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ESE - 2020

PRELIMINARY EXAMINATION

Questions with Detailed Solutions

CIVIL ENGINEERING

(SET- A)

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01. When the deposit of efflorescence is more than 10% but less than 50% of the exposed area of the brick, the presence of efflorescence is
(a) Moderate (b) Slight
(c) Heavy (d) Serious

01. Ans: (a)

Sol: Efflorescence in bricks is classified as:
(i) **Nil:** If the deposit of efflorescence is imperceptible (0%)
(ii) **Slight:** If efflorescence is less than 10% of exposed brick area
(iii) **Moderate:** If efflorescence is between 10% and 50% of exposed brick area
(iv) **Heavy:** If efflorescence is more than 50% of the exposed brick area.

02. Mohs scale is used for stones to determine
(a) Flakiness index (b) Durability
(c) Strength (d) Hardness

02. Ans: (d)

Sol: Moh's scale is used for the determination of hardness of stones, The scale ranges from 1 to 10. Higher the number on the scale, the harder the stone.

03. Which of the following conditions are recommended for using sulphate resisting cement?
1. Concrete to be used in foundation and basement, where soil is not infested with sulphates.
2. Concrete used for fabrication of pipes which are likely to be buried in marshy region or sulphate bearing soils.
3. Concrete to be used in the construction of sewage treatment works
(a) 2 and 3 only (b) 1 and 2 only
(c) 1 and 3 only (d) 1, 2 and 3

03. Ans: (a)

Sol: Sulphate Resistant Cement (SRC) has a very low proportion of C_3A (<6%). This cement is used for the construction of foundations in polluted soils, marine structures, sewer lines and sewage treatment plant.

04. Which one of the following cements is a *deliquescent*?
(a) Quick setting Portland cement
(b) White and Coloured cement
(c) Calcium Chloride cement
(d) Water Repellent cement

04. Ans: (c)

Sol: Deliquesance is characterized by a strong affinity for water and tendency to absorb moisture from the atmosphere to form an aqueous solution. Some of the common deliquescent salts are calcium chloride, magnesium chloride, zinc chloride, ferric chloride, etc. Because of calcium chloride in calcium chloride cement, the cement has deliquesance.

05. Consider the following data for concrete with mild exposure:
Water - cement ratio = 0.50
Water = 191.6 litre
The required cement content will be
(a) 561 kg/m^3 (b) 472 kg/m^3
(c) 383 kg/m^3 (d) 294 kg/m^3

05. Ans: (c)

Sol: Given water cement ratio = 0.5
Water content = 191.6 liters
= 191.6 kgs

$$\text{Cement content} = \frac{191.6}{0.5}$$
$$= 383.2 \text{ kgs}$$

For mild exposure conditions, minimum cement

content = 300 kg/m^3 and maximum cement content = 450 kg/m^3.

Hence 383 kgs is the correct answer

06. The strength of a fully matured concrete sample is 500 kg/cm^2. When cured at an average temperature of 20°C in day, 10°C in night, datum temperature T_o is -11°C. If Plowman constants A is 32 and B is 54, the strength of identical concrete at 7 days will be nearly

(a) 333 kg/cm^2 (b) 312 kg/cm^2
(c) 272 kg/cm^2 (d) 243 kg/cm^2

06. Ans: (a)

Sol: Maturity = [(20 – (–11)) × 12 × 7] + [(10 – (–11) × 12 ×7]

= 4368 °C hours

% of ultimate strength

$$= A + B\log_{10}\frac{\text{Maturity}(^{\circ}\text{Chours})}{1000} \times \text{Plowman equation}$$

$$= 32 + 54\log_{10}\frac{4368}{1000}$$

= 66.58%

$$\Rightarrow 7\text{day strength} = \frac{66.58}{100} \times 500 \text{ kg/cm}^2$$

= 333 kg/m^2

07. A sample of concrete is prepared by using 500 g of cement with water cement ratio of 0.55 and 240 N/mm^2 intrinsic strength of gel. The theoretical strength of concrete on fully hydration will be nearly.

(a) 148 N/mm^2 (b) 126 N/mm^2
(c) 104 N/mm^2 (d) 82 N/mm^2

07. Ans: (c)

Sol: Powers and Brownyard have established the relationship between strength of concrete and gel space ratio.

Strength of concrete = Intrinsic strength of gel × (Gel – space ratio)^3

Given

Intrinsic strength of gel = 240 N/mm^2

$$\text{Gel space ratio} = \frac{0.657C}{0.319C + W}$$

C = Weight of cement used in grams

W = Volume of water in m*l*.

Given C = 500 gm

Wt of water = 0.55 × 500

= 275 gm

Volume of water = 275 m*l* (∵ Density of water 1 gm/cc)

$$\text{Get space ratio} = \frac{0.657 \times 500}{0.319 \times 500 + 275}$$

= 0.756

Strength of concrete = 240 × (0.756)^3 N/mm^2

= 104 N/mm^2

08. The cement and water slurry coming on the top and setting on the surface is called.

(a) Crazing (b) Efflorescence
(c) Sulphate deterioration (d) Laitance

08. Ans: (d)

Sol: Concrete laitance is a layer of weak and nondurable cement and fine particles originating from aggregates. These materials move upwards due to bleeding because of high water content, over compaction, etc.

09. Polymer concrete is most suitable for

(a) Sewage disposal works
(b) Mass concreting works
(c) Insulating exterior walls of an air-conditioned building
(d) Road repair works

09. Ans: (a)

Sol: Polymer concrete is a type of concrete where polymers replace cement as the binder. The low permeability and corrosive resistance of the concrete makes it suitable in the construction of sewage disposal works.

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10. Which one of the following limes will be used for finishing coat in plastering and white washing?
(a) Semi Hydraulic lime
(b) Kankar lime
(c) Magnesium/Dolomitic lime
(d) Eminently Hydraulic lime

10. Ans: (c)

Sol: According to IS 712-1973, lime is classified into 6 categories (i.e) class A, B, C,D,E &F.
Class D is magnesium or dolomite lime, which is used for finishing works of plastering and white-washing.

11. Which one of the following light weight element will be added to enhance the protective properties for X-ray shielding mortars?
(a) Sodium (b) Potassium
(c) Lithium (d) Calcium

11. Ans: (c)

Sol: Heavy mortars of bulk density over 220 kg/m^3 are used for plastering the walls & ceiling of x-ray rooms. Admixtures containing light weight elements like Lithium, Cadmium, etc are added to enhance the protective properties of this mortar.

12. Which one of the following stone is produced by moulding a mixture of iron slag and Portland cement?
(a) Imperial stone
(b) Garlic stone
(c) Ransom stone
(d) Victoria stone

12. Ans: (b)

Sol: Garlic stone is an artificial stone which is produced by mixing Portland cement and iron slag. This stone is used for surface drains and flag stones.

13. When a round bar material with diameter of 37.5 mm, length of 2.4 m, Young's modulus of 110 GN/m^2 and shear modulus of 45 GN/m^2 is stretched for 2.5 mm, its Bulk modulus will be nearly
(a) 104 GN/m^2 (b) 96 GN/m^2
(c) 84 GN/m^2 (d) 76 GN/m^2

13. Ans: (b)

Sol: d = 37.5 mm (extra data)
l = 2400 mm (extra data)
$E = 110 \times 10^3$ N/mm^2
$G = 42 \times 10^3$ N/mm^2
δl = 2.5 mm (extra data)
From
$E = 2G(1+\mu)$
$110 \times 10^3 = 2(42 \times 10^3)(1+\mu)$
$\mu = 0.31$
From
$E = 3k(1 - 2\mu)$
$(110 \times 10^3) = 3(k)(1-2 \times 0.31)$
$K = 96.49 \times 10^3$ MPa = 96.49 GPa
$\simeq$ 96GPa

14. A punch of 20 mm diameter is used to punch a hole in 8 mm thick plate. If the force required to create a hole is 110 kN, the average shear stress in the plate will be nearly
(a) 410 MPa (b) 320 MPa
(c) 220 MPa (d) 140 MPa

14. Ans: (c)

Sol: **Given:** Diameter of punch, d = 20 mm
Thickness of plate, t = 8 mm
Punching force = Shear resisting force
$110 \times 10^3 = \tau$ [Shearing area]
$= \tau [\pi . D.t]$
$110 \times 10^3 = \tau [\pi \times 20 \times 8]$
$\tau = 218.8$ MPa $\simeq$ 220 MPa

15. A reinforcement concrete circular section of 50,000 mm^2 cross-sectional area carries 6 reinforcing bars whose total area is 500 mm^2. If the concrete is not to be stressed more than 3.5 MPa and modular ratio for steel and concrete is 18, the safe load the column can carry will be nearly

(a) 225 kN (b) 205 kN
(c) 180 kN (d) 160 kN

15. Ans: (b)

Sol: Cross sectional area of column, A = 50, 000 mm^2
Area of reinforcement A_{st} = 500 mm^2
Cross sectional area of concrete, $A_c = A - A_{sc}$
$= 50{,}000 - 500$
$= 49500\ mm^2$

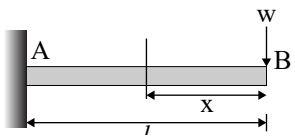
$\sigma_{cc} = 3.5$ MPa
m = 18
$P = (\sigma_{cc} A_c) + m(\sigma_{cc})(A_{sc})$
$= 3.5\ [50{,}000\text{-}500] + 18 \times 3.5 \times 500$
= 204.75 kN
= 205 kN

16. The strain energy U stored due to bending of the cantilever beam due to point load at the free end will be

(a) $\frac{W^2\ell^3}{6EI}$ (b) $\frac{W^2\ell^2}{6EI}$
(c) $\frac{W^3\ell^3}{36EI}$ (d) $\frac{W^2\ell^3}{36EI}$

16. Ans: (a)

Sol:



$$U = \int \frac{(Mx)^2 dx}{2EI} = \int_0^{\ell} \frac{[W(x)]^2 dx}{2EI} = \frac{W^2}{2EI}\left(\frac{x^3}{3}\right)_0^{\ell} = \frac{W^2\ell^3}{6EI}$$

17. A steel bar 2 m long, 20 mm wide and 15 mm thick is subjected to a tensile load of 30 kN. If Poission's ratio is 0.25 and Young's modulus is 200 GPa, an increase in volume will be

(a) 160 mm^3 (b) 150 mm^3
(c) 140 mm^3 (d) 130 mm^3

17. Ans: (b)

Sol: l = 2000 mm
b = 20 mm $\sigma_x = \frac{30 \times 10^3}{20 \times 15} = 100$ MPa
t = 15 mm $\sigma_y = 0 = \sigma_z$
P = 30 kN
$\mu = 0.25$
$E = 200 \times 10^3\ N/mm^2$

$$\varepsilon_v = \frac{\sigma_x + \sigma_y + \sigma_z}{E}(1 - 2\mu)$$

$$\frac{\delta V}{V} = \frac{(100 + 0 + 0)}{(200 \times 10^3)}(1 - 2 \times 0.25)$$

$\delta V = 2.5 \times 10^{-4}\ (2000 \times 20 \times 15)$
$\delta V = 150\ mm^3$

18. A bolt is under an axial thrust of 9.6 kN together with a transverse force of 4.8 kN. If factor of safety is 3, yield strength of bolt material is 270 N/mm^2 and Poission's ratio is 0.3, its diameter as per maximum principal stress theory will be nearly

(a) 13 mm (b) 15 mm
(c) 17 mm (d) 19 mm

18. Ans: (a)

Sol:

$$\sigma_x = \frac{P}{A} = \frac{9.6 \times 10^3}{A}; \sigma_y = 0$$

$$\tau_{xy} = \frac{F}{A} = \frac{4.8 \times 10^3}{A}$$

Allowable stress, $\sigma = \frac{f_y}{F.S} = \frac{270}{3}$

Maximum principal stress

$$\sigma_1 = \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + (\tau_{xy})^2}$$

$$= \frac{10^3}{A}\left[\frac{9.6}{2} + \sqrt{\left(\frac{9.6}{2}\right)^2 + (4.8)^2}\right]$$

$$= \frac{11.58 \times 10^3}{A}$$

$$\sigma_1 = \frac{11.58 \times 10^3}{A}$$

From maximum principal stress theory

$$\sigma_1 = \frac{f_y}{Fs}$$

$$\frac{11.58 \times 10^3}{A} = \frac{270}{3}$$

$$A = 128.67 \text{ mm}^2 = \frac{\pi}{4}d^2$$

Diameter, d = 12.79 mm

$\simeq$ 13 mm

19. In a material the principal stresses are 60 MN/m^2, 48 MN/m^2 and -36 MN/m^2. When the values of E = 200 GN/m^2 and $\frac{1}{m} = 0.3$, the total strain energy per unit volume will be nearly

(a) 43.5 kNm/m^3 (b) 35.5 kNm/m^3

(c) 27.5 kNm/m^3 (d) 19.5 kNm/m^3

19. Ans: (d)

Sol: Total strain energy/ unit volume

$$= \frac{1}{2E}\left[\sigma_1^2 + \sigma_2^2 + \sigma_3^2 - 2\mu(\sigma_1\sigma_2 + \sigma_2\sigma_3 + \sigma_3\sigma_1)\right]$$

$$= \frac{1}{2E}\left[\begin{matrix}60^2 + 48^2 + 36^2 - 2 \times 0.3 \\ (60 \times 48 - 48 \times 36 - 36 \times 60)\end{matrix}\right]$$

$$= \frac{-1}{2E}\left[\begin{matrix}60^2 + 48^2 + 36^2 - 2 \times 0.3 \\ (60 \times 48 - 48 \times 36 - 36 \times 60)\end{matrix}\right]$$

$$= \frac{1}{2 \times E}[7804.8] = 19.52 \text{ kNm/m}^3$$

20. At a point in a two dimensional stress system, and normal stress on two mutually perpendicular planes are σ_{xx} and σ_{yy} and shear stress is τ_{xy}. One of the principal stresses will become zero when the value of shear stress τ_{xy} is

(a) $\pm(\sigma_{xx}\,\sigma_{yy})$ (b) $\pm\sqrt{\sigma_{xx} - \sigma_{yy}}$

(c) $\pm\sqrt{\sigma_{xx} + \sigma_{yy}}$ (d) $\pm\sqrt{\sigma_{xx}\sigma_{yy}}$

20. Ans: (d)

Sol:

$$\sigma_2 = 0 = \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\left(\frac{\sigma_x + \sigma_y}{2}\right)^2 = \left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + (\tau \times y)^2$$

$$\sigma_x^2 + \sigma_y^2 + 2\sigma_x\sigma_y = \sigma_x^2 + \sigma_y^2 - 2\sigma_x\sigma_y + 4\tau_{xy}^2$$

$$4\,\sigma_x\,\sigma_y = 4\,(\tau \times y)^2$$

$$\tau_{xy} = \sqrt{\sigma_x\sigma_y}$$

21. The deflection δ of the closed coil helical spring is

(a) $\frac{WR^2n}{8Cd^3}$ (b) $\frac{64WR^3n}{Cd^4}$

(c) $\frac{128WR^3n}{Cd^2}$ (d) $\frac{64WR^2n}{Cd^2}$

Where:

W is the axial load

R is the radius of the coil

n is the number of turns of coil

C is the modulus of rigidity

d is the diameter of the wire of the coil

21. Ans: (b)

Sol: Deflection at the free end of a spring is $\delta = \frac{64WR^3n}{Cd^4}$

22. A closely-coiled helical spring of round steel wire 5 mm in diameter having 12 complete coils of 50 mm mean diameter is subjected to an axial load of 100 N. If modulus of rigidity is 80 GPa, the deflection of the spring will be

(a) 36 mm (b) 32 mm

(c) 28 mm (d) 24 mm

22. Ans: (d)

Sol: d = 5 mm

n = 12

R= $\frac{50}{2}$ = 25 mm

P = 100 N

G = 80 × 10^3 N/mm^2

$$\delta = \frac{64WR^3n}{Gd^4}$$

$$= \frac{64(100)(25)^3(12)}{(80\times10^3)(5)^4}$$

$$= 24 \text{ mm}$$

23. A hollow shaft of external and internal diameters as 100 mm and 40 mm respectively is transmitting power at 120 rpm. If the shearing stress is not to exceed 50 MPa, the power the shaft can transmit will be

(a) 100 kW (b) 120 kW
(c) 140 kW (d) 160 kW

23. Ans: (b)

Sol: D = 100 mm
d = 40 mm
N = 120 rpm
τ_{max} = 50 MPa
From Torsion equation

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

$$T = (\tau_{max})(Z_p) = \tau_{max}\left[\frac{\pi}{16D}(D^4 - d^4)\right]$$

$$= 50\left[\frac{\pi}{16\times100}(100^4 - 40^4)\right]$$

$$= 9.6\times10^6 \text{ N-mm} = 9.6 \text{ kN-m}$$

$$\text{Power, } P = \frac{2\pi NT}{60}$$

$$= \frac{2(\pi)(120)(9.6)}{60}$$

$$= 120.63 \text{ kN.m/s} = 120.63 \text{ kW}$$

$$\simeq 120 \text{ kW}$$

24. A circular beam of 100 mm diameter is subjected to a shear force of 30 kN. The maximum shear stress will be nearly.

(a) 5.1 MPa (b) 6.3 MPa
(c) 7.5 MPa (d) 8.7 MPa

24. Ans: (a)

Sol: Diameter, d = 100 mm
SF, V = 30 kN

$$\tau_{max} = \frac{4}{3}[\tau_{avg}], \text{ for solid circular shaft}$$

$$= \frac{4}{3}\left[\frac{V}{\text{c/s area}}\right] = \frac{4}{3}\left[30\times\frac{30\times10^3}{\frac{\pi}{4}\times100^2}\times100^2\right]$$

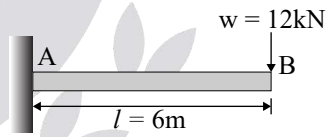
$$= 5.09 \text{ MPa} \simeq 5.1 \text{ MPa}$$

25. A cantilever beam AB as shown in figure is subjected to a point load of 12 kN over a span of 6 m with $E = 2\times10^5$ N/mm^2 and $I_{xx} = 6\times10^7$ mm^4. The deflection at the free end will be

(a) 80 mm (b) 72 mm
(c) 64 mm (d) 56 mm

25. Ans: (b)

Sol:



$$\text{Maximum deflection at free end } \delta = \frac{W\ell^3}{3EI}$$

$$= \frac{(12\times10^3)(6000^3)}{3(2\times10^5)(6\times10^7)} = 72 \text{ mm}$$

26. A floor has to carry a load of 12 kN/ m^2. The floor is supported on rectangular joists each 100 mm wide, 300 mm deep and 5 m long. If maximum stress in the joists should not exceed 8 MN/m^2 , the centre to centre distance of joists will be

(a) 430 mm (b) 400 mm
(c) 360 mm (d) 320 mm

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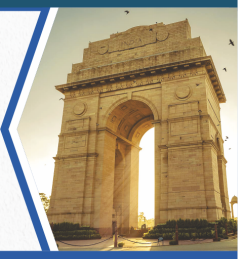

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26. Ans: (d)

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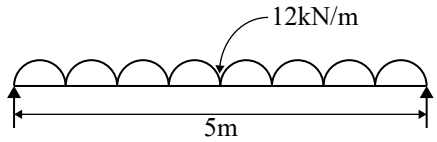


Consider 'b' meter with of slab

The Ud*l* on joist = 12 × b = (12b) kN/m

$$\text{Maximum BM, } M = \frac{W\ell^2}{8} = \frac{12b(5)^2}{8}$$

$$= 6[37.5] \text{ kN-m}$$

Maximum bending stress, $f_{max} = 8$ MN/m^2 (MPa)

From bending equation

$$\frac{M}{I} = \frac{f_{max}}{y_{max}}$$

$$M = f_{max}(Z)$$

$$[37.5 \times b] \times 10^6 = (8)\left[\frac{100 \times 300^2}{6}\right]$$

$$b = 0.32 \text{ m} = 320 \text{ mm}$$

27. A simply supported wooden beam 100 mm wide, 250 mm deep and 3 m long is carrying a uniformly distributed load of 40 kN/m. The maximum shear stress will be

(a) 2.4 MPa (b) 2.8 MPa

(c) 3.2 MPa (d) 3.6 MPa

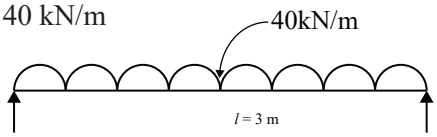
27. Ans: (d)

Sol: b = 100 mm

d = 250 mm

l = 3 m

w = 40 kN/m



$$\text{Maximum SF, } V = \frac{40 \times 3}{2} = 60 \text{ kN}$$

For a rectangular cross-section

$$\tau_{max} = \frac{3}{2}[\tau_{avg}] = \frac{3}{2}\left[\frac{60 \times 10^3}{100 \times 250}\right] = 3.6 \text{ MPa}$$

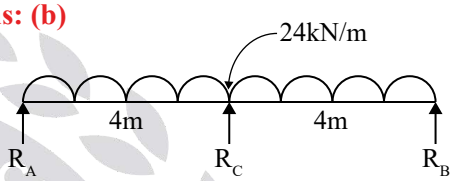
28. A simply supported beam of span 8 m carries a uniformly distributed load of 24 kN/m run over the whole span. The beam is propped at the middle of the span. The values of E = 200 × 10^6 kN/m^2 and I = 20 × 10^{-5} m^4. The amount by which the prop should yield in order to make all three reactions equal will be nearly

(a) 20 mm (b) 15 mm

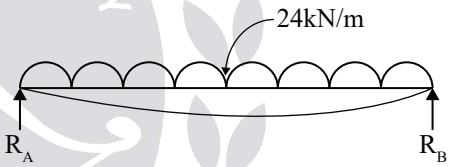
(c) 10 mm (d) 5 mm

28. Ans: (b)

Sol:



$$\text{Given } R_A = R_B = R_C = \frac{24 \times 8}{3} = 64 \text{ kN}$$

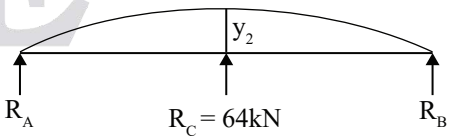


Assume middle prop is removed

$$y_1 = \frac{5W\ell^4}{384EI}$$

$$= \frac{(5)(24)(8)^4}{384(200 \times 10^6)(20 \times 10^{-5})} = 0.032 \text{ m}$$

$$= 32 \text{ mm } (\downarrow)$$



Apply middle reaction (R_c) as the point load (up)

$$y_2 = \frac{W\ell^3}{48EI}$$

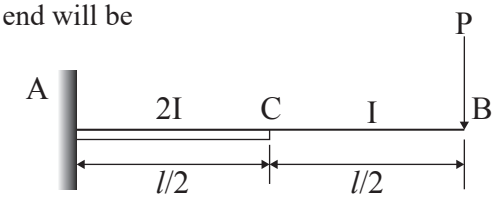
$$= \frac{(64)(8^3)}{(48)(200 \times 10^6)(20 \times 10^{-5})} = 0.017 \text{ m}$$

$$= 17 \text{ mm } (\uparrow)$$

The yield / settlement of support C = 32-17

$$= 15 \text{ mm } (\downarrow)$$

29. A cantilever beam ACB has end A fixed and subjected to a point load P at free end B. The point C is mid-point of AB and the moment of inertia of AC is twice that of CB. The deflection at the free end will be

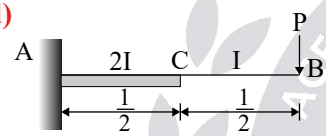


(a) $\frac{P\ell^3}{3EI}$ (b) $\frac{P\ell^3}{48EI}$

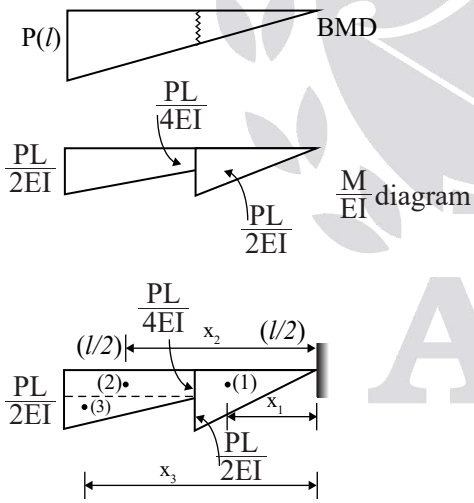
(c) $\frac{5P\ell^3}{96EI}$ (d) $\frac{9P\ell^3}{48EI}$

29. Ans: (d)

Sol:



Using conjugate beam method



Moment Area Method:

$A_1 = \frac{1}{2} \times \frac{P\ell}{2EI} \times \frac{\ell}{2} = \frac{P\ell^2}{8EI}$

$A_2 = \frac{P\ell}{4EI} \times \frac{\ell}{2} = \frac{P\ell^2}{8EI}$

$A_3 = \frac{1}{2} \times \frac{P\ell}{4EI} \times \frac{\ell}{2} = \frac{P\ell^2}{16EI}$

$x_1 = \frac{2}{3} \times \frac{\ell}{2} = \frac{\ell}{3}$

$x_2 = \frac{\ell}{2} + \frac{\ell}{4} = \frac{3\ell}{4}$

$x_3 = \frac{\ell}{2} + \frac{2}{3} \times \frac{\ell}{2} = \frac{5\ell}{6}$

$y_B = A_1x_1 + A_2x_2 + A_3x_3$

$= \frac{P\ell^2}{8EI}\left(\frac{\ell}{3}\right) + \frac{P\ell^2}{8EI}\left(\frac{3\ell}{4}\right) + \frac{P\ell^2}{16EI}\left(\frac{5\ell}{6}\right)$

$= \frac{18}{96}\frac{P\ell^3}{EI}$

$= \frac{9PL^3}{48EI}$

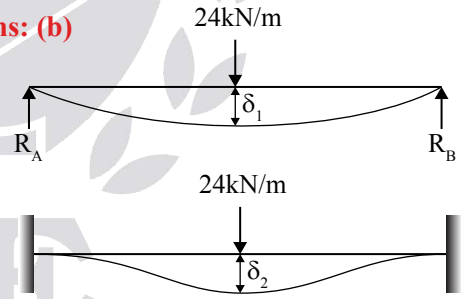
30. A beam of uniform cross-section, simply supported at ends carries a concentrated load W at midspan. If the ends of the beam are fixed and only load P is applied at the midspan such that the deflection at the centre remains the same, the value of the load P will be

(a) 6W (b) 4W

(c) 2W (d) W

30. Ans: (b)

Sol:



$\delta_1 = \frac{WL^3}{48EI}$

$\delta_2 = \frac{1}{4}\left[\frac{PL^3}{48EI}\right]$

Given $\delta_1 = \delta_2$

$\frac{WL^3}{48EI} = \frac{1}{4}\left[\frac{PL^3}{48EI}\right]$

$P = 4(W)$

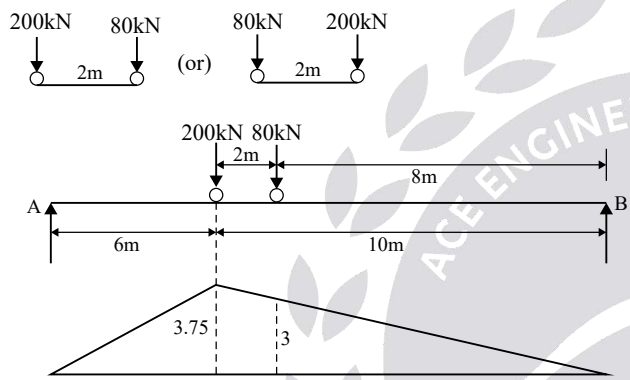
31. Two wheel loads 200 kN and 80 kN spaced at 2 m apart move on the span of girder of 16 m. If any wheel load can lead the other, the maximum bending moment that can occur at a section of 6 m from the left end will be

(a) 1050 kNm (b) 990 kNm

(c) 870 kNm (d) 750 kNm

31. Ans: (b)

Sol:



$$\text{Maximum BM at C} = \frac{200 \times 15}{4} + 80 \times 3$$
$$= 990 \text{ kN-m}$$

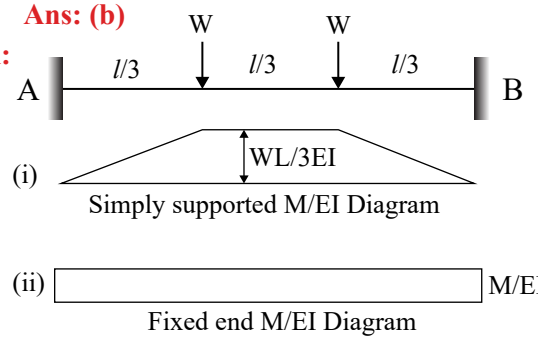
32. A beam of length *l* is fixed at its both ends and carries two concentrated loads of W each at a distance of $\frac{\ell}{3}$ from both ends. The fixed end moment at A will be

(a) $-\frac{W\ell}{3}$ (b) $\frac{-2W\ell}{9}$

(c) $\frac{-6W\ell}{15}$ (d) $\frac{-4W\ell}{27}$

32. Ans: (b)

Sol:



$$A_{(i)} = A_{(ii)}$$

$$2\left(\frac{1}{2} \cdot \frac{\ell}{3} \cdot \frac{WL}{3EI}\right) + \left[\frac{WL}{3EI} \cdot \frac{\ell}{3}\right] = \frac{ML}{EI}$$

$$\frac{WL^2}{9} + \frac{WL^2}{9} = M\ell$$

$$\therefore \overline{M}_{AB} = \frac{2WL}{9}$$

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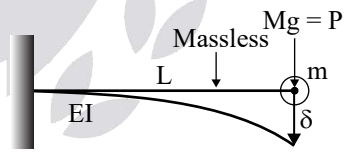
33. The natural frequency of a mass m at the end of the cantilever beam of negligible mass with usual notations will be

(a) $\frac{1}{2\pi}\left(\frac{3EI}{mL^3}\right)^{\frac{1}{2}}$ (b) $\frac{1}{\pi}\left(\frac{6EI}{mL^3}\right)^{\frac{1}{2}}$

(c) $\frac{1}{2\pi}\left(\frac{6EI}{mL^3}\right)^{\frac{1}{2}}$ (d) $\frac{1}{\pi}\left(\frac{3EI}{mL^3}\right)^{\frac{1}{2}}$

33. Ans: (a)

Sol: Natural frequency of a mass 'm' at the end of cantilever beam of negligible mass with usual notation



Due to load (mg) at free end deflection "δ" is

$$\delta = \frac{(mg)L^3}{3EI}$$

But spring stiffners $K = \frac{P}{\delta}$

$\therefore$ Beams Transverse stiffners, $K_t = \frac{P}{\delta}$

$$\therefore K_t = \frac{mg}{\frac{mgL^3}{3EI}} = \frac{3EI}{L^3}$$

But Natural frequency $f_n = \frac{1}{2\pi}\sqrt{\frac{k}{m}}\,H_z$

$$\therefore f_n = \frac{1}{2\pi}\sqrt{\frac{3EI}{m\ell^3}}\,Hz$$

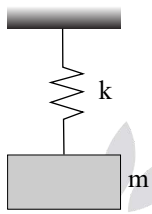
34. The simple oscillator under idealized conditions of no-damping, once excited will oscillate indefinitely with constant amplitude at its natural frequency f will be

(a) $\frac{1}{2\pi}\sqrt{\frac{m}{k}}$ (b) $\frac{1}{\pi}\sqrt{\frac{k}{m}}$

(c) $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$ (b) $\frac{1}{\pi}\sqrt{\frac{m}{k}}$

34. Ans: (c)

Sol: Simple oscillator under idealized conditions of no damping is given in figure



∴Standard formula for natural frequency in Hertz is

$$f_n = \frac{1}{2\pi}\sqrt{\frac{k}{m}}\,Hz$$

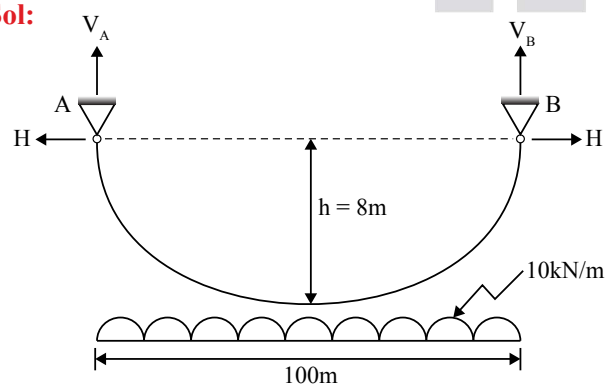
35. A cable carrying a load of 10 kN/m run of horizontal span is stretched between supports of 100 m apart. If the supports are at same level and central dip of 8 m, the ratio of greatest and least tension in the cable will be

(a) 1.05 (b) 1.35

(c) 1.65 (d) 1.95

35. Ans: (a)

Sol:



If the supports are same level, maximum tension will develop at the supports & minimum tension will develop at the lower point of cable.

$$V = \frac{W\ell}{2}$$

$$V = \frac{10 \times 100}{2} = 500\ kN$$

$$H = \frac{10 \times 100 \times 100}{8 \times 8} = 1562.5\,kN$$

Maximum tension $T_{max} = \sqrt{V^2 + H^2}$

$$= \sqrt{(500)^2 + (1562.5)^2}$$

$$= 1640.5\ kN$$

T_{min} = Horizontal Reaction = 1562.5kN

$$\frac{T_{max}}{T_{max}} = \frac{1640.55}{1562.5} = 1.049 = 1.05\ kN$$

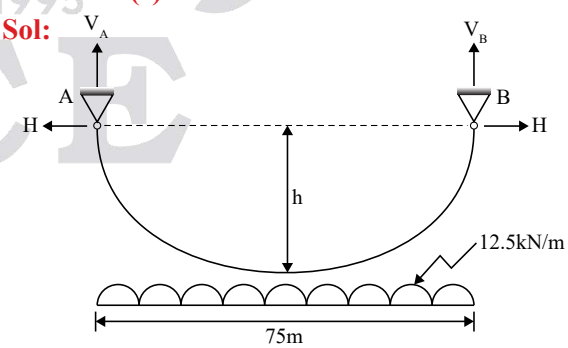
36. A cable is suspended between two points 75 m apart at the same level. It carries a uniformly distributed load of 12.5 kN per horizontal meter. If the maximum tension in the cable is limited to 1000 kN, the minimum central dip will be nearly

(a) 14 m (b) 12 m

(c) 10 m (d) 8 m

36. Ans: (c)

Sol:



Maximum tension (T_{max}) = 1000 kN

$T_{max} = \sqrt{V^2 + H^2}$

$$1000 = \sqrt{(468.75)^2 + \left(\frac{12.5 \times 7.5^2}{8 \times h}\right)^2}$$

h = 10 m

37. A tie bar 50 mm × 8 mm is to carry a load of 80 kN. A specimen of the same quality steel of cross-sectional area is 250 mm^2. For a maximum load of 125 kN carried by the specimen, the factor of safety in the design will be
(a) 3.0 (b) 2.5
(c) 2.0 (d) 1.5

37. Ans: (b)

Sol:

$$\sigma_1 = \frac{80 \times 10^3}{50 \times 8} = 200 \text{ MPa}$$

$$\sigma_2 = \frac{125 \times 10^3}{(250)} = 500 \text{ MPa}$$

$$F_s \frac{\sigma_2}{\sigma_1} = \frac{500}{200} = 2.5$$

38. Hanger connections are made when
(a) Beam as well as girder is meeting at different level. A plate or hanger is interposed between the beam and the girder and finally interconnected by means of angle cleats or bolts and rods.
(b) Beam as well as girder is meeting at same level. A plate is interposed between the beam and the girder
(c) The beam are meeting at different levels. A hanger is interposed between the beams and finally interconnected by means of angle cleats or bolts and rods
(d) The girders are meeting at same level. A plate is interposed between the girders and finally interconnected by means of bolts and rods.

38. Ans: (a)

39. The splicing of a column becomes necessary, where
(a) The available length of structural steel section is less than the required length of the column
(b) Section remains same through out at all floors
(c) Only riveted columns are to be designed
(d) Splices should be designed to carry axial loads only

39. Ans: (a)

Sol: A joint is required in the length of column member in multistoryed building frame is called column splice. Column is adopted when length of steel column is required is more than the available length of structural steel column in rolling mill/factory and also provided to join two different sizes of steel column sections.

40. A tie bar 50 mm × 8 mm is to carry a load of 80 kN. A specimen of same quality steel of cross-sectional area is 250 mm^2. If the maximum load carried by the specimen is 125 kN, the gauge length will be
(a) 133 mm (b) 126 mm
(c) 113 mm (d) 106 mm

40. Ans: (c)

Sol: Cross sectional area of tie bar A = 50 × 8 = 400 mm^2
The gauge length of tie bar = $5.65\sqrt{A}$

$= 5.65 \times \sqrt{400}$

$= 113$ mm

Cross sectional area of specimen A_o = 250 mm^2
The gauge length of specimen = $5.65\sqrt{A_o}$

$= 5.65 \times \sqrt{250}$
$= 89.33$ mm

Hence right choice is Answer (c)

41. The strength of a column depends on which of the following imperfections?
1. The material being isotropic and homogeneous
2. Geometric variations of columns
3. Eccentricity of load
(a) 1, 2 and 3 (b) 2 and 3 only
(c) 1 and 3 only (d) 1 and 2 only

41. Ans: (b)

Sol: The following factors that influence the strength of a columns are
- Eccentricity of load
- Initial out of straightness (column curvature)

- Non homogeneity of material
- Lateral loads
- Shape of cross sections
- Lateral loads
- End restraints (support conditions)]

Hence right choice is answer (b)

42. Which of the following types of failures occur in the beam-column connections?

1. Failure by lateral-torsional buckling
2. Failure by combined instability in both the principal directions
3. Failure by combined twisting and bending on the torsionally weak sections
4. Failure by combined twisting and bending when plane of bending does not contain the shear centre

(a) 1, 2 and 3 only (b) 1, 3 and 4 only
(c) 1, 2 and 4 only (d) 2, 3 and 4 only

42. Ans: (b)

Sol: Beam column is a structural member is subjected to both axial compression and bending moment with likely mode of failures may exist, which are

1. Failure by instability in plane of bending without twisting under axial compression and bending about one axis.
2. Failure by lateral torsional buckling under axial compression and bending about the major axis.
3. Failure by instability in one of the principal direction due to axial compression and biaxial bending (torsionally stiff sections)
4. Failure by combined twisting and bending on torsionally weak sections (thin walled sections)
5. Failure by combined twisting and bending when plane of bending does not contain the shear centre under axial compression, biaxial bending and torsion.

Hence right choice of this question is answer (b)

43. In a design of beam columns, the values of plastic section ratio $\beta_b = 1$, the plastic sectional modulus $Z_{pz} = 3948812\ mm^3$, the yield stress $f_y = 250\ N/mm^2$ and critical moment of $M_{cr} = 16866 \times 10^6$ N.mm. The non-dimensional lateral torsional slenderness ratio will be nearly

(a) 0.141 (b) 0.242
(c) 0.323 (d) 0.424

43. Ans: (b)

Sol: The Non-dimensional lateral -torsional slenderness ratio

$$\lambda_{LT} = \sqrt{\frac{\beta_b \times Z_{pz} \times f_y}{M_{cr}}}$$

$$= \sqrt{\frac{1.0 \times 3948812 \times 250}{16866 \times 10^6}} = 0.242$$

44. As per Indian Railway Board, the impact factor i (also known as coefficient of dynamic augment, CDA) in steel girders for single track span is

(a) $\left[0.15 + \frac{8}{6+L}\right] / 1.0$ (b) $\left[0.75 + \frac{6}{8+L}\right] / 1.0$

(c) $\left[0.15 + \frac{6}{8+L}\right] / 1.0$ (d) $\left[0.75 + \frac{8}{6+L}\right] / 1.0$

Where: L is span

44. Ans: (a)

Sol: As per Indian railway board. The impact factor in steel girder for single track span

$$i = \left[0.15 + \frac{8}{6+L}\right] \not> 1.0$$

Where L = Span of steel girder

45. An ISHB 300 with plastic section modulus of $921.68 \times 10^3\ mm^3$, flange width of 250 mm, the yield stress of 250 N/mm^2 is embedded in a pocket base to develop its strength with M 25 concrete in design of beam-column. The required depth will be nearly

(a) 475 mm (b) 425 mm
(c) 375 mm (d) 325 mm

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45. Ans: (a)

Sol: $f_y = 250\ N/mm^2$;

$Z_{pz} = 921.68 \times 10^3\ mm^3$

$f_{ck} = 25\ N/mm^2 = b_f = 250\ mm$

The required depth of section (d)

$$a = \left[\frac{f_y \times Z_{Pz}}{0.164 \times f_{ck} \times b_f}\right]^{0.5}$$

$$= \left[\frac{250 \times 921.68 \times 10^3}{0.164 \times 25 \times 250}\right]^{0.5} = 471.13\ mm$$

$$\simeq 475\ mm$$

46. In beam-columns or eccentric loaded columns, an elastic critical stress in compression f_{cc} is

(a) $\frac{\pi E}{\lambda}$ (b) $\frac{\pi^2 E}{\lambda^2}$

(c) $\frac{\pi E}{\lambda^2}$ (d) $\frac{\pi^2 E}{\lambda}$

where: E = Modulus of elasticity of steel

λ = Slenderness ratio in the plane of bending

46. Ans: (b)

Sol: From Euler's formula

$$P_e = \frac{\pi^2}{\ell^2} E I_{min}$$

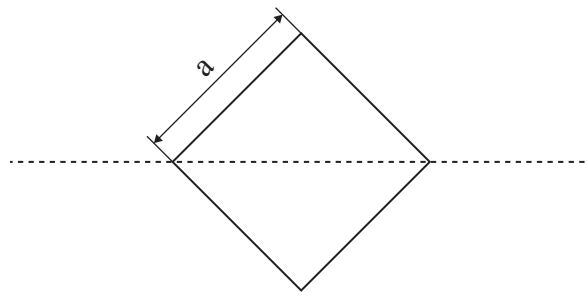
Divide with (A)

$$\frac{P_e}{A} = \frac{\pi^2}{\ell^2} E\left(\frac{I_{min}}{A}\right)$$

$$f_{cc} = \frac{\pi^2}{\ell^2} E(r_{min}); f_{cc} = \frac{\pi^2}{\left(\frac{\ell}{r_{min}}\right)^2} E$$

$$f_{cc} = \frac{\pi^2}{\lambda^2}(E)$$

47. A square of side a is placed such that its diagonal is horizontal. The shape factor of the square will be

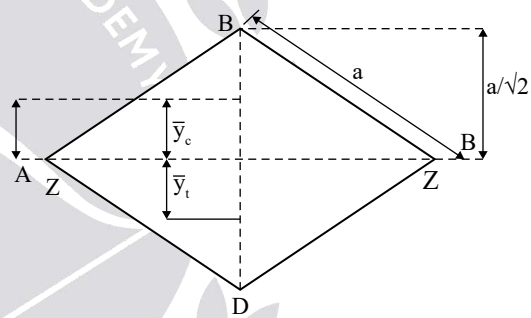


(a) 3.2 (b) 2.0

(c) 1.5 (d) 1.0

47. Ans: (b)

Sol: Diagonal length length of a square



$= \sqrt{a^2 + a^2} = \sqrt{2}\,a$

Moment of inertia about zz axis

$$I_{zz} = 2 \times \frac{\sqrt{2}\,a\left(\frac{a}{\sqrt{2}}\right)^3}{12} = \frac{a^4}{12}$$

Elastic section modulus about zz axis (Z_{ez})

$$Z_{ez} = \frac{I_{zz}}{y} = \frac{\frac{a^4}{12}}{\frac{a}{\sqrt{2}}} = \frac{a^3}{6\sqrt{2}}$$

Plastic section modulus about zz axis (Z_{pz}0

$$Z_{pz} = A_1 y_1 + A_2 y_2 = \frac{A}{2}(y_1 + y_2)$$

$$= \frac{a^2}{2}\left(\frac{a}{3\sqrt{2}} + \frac{a}{3\sqrt{2}}\right) = \frac{a^3}{3\sqrt{2}}$$

$$\text{Shape factor (s)} = \frac{\text{Plastic section modulus}}{\text{Elastic section modulus}}$$

$$= \frac{Z_{pz}}{Z_{ez}} = \frac{\frac{a^3}{3\sqrt{2}}}{\frac{a^3}{6\sqrt{2}}} = 2.0$$

48. Which one of the following is the correct assumption made in evaluation of fully plastic moment?
(a) The upper and lower yield stresses and the modulus of elasticity have different values in compression and tension
(b) The material is homogeneous and isotropic in both the elastic and plastic states
(c) There will be resultant axial force on the beam
(d) Some layers of the material are not free to expand and contract longitudinally and laterally under stress

48. Ans: (b)

Sol: Assumptions:

- The material obeys Hook's law until the stress reaches the upper yield value. On further straining the stress drops to the lower yield value and there after remains constant.
- The upper and lower yield stresses and 'E' have the same values in compression and in tension.
- The material is homogeneous,and isotropic in both elastic and plastic stages.
- Plane transverse sections remain plane and normal to the longitudinal axis after bending, the effect of shear being neglected.
- There is no resultant axial force on the beam.
- The cross section of beam is symmetrical about an axis through its centroid parallel to the plane of bending.
- Every layer of material is free to expand and contract.

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49. As per IS - 456-2000, cracking of concrete in tension zone cannot be avoided but can be limited by
1. Adhering to the codal requirements of minimum steel area
2. Proper and prolonged curing of concrete
3. Increasing water cement ratio to increase workability

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

49. Ans: (a)

Sol: Cracking of concrete in tension can be limited by
(i) following codal requirements of minimum steel area and max. spacing of bars
(ii) Proper and prolonged curing of concrete
(iii) Good quality of mix

Note:
Water cement ratio beyond certain limit increases cracking (though it increases workability)

50. Which of the following assumptions are made with respect to Euler's theory applied to columns?
1. The section of the column is uniform
2. The length of the column is very large compared to the lateral dimensions
3. The direct stress is large when compared with the bending stress

(a) 1, 2 and 3 (b) 1 and 3 only
(c) 2 and 3 only (d) 1 and 2 only

50. Ans: (d)

Sol: The column is uniform in cross-section
The length of column is very large compared to lateral dimensions.
The direct stress in column is very small.

51. A rectangular beam with b = 200 mm and effective depth d = 300 mm is subjected to limit state shear of 80 kN and torsional moment of 6 kNm. The equivalent value of shear will be
(a) 128 kN (b) 116 kN
(c) 104 kN (d) 92 kN

51. Ans: (a)

Sol: Equivalent shear force

$$V_e = V_u + V_t$$
$$= V_u + \frac{1.6T_u}{b}$$
$$= 80 + \frac{1.6 \times 6}{0.2}$$
$$= 128 \text{ kN}$$

52. As per IS - 456 : 2000, the value of maximum compression strain in concrete in axial compression for limit state of collapse is

(a) 0.001 (b) 0.002
(c) 0.003 (d) 0.004

52. Ans: (b)

Sol: The value of maximum compressive strain in concrete in axial compression is 0.002

53. The positive bending moment coefficient at the middle of the end-span of a continuous one way slab is

(a) $\left(\frac{w_l}{10} + \frac{w_d}{12}\right)L^2$ (b) $\left(\frac{w_l}{9} + \frac{w_d}{10}\right)L^2$

(c) $\left(\frac{w_l}{12} + \frac{w_d}{16}\right)L^2$ (d) $\left(\frac{w_l}{9} + \frac{w_d}{12}\right)L^2$

where : w_l = Live load
w_d = Dead load

53. Ans: (a)

Sol: The positive B.M near middle of end span
From table (12), In IS: 456-2000 is

$$M_A = \left\{\frac{1}{12}w_d + \frac{1}{10}w_l\right\}L^2$$

54. Which of the following are the general design requirements of retaining wall?

1. The factor of safety against sliding should be at least 1.5
2. The factor of safety against over-turning should be at least 2.0
3. The bearing pressure at toe should be less than the bearing capacity of the soil
4. The length of retaining wall to be cast in one go should not exceed 10 m otherwise cracks may develop

(a) 1, 2 and 3 only (b) 1, 3 and 4 only
(c) 1, 2 and 4 only (d) 2, 3 and 4 only

54. Ans: (a)

Sol: The design requirement of retaining wall is:

- Minimum F.O. safety against sliding : 1.5
- Minimum F.O. safety against overturning : 2
- Minimum F.O. safety against bearing capacity failure: 3

Since the question is on the 'Design criteria' and not on the construction aspect, the best answer is (a).

55. Which of the following are the desirable properties for efficient functioning in design for movement joint of water tank?

1. The joint should accommodate repeated movement of the structure without loss of water-tightness
2. The design should provide for exclusion of grit and debris which would prevent the closing of the joint
3. The material used in the construction of movement joints should not slump unduly in hot weather or become brittle in cold weather

(a) 1, 2 and 3 (b) 1 and 2 only
(c) 1 and 3 only (d) 2 and 3 only

55. Ans: (a)

Sol: As per cl. 10.2 of IS 3370 - Part 1 - 2009
The following properties are desirable in the design of a movement joint its efficient functioning.

(a) The joint should accommodate repeated movement of the structure without loss of water tightness
(b) The design should provide for exclusion of grill and debris which would prevent the closing of the joint.

(c) The material used in the construction of movement joints should have the following properties:

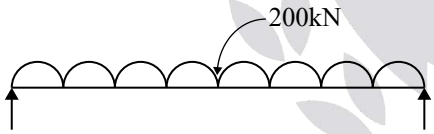
1. It should not slump unduly in hot weather or become brittle in cold weather.
2. It should not suffer permanent distortion or extension and should not be displaced by fluid pressure.
3. It should be insoluble and durable and should not be affected by exposure to light or by evaporation of solvent or plasticizers.
4. In special cases, the materials should be non-toxