179.35 m D. 287.50 m

Ans. A

Sol. (A) 168.25



Consider lower is at horizon and it will be just visible after considering curvature correction & refraction correction, i.e. combined correction.

C = h = 0.0673 k

Where, dis distance in km

h is height of object.

Given distance is 50 km.

So, height, h = 0.0673 $(50)^2$

$\boxed{h = 168.25m}$

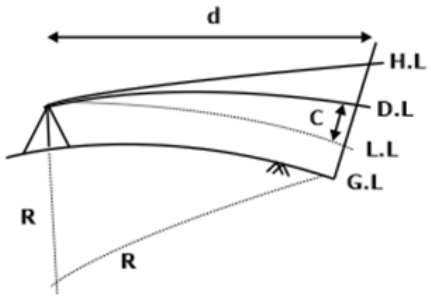
3. The combined correction due to curvature and refraction (in m) for distance of 1 km on the surface of the earth is _____.

A. 0.763 B. 0.673

C. 7.63 D. 0.0673

Ans. D

Sol. Correct option is (d) 0.0673



⇒ Correction due to Earth curvature

$$C_c = \frac{d^2}{2R}$$

$$= \left(\frac{d^2}{2 \times 6370}\right) \times 1000$$

$= 0.0785d^2$

Which is always negative

⇒ Refraction correction is considered as $\frac{1}{7} C_C$

$$C_R = \frac{1}{7} C_C$$

Always positive.

Total correction $C = -C_C + C_R$

$= -0.0785d^2 + \frac{1}{7} \times 0.0785d^2$

$= 0.0673d^2$

For d = 1Km

$\boxed{C = 0.0673}$

4. Consider the following surveys involved in the selection of alignment of a road:

1) Map study

2) Preliminary survey

3) Reconnaissance

4) Detailed survey

The correct sequence of these survey is

A. 1, 2, 3 and 4 B. 1, 3, 2 and 4

C. 1, 4, 2 and 3 D. 2, 1, 3 and 4

Ans. B

Sol. Correct option (B) 1,3,2 & 4.

Steps of survey for highway alignment

(a) Map study:- Various highway allurements drawn using contour maps, topographical maps & cadastral map. And best one is chosen.

(b) Reconnaissance: - It is done by site location to identify those features which are not available on maps.

(c) Preliminary survey:- Traversing, levelling, traffic study, material location, soil investigation and highway alignment is realised.

(d) Detailed survey:- Planning, designing, estivation, methodology along with the finalised alignment and DPR is prepared.

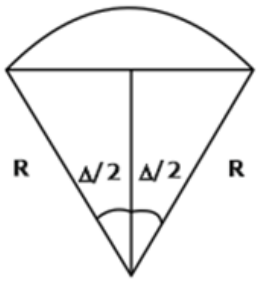
5. If a radius of a circular curve is 100 m, deflection angle is 90°, the length of long chord is _____.

A. Zero
B. 100 m
C. infinity
D. 141.42 m

Ans. D

Sol. Correct option (d) 141.42

Given:-



Radius of circular curve = 100m

Deflection angle = Δ = 90°

Length of lang chord = ?

$$L = 2R\sin\frac{1}{2}$$

$$= 2\times 100\times \sin\left(\frac{90^\circ}{2}\right)$$

$$= 2\times 100\times \frac{1}{52} = 141.42\text{m}$$

$$\boxed{L = 141.42\text{m}}$$

6. A body is subjected to a direct tensile stress of 400 MPa in one plane accompanied by a simple shear stress of 150 MPa. The maximum normal stress will be

A. –100 MPa
B. 150 MPa
C. 450 MPa
D. ?550 MPa

Ans. C

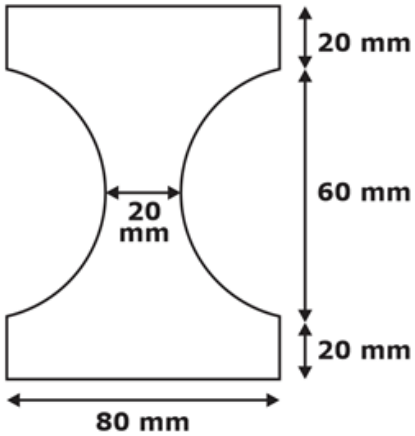
Sol.

$$\sigma_{max,\,min} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$= \frac{400}{2} \pm \sqrt{\left(\frac{400}{2}\right)^2 + 150^2}$$

σ_{max} = 450 MPa

7. A steel section as shown in figure is subjected to a shear force of 20 kN. What will be shear stress at the centre of section?



A. 20.4 MPa
B. 13.6 MPa
C. 16.6 MPa
D. 11.4 MPa

Ans. B

Sol.

$$I_{xx} = \frac{80 \times (100)^3}{12} - \frac{\pi}{64}(60)^4 = 6.03 \times 10^6 \text{ mm}^4$$

$$A\bar{y} = [80 \times 50 \times 25] - \frac{\pi}{2}(30)^2 \times \frac{4 \times 30}{3\pi} = 82000 \text{ mm}^3$$

b = 20 mm

$$\tau = \frac{VA\bar{y}}{Ib} = \frac{20 \times 10^3 \times 82000}{6.03 \times 10^6 \times 20} = 13.60 \text{ MPa}$$

8. The bursting pressure for a cold drawn seamless steel tubing of 60mm inside diameter with 2mm wall thickness is (the ultimate strength of steel is 380 MN/m^2)

A. 25.33 MN/m^2
B. 24.33 MN/m^2
C. 26.33 MN/m^2
D. 50.66 MN/m^2

Ans. A

Sol. Bursting or circumferential stress, $\sigma_c = \frac{Pd}{2t}$

$$380 = \frac{P \times 60}{2 \times 2}$$

P = 25.33 MN/m^2

9. The eccentricity in a hollow circular column of external diameter 25cm, internal diameter 15cm for an eccentric load of 1000kN for no – tension condition is

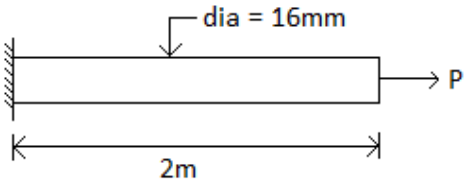
A. 2.75 cm
B. 3.00 cm
C. 2.50 cm
D. 4.25 cm

Ans. D

Sol.

$$e = \frac{D^2 + d^2}{8D} = \frac{25^2 + 15^2}{8 \times 25} = \frac{850}{200} = 4.25\,cm$$

10. A steel rod as shown is figure possesses an elastic strain energy of 15.70 N – m. Taking Young's modules as 200 Gpa, the required yield strength in Mpa) of the steel, if the factor of safety with respect to permanent deformation is 4.0:



A. 250
B. 240.8
C. 230.8
D. 225

Ans. A

Sol. Strain energy $U = \frac{1}{2} \times \sigma \times \epsilon \times V = \frac{\sigma^2}{2E} \times V$

Where, $V = \frac{\pi}{4} \times 16^2 \times 2 \times 10^3$= 402123.86 mm^3

Now,

$\frac{\sigma^2}{2E} \times V = 15.7 \times 10^3 \times 4$ [[$\because$ F.O.S. = 4]

$\Rightarrow \frac{\sigma^2}{2 \times 2 \times 10^5}$ x 402123.86 = 15.7 x 4 x 10^3

Which gives, σ = 250 MPa

11. A column is fixed at both ends. The material of the column has Young's modules of elasticity, E = 190 kN/mm^2. Crushing stress, σ_c= 225 N/mm^2. The slenderness ratio should be:

A. less than 92.72
B. More than 72.54
C. Less than 72.54
D. More than 92.72

Ans. D

Sol. Slenderness ratio, $\lambda = \frac{l_e}{r}$

$$\frac{P_{cr}}{A} = \frac{\pi^2 EI}{Al_e^2} = \frac{\pi^2 E(Ar^2)}{Al_e^2} \left(\because r = \sqrt{\frac{I}{A}} \right)$$

$$\Rightarrow \frac{P_{cr}}{A} = \frac{\pi^2 E}{\lambda^2}$$

$$\Rightarrow \lambda > \sqrt{\frac{\pi^2 E}{\lambda^2}} = \sqrt{\frac{\pi^2 \times 190 \times 10^3}{225}} = 92.72$$

12. Hoop strain in a cylindrical vessel is 3.5 times the longitudinal strain. The value of Poisson's ratio is:

A. 0.25 B. 0.27

C. 0.30 D. 0.33

Ans. A

Sol. Hoop strain is cylindrical vessel = $\frac{pd}{4tE}(2-\mu)$

Longitudinal strain = $\frac{pd}{4tE}(1-2\mu)$

As given,

$$\frac{pd}{4tE}(2-\mu) = 3.5\left[\frac{pd}{4tE}(1-2\mu)\right]$$

$$\Rightarrow 2-\mu = 3.5-7\mu$$

Which gives,

μ = 0.25

13. In the conventional pre-stressing, the diagonal tension in concrete _____.

A. increases B. decreases

C. does not change D. may increase or decrease

Ans. B

Sol. In the conventional pre-stressing, the diagonal tension in concrete decreases , due to induced shear stress in the beam a complimentary shear applied at diagonal to maintain the equilibrium , this complimentary shear creates a diagonal tension, and this tension is neutralized by pre stressing.

14. If a concrete column 200 x 200 mm in cross-section is reinforced with four steel bars of 1200 mm^2 total cross-sectional area. What is the safe load for the column if permissible stress in concrete is 5 N/mm^2 and E_s =15 E_c?

A. 264 kN B. 274 kN

C. 284 kN D. 294 kN

Ans. C

Sol. Permissible stress in steel/permissible stress in concrete = Es/Ec.

Permissible stress in steel = 5 * 15Ec/Ec = 75 N/mm^2

Now,

P = 5 x (200 x 200 - 1200) + (1200 x75) = 284000N = 284 kN

15. Which of the following statements is true?

A) Impact loads are equal to the sum of the magnitude of the loads actually caused and the magnitude of the loads had they been dead loads.

B) Impact loads are equal to the difference between the above mentioned entities.

A. Only A B. Only B

C. Both A and B D. Neither A nor B

Ans. B

Sol. Impact Loads are the loads which are caused due to the sudden application of loads with an impact and can be stated as the difference of actual load and dead loads. For linear elastic loading Impact load is twice of gradual load.

16. If σ_a is the stress in bar and τ_{bd} is the design bond stress, then the development length of a bar of diameter φ is given by

A. $\frac{4\phi\sigma_a}{\tau_{bd}}$ B. $\frac{\phi\sigma_a}{4\tau_{bd}}$

C. $\frac{2\phi\sigma_a}{3\tau_{bd}}$ D. $\frac{\phi\sigma_b}{3\tau_{bd}}$

Ans. B

Sol. To calculate tension or compression in any bar at any section by an appropriate development length or end anchorage

Development length L_d is given by,

$L_d = \frac{\phi\sigma_a}{4\tau_{bd}}$

Where,

Φ = nominal diameter of bar

σ = shear in bar at the section considered as design load

τ_{bd} = design bond stress

17. The floor slab of a building is supported on reinforced cement floor beams. The ratio of the end and intermediate spans is kept at _____.

A. 0.7 B. 0.8

C. 0.9 D. 0.6

Ans. C

Sol. The floor slab of a building is supported on reinforced cement floor beams. The ratio of the end and intermediate spans is kept at 0.9

18. In a RC frame structures, square columns are provided of side 500 mm. Percentage of reinforcement of grade Fe415 is 4%. For M20 grade of concrete, factored axial load that a single column can resist is

A. 441 kN B. 44100 N

C. 4700.5 kN D. 441 N

Ans. C

Sol. Gross area of column, $A_g = 500 \text{ x } 500 = 250000 \text{ mm}^2$

Percentage of steel, p = 4%

Area of steel, $A_{sc} = A_g x \frac{p}{100}$

$A_{sc} = 250000x\frac{4}{100} = 10000 \text{ mm}^2$

Area of concrete, $A_c = A_g - A_{sc}$

$A_c = 250000 - 10000 = 240000 \text{ mm}^2$

Strength of concrete, $f_{ck} = 20\ N/mm^2$

Strength of steel, $f_y = 415\ N/mm^2$

Factored axial load at each column, $P_u = 0.4A_c f_{ck} + 0.67A_{sc} f_y$

$P_u = 0.4x240000x20 + 0.67x10000x415$

$P_u = 1920000 + 2780500 = 4700500\ N = 4700.5\ kN$

19. If W is total load per unit area on a panel, D is the diameter of the column head, L is the span in two directions, then the sum of the maximum positive bending moment and average of the negative bending moment for the design of the span of a square flat slab, should not be less than.

A) $\frac{WL}{12}\left(L-\frac{2D}{3}\right)^2$ B) $\frac{WL}{12}\left(L+\frac{2D}{3}\right)^2$

C) $\frac{WL}{10}\left(L-\frac{2D}{3}\right)^2$ D) $\frac{WL}{12}\left(L-\frac{D}{3}\right)^2$

A. Only A B. Only B

C. Only C D. Only D

Ans. C

Sol. The sum of the maximum positive bending moment and average of the negative bending moment,

$M = WL/10\ (L - 2D/3)^2$

Where,

W = total load on panel

L = length of span in two direction

D = diameter of the column head

20. Which of the following is not a post tensioning method of prestressing?

A. Freyssinet System B. Magnel Blaton System

C. Hoyer System D. Gifford Udall System

Ans. C

Sol. Major post tensioning methods are:

(i) Freyssinet System

(ii) Magnel Blaton System

(iii) Lee Mccall System

(iv) Gifford Udall System

Hoyer system is pre tensioning method of prestressing.

21. 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

22. The cell pressure and pore water pressure is increased from 0.1 N/sq. m to 0.26 N/sq. m and 0.07 N/sq. m to 0.15 N/sq. m respectively in the triaxial test. The Skempton's pore pressure parameter is given _____.

A. -3 B. -0 .5

C. 0.5 D. 2

Ans. C

Sol. skempton's pore pressure = $\frac{change\,in\,pore\,pressure}{change\,in\,cell\,pressure}$

$$= \frac{0.15-0.07}{0.26-0.1} = 0.5$$

23. 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), $i = h/L$

24. 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

25. 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. $$\Delta H = H_o \frac{\Delta e}{1+e_o}$$

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

Hence the final thickness= 2.4-0.6=1.8cm

26. A wooden plank (Specific Gravity = 0.5) 1 m x 1 m x 0.5 m floats in water with 1.5 KN load on it with 1 m x 1 m surface horizontal. The depth of plank lying below water surface shall be:

A. 0.178 m B. 0.250 m

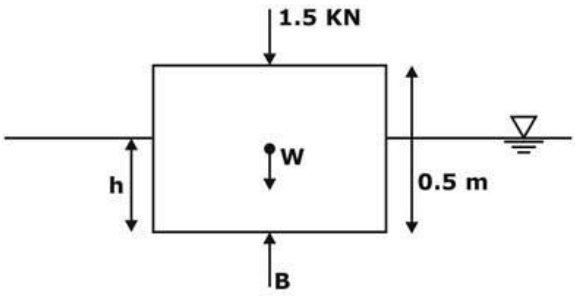
C. 0.403 m D. 0.500 m

Ans. C

Sol. Volume of the plank V = 0.5 m^3

Let the depth of plank below water surface is h.

Submerged volume V_s = h m^3



1.5 + w – B = 0

B = 1.5 + w = 1.5 + 0.5 x 0.5 x 0.5 x 10 = 4 KN

$v_s \rho_w g$ = 4 KN

h x 1 x 10 = 4

h = 0.4 m

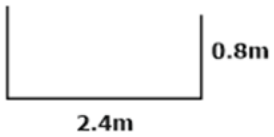
27. Water flows in a 2.4-m-wide, rectangular, finished concrete channel (Manning's rugosity coefficient, n = 0.012) at a depth of 80 cm. If the the flow rate is nearest

A. 2.4 m^3/s B. 3.4 m^3/s

C. 4.4 m^3/s D. 6.0 m_3/s

Ans. C

Sol. Correct option (c) 4.4



Given: Rectangular channel

Width B = 2.4m

Depth d = 0.8m

Manning coefficient, n = 0.012

Slope, S = 0.002013

Discharge, $Q = \frac{1}{n} AR^{2/3} s^{1/2}$

$A = B \times d = 2.4 \times 0.8 = 1.92m$

$R = \frac{A}{p}, \quad P = (2 \times 0.8) + 2.4 = 4m$

$R = \frac{1.92}{4} = 0.48m$

$Q = \frac{1}{0.012} \times 1.92 \times (0.48)^{0.667} (0.002013)^{1/2}$

$\boxed{Q = 4.4m^3 / s}$

28. A viscometer constructed of two 30-cm-long concentric cylinders is used to measure the viscosity of a fluid. The outer diameter of the cylinder and the gap between the two cylinders is 0.18 cm. The inner cylinder is rotated at 250 rpm, and the torque is measured to be 1.4 N.m. The viscosity of fluid is

A. 0.062 N.s/m^2 B. 0.0084 N.s/m^2

C. 0.56 N.s/m^2 D. 0.0049 N.s/m^2

Ans. C

Sol. Correct option (c) 0.56 N.S/m^2

Given:- In a concentric cylinder.

Length = 30cm = 0.3m

Outer dia = 9.36cm

Gap = 0.18cm = 0.0018m

Rotation speed = 250 rpm = $\frac{250}{60}$ rps

torque = 1.4 N.m

$\mu = \frac{T \cdot l}{4\pi^2 R^3 \cdot n \cdot L}$

Where T = torque.

l = gap

L = Length

R = inner radius

$$\mu = \frac{1.4 \times 0.0018}{4 \times \pi^2 \times 0.045^3 \times \frac{250}{60} \times 0.3}$$

$$\boxed{\mu = 0.56 Ns/m^2}$$

29. The drag on a 10-m-diameter spherical water storage tank in an 80 km/h wind (with air density of 1.23 kg/m^3) and coefficient of drag is approximately:

A. 4770 N
B. 2385 N
C. 6361 N
D. 3181 N

Ans. A

Sol. Option (A) 4770 is correct

Given, dia d = 10m

Wind velocity v = $80\frac{km}{h} = 22.22 m/sec$

Air density = 1.23 kg/m^3

Cd = 0.2

Using Drag, force formula

$$F_D = \frac{1}{2}\rho V^2 \times CD \times A$$

$$= \frac{1}{2} \times 1.2.3 \times 22.22^2 \times 0.2 \times \frac{\pi}{4} \times 10^2$$

F_D = 47.70 N

30. Air (R=0.287 kJ/kg.K) flows through an 8-cm-diameter pipe with an average velocity of 70 m/s with a temperature of 20°C and a pressure mass flux is nearest:

A. 2.37 kg/s
B. 3.70 kg/s
C. 0.84 kg/s
D. 1.26 kg/s

Ans. A

Sol. Given,

R = 0.287 kj/ kg. k

T = 20°C = 20 + 273 = 293 k

P = 200 kPa

Calculating (density) of air

Pv = MRT ρ = m/v

$$\rho = \frac{P}{RT} = \frac{200 \times 10^3}{0.287 \times 10^3 \times 2 \times 3}$$

ρ = 2.378 kg/m^3

31. Flow around an underwater structural component is to be studied in a 20 °C-wind tunnel with a 10:1 scale model. What speed should be s tunnel to simulate an actual 10 °C water speed of 5.0 m/s? Take kinematic viscosity of water as 1.31 × 10^{-6} m^2/sec and 1.51 × 10^5 m^2/sec °C respectively.

A. 576.3 m/s
B. 57.63 m/s
C. 5.76 m/s
D. 50.0 m/s

Ans. C

Sol. Given: Scale 10:1

For an under water structural component model & its

Prototype	Model	Prototype
Temperature	10°C	20°C
kinematic viscosity	1.51×10^{-5}	1.31×10^{-6}
Velocity V	5M/S	?

Equating Reynolds number of model & prototype

$$\left(\frac{VD}{\nu}\right)_{model} = \left(\frac{VD}{\nu}\right)_{prototype}$$

$$\frac{V_m}{V_p} = \frac{D_p}{P_m} \times \frac{\nu_m}{\nu_m}$$

$$\left\{\frac{D_f}{P_m} = \frac{10}{1} \quad Sade10:1\right\}$$

$$\frac{V_m}{V_p} = \frac{10 \times 1.31 \times 10^{-6}}{1.51 \times 10^{-5}}$$

$$V_p = \frac{1.51 \times 10^{-5}}{10 \times 1.31 \times 10^{-6}} \times V_m \quad \{V_m = 5m/s\}$$

$$\boxed{V_p = 5.76m/s}$$

32. The SI unit of kinematic viscosity is:

A. m/s^2 B. m^2/s

C. m^3/s^2 D. kg/m-s

Ans. B

Sol. SI unit Kinematic visocity = m^2/sec

SI unit Dynamic viscosity = kg/m-sec

33. A regime canal carries silt of size 0.25 mm. If the velocity of 0.44 m/sec then hydraulic mean depth will be

A. 0.55 m B. 0.97 m

C. 1.03 m D. 1.25 m

Ans. A

Sol. $f = 1.76\sqrt{0.25} = 0.88$

$R = 2.5\frac{V^2}{f} = 2.5 \times \frac{0.44^2}{0.88} = 0.55$ m

B. Both statement (I) and 34. Statement (I): Installation of water meters in the field will decrease the 'Duty' of water for that field.

Statement (II): Due to installation of water meter, the farmer will use water more economically.

A. Both statement (I) and statement (II) are individually true; and statement (II) is the correct explanation of statement (I).

statement (II) are individually true; but statement (II) is NOT the correct explanation of statement (I).

C. Statement (I) is true; but statement (II) is false

D. Statement (I) is false; but statement (II) is true

Ans. D

Sol. Due to installation of water meter in the field, the farmer will use the water more economically, hence same area of field can be irrigated by lesser amount of water. Hence duty will be high.

35. Match list-I with list-II and select the correct answer using the codes given below the lists:

List-I	List-II
a. Mean velocity in lined channel.	**1.** $S^{1/2}$
b. Mean velocity in Lacey's regime channel.	**2.** $S^{1/3}$
c. Wetted perimeter of a Lacey's regime channel.	**3.** $Q^{2/3}$
d. Normal scour depth in an alluvial channel.	**4.** $Q^{1/2}$.

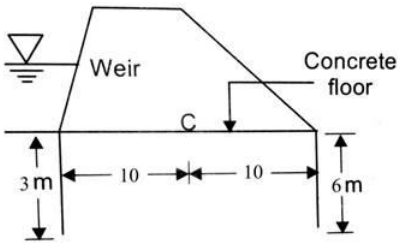
Here, S = Bed slope, Q = discharge

A. a-1 b-2 c-4 d-3 B. a-3 b-4 c-2 d-1

C. a-1 b-3 c-2 d-4 D. a-3 b-1 c-4 d-2

Ans. A

36. What is the thickness of floor of the weir shown below in figure, if the relative density of the concrete is 2.5 and uplift pressure head is 2m?



A. 0.52 m B. 0.63 m

C. 0.74 m D. 0.80 m

Ans. D

Sol. Total uplift force = 2 x (γ_w)x 20 x 1

Thickness of floor = $\frac{F_{uplift}}{Area \times \gamma_{concrete}} = \frac{2 \times \gamma_w \times 20 \times 1}{20 \times 1 \times \gamma_w \times 2.5}$ = 0.8 m

37. A certain crop is grown in an area of 2000 hectares, which is fed by a canal system. The data pertaining to irrigation are as follows:
Field capacity of soil = 25% ; Optimum moisture = 10% ; Permanent wilting point = 8% ; Effective Depth of root zone = 75cm ; Apparent relative density of soil = 1.4.
If the frequency of irrigation is 10 days and the overall irrigation efficiency is 20% then water discharge required in the canal, feeding the area, is

A. 18.23 m^3/sec
B. 20.66 m^3/sec
C. 24.79 m^3/sec
D. 36.45 m^3/sec

Ans. A

Sol. Depth of water used by plants for growth, which is supplemented by irrigation after every 10 days = $\frac{\gamma_d}{\gamma_w} \times d \times (FC - OMC)$

$= \frac{1.4}{1} \times 75 \times (0.25 - 0.10) = 15.75$ cm

Daily consumptive use = $\frac{15.75}{10} = 1.575$ cm

Total irrigation water required i.e. losses in field and conveyance = $\frac{N.I.R.}{\eta_{irrigation}}$

$= \frac{1.575}{0.20} = 7.875$ cm/day

Discharge required in irrigation canal = $\frac{7.875 \times 2000 \times 10^4}{100 \times 24 \times 60 \times 60} = 18.23$ m^3/sec

38. 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.

39. A mixed liquor with 2500 mg/l of suspended solids has the settled volume of 225 ml from a liter of this mixed liquor. Its sludge volume index is

A. 75 ml/g
B. 90 ml/g
C. 120 ml/g
D. 135 ml/g

Ans. B

Sol. Settle sludge volume, V = 225 ml
Concentration of suspended solids in mixed liquor, X = 2500 mg/l
Sludge Volume index, $\mathrm{SVI} = \frac{\mathrm{V}}{\mathrm{X}} \mathrm{x} 1000\ \mathrm{ml/g}$

$\mathrm{SVI} = \frac{225}{2500} \mathrm{x} 1000 = 90\ \mathrm{ml/g}$

40. Due to super-saturation of water body with dissolved oxygen cause

A. Eutrophication
B. Gas Bubble dieses in fish
C. Methemoglobinemia
D. Endemic goiter

Ans. B

Sol. i) Eutrophication is an enrichment of water by nutrient salts that causes structural changes to the ecosystem such as: increased production of algae and aquatic plants, depletion of fish species, general deterioration of water quality and other effects that reduce and preclude use.

ii) Gas bubble disease is associated with the super-saturation, with nitrogen or oxygen, of the water in which fish are kept. It occurs when the total pressure of gases dissolved in water is higher than the ambient atmospheric pressure.

iii) Methemoglobinemia is a blood disorder in which too little oxygen is delivered to your cells. Oxygen is carried through your bloodstream by haemoglobin, a protein that's attached to your red blood cells.

iv) Endemic goitre is a type of goitre that is associated with dietary iodine deficiency. Some inland areas where soil and water lacks in iodine compounds and consumption of marine foods is low are known for higher incidence of goitre. In such areas goitre is said to be "endemic".

41. For a grit channel, if the recommended flow velocity is 0.25 m/s and the detention period is 1 minute, then length of the tank is:

A. 15 m
B. 25 m
C. 32.5 m
D. 40 m

Ans. A

Sol. Length = Flow velocity x Detention time

Length = 0.25 x 60

Length = 15 m

42. Compute the theoretical oxygen demand of the water that contains 25 mg/l of benzene?

A. 64 mg/l
B. 70 mg/l
C. 72 mg/l
D. 77 mg/l

Ans. D

Sol. The equation for the total oxidation of benzene is given as:

$C_6H_6 + 7.5\ O_2 = 6CO_2 + 3\ H_20$

78 gm of benzene reacts with 240 gm of oxygen to give 264 gm of carbon dioxide and 54 gm of water

Total theoretical oxygen demand = $\frac{240}{78}\ x\ 25$ = 77 mg/l

43. On a hill road a ruling gradient of 5% is provided and has a radius of horizontal curve of 50 m. Design speed on the road is 50 kmph. The gradient of the curve is _____ %.

A. 3 %
B. 3.5 %
C. 4 %
D. 4.5 %

Ans. C

Sol. When there is horizontal curve in addition to gradient then there will be increased resistance to traction due to both curve and gradient. Therefore, it is necessary to compensate gradient at horizontal curve.

Grade compensation (G.C%) = $\min\begin{Bmatrix}(30+R)/R\\75/R\end{Bmatrix}$

$= \min\begin{Bmatrix}1.6\\1.5\end{Bmatrix} = 1.5\%$

Compensated gradient = Gradient – GC

= 5 – 1.5 = 3.5%

According to IRC, grade compensation is not necessary for gradient flatter than 4%.

So, option © 4% is correct answer.

44. The design speed of a highway is 80 km/hr and the radius of circular curve is 150 m in plain topography. Which of the following is the min radius of transition curve?

A. 120 m B. 142 m

C. 174 m D. 85 m

Ans. B

Sol. Correct option (B) 142m.

Explanation:-

Given,

Design speed = 80 km/hr.

Radius of curvature, R = 150m

Length of transition curve ;-

Criteria Ist

$$L_T = \frac{(0.278V)^3}{CR}$$

Here, V = Design speed in km/hr

C = Rate of change of acceleration

R = radius of curvature

$$c = \frac{80}{v+75} = \frac{80}{80+75} = \frac{80}{155} = 0.516$$

$$L_T = \frac{(0.278\times 80)^3}{0.516\times 150} = 142m$$

Criteria 2:-$L_1 = \frac{2.7V^2}{R}$ (for plain terrain)

$$= \frac{2.7\times(80^2)}{150}$$

= 115.2

Criteria 3:-

150x

$x = e\ (w + w_e)$

Where, e = superelevation

w = width of lane

w_e = extra widening.

Since, no data is available to calculate these terms we will consider only criteria 1 & 2

So, L_T will be max of L & 2.

$\boxed{L_T = 142m}$

45. A vehicle moving at 60 kmph on an ascending gradient of a highway has to come to stop position to avoid collision with a stationary object with lag distance 6m. Considering total reaction time of the driver as 2.5 seconds and coefficient of longitudinal friction as 0.36, the ascending gradient (%) is

A. 3.3 B. 6.8

C. 4.8 D. 5.3

Ans. C

Sol. Correct option (c) 4.8%

Given for SSD.

Design speed = 60km/hr, reaction time = 2.5 sec.

$$\frac{\text{Lag distance}}{\text{Braking distance}} = \frac{6}{s}, \text{coefficient of longitudinal friction}$$

$$0.36$$

$$\frac{0.278 \times V_D \times t_e}{\frac{V^2}{254(f \pm s)}} = \frac{6}{s} \Rightarrow \frac{0.298 \times 60 \times 2.5}{\frac{60^2}{254(0.36 + s)}} = \frac{6}{s}$$

S = 0.048

$\boxed{S = 4.8\%}$ ascending gradient.

46. Reaction time of driver increases with

A. increase in vehicle length B. decrease in vehicle speed

C. increase in vehicle speed D. decrease in vehicle length

Ans. B

Sol. If the speed is less, the reaction time increases due to the fact that driver is less attentive.

47. In which of the following solvents bitumen dissolves?

1) Carbon disulphide

2) Carbon tetrachloride

3) Benzene

4) Naphtha

A. 2 and 3 B. 1 and 4

C. 3 and 4 D. 1 and 2

Ans. D

Sol. Bitumen dissolves in carbon disulphide and carbon tetrachloride solvent

Option (D) 1 and 2 is correct.

48. The speed density (u – k) relationship on a single lane road with unidirectional flow is u = 65 – 0.8 K where u is in km/hr and K is in Vehicle capacity of the road is _____ vehicles/hr.

A. 1410 B. 1350

C. 1450 D. 1320

Ans. D

Sol. Given

Speed density (u-k) relationship

U = 65 – 0.8k

Capacity of road is calculated by using formula

c = 4 × k

= (65 – 0.8) × k

c = 65 k – 0.8 k^2 (i)

⇒ for capacity $\frac{dc}{dk} = 0$

65 – 2 × 0.8k = 0

k = 40.625

Putting value of k in eq. (i)

C = 65 × 40.625 – 0.8 × 40.625 × 40.625

C = 1320 vehicles / hr.

Option (d) = 1320 is correct.

49. Desire lines are plotted in

A. Origin and destination studies B. Speed studies

C. Axle load studies D. None of these are correct

Ans. A

Sol. Desire lines are the lines plotted where the movement of traffic is more. These lines are plotted in origin and destination studies and show the potential movement of the traffic. Desire lines are used to plan the development of new roads.

50. Which type of coordinated signal system is not conductive to give continuous movement of all vehicles as given in IRC 93-1985?

A. Flexible progressive system B. Limited progressive system

C. Simple progressive system D. Simultaneous system

Ans. D

Sol. Simultaneous system does not give continuous movement.

51. One degree of curve is equivalent to

A. $\frac{1600}{R}$ B. $\frac{1700}{R}$

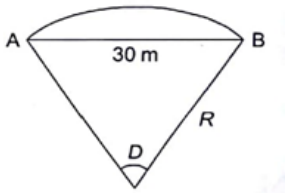
C. $\frac{1720}{R}$ D. $\frac{1820}{R}$

Ans. C

Sol. Degree of curve is defined as the central angle to the ends of an arc or chord of agreed length standard chord length used in railways and highways is 30m

Since R>>30m

$\overline{AB} \approx \overset{\frown}{AB}$



From arc principle

$$R \times \left(D \times \frac{\pi}{180} \right) = 30$$

$$R = \frac{30 \times 180}{\pi D} = \frac{1718}{D} \approx \frac{1720}{D}$$

52. The reception signal is

A. Advanced starter only
B. Starter only
C. None of the other options provided
D. Both Advanced starter and Starter

Ans. C

Sol. Reception signals $\rightarrow$ Other and home signals

Departure signals $\rightarrow$ Starter and advance starter signals

53. Reinforcement bars are spaced at 150 mm centre to centre spacing in a slab spanning 4500 mm. Calculate the number of bars in the slab.

A. 29
B. 30
C. 31
D. 32

Ans. C

Sol. Number of bars = $\frac{Span}{Spacing} + 1 = \frac{4500}{150} + 1 = 31$

54. Overhead expenses on a project are included in

A. Indirect cost
B. Direct cost
C. Variable cost
D. Fixed cost

Ans. A

55. Pick up the **incorrect** statement :

A. CPM is an activity oriented network
B. PERT is event oriented
C. Slack for any event may be positive, zero or negative
D. Float is always negative

Ans. D

Sol. A float is the range within which start or finish time of an activity may fluctuate without affecting project completion time.

Floats cannot be negative.

56. Whenever the whitewashing or distempering is done on corrugated iron sheets, in the estimation the plan area of the sheets is increased by _____.

A. 2%
B. 7%
C. 10%
D. 14%

Ans. D

Sol. Due to corrugation the plan area estimate increase by 14%

57. The estimate prepared on the basis of the built-up covered area at the floor level of any storey of a building is known as:

A. Building cost index estimate
B. Cubical content method
C. Unit base method
D. Plinth area estimate

Ans. D

Sol. Plinth area estimate: The cost of construction is determined by multiplying plinth area with plinth area rate. The area is obtained by multiplying length and breadth (outer dimensions of building). In fixing the plinth area rate, careful observation and necessary enquiries are made in respect of quality and quantity aspect of materials and labour, type of foundation, height of building, roof, wood work, fixtures, number of storey's etc.

58. _____ recognizes that a project or phrase should begin and commits the organization to do so:

A. Initiating Process
B. Solicitation Process
C. Scoping process
D. Planning process

Ans. A

Sol. Creation of project character is the specific activity that is done in the Initiating process.

59. Which of the following activity is non-critical in the project given in the table below?

Activity	Predecessor	Duration	Cost slope	Workers/day
P	-	3	20	5
Q	-	4	30	4
R	P	4	25	4
S	P,Q	3	25	5
T	R	3	15	5
U	R,U	4	55	4

A. P
B. R
C. T
D. U

Ans. C

Sol. Non-critical activity is the one, which has least cost slope, is activity T.

60. Injury frequency rate per lakh of man-hours worked is calculated as:

A. $\frac{No.\ of\ days\ lost\ x1,00,000}{No.\ of\ man-hours\ worked}$

B. $\frac{No.\ of\ disabling\ injuries\ x1,00,000}{Total\ No.\ of\ man-hours\ worked}$

C. $\frac{Injury\ frequency\ rate\ x\ Injury\ service\ rate}{1000}$

D. $\frac{No.\ of\ disabling\ injuries}{Total\ No.\ of\ man-hours\ worked}$

Ans. B

Sol. Injury frequency rate per lakh of man hours worked.

$$=\left(\frac{No.\ of\ disabling\ injuries}{Total\ No.\ of\ man-hours\ worked}\right)\times 100000$$

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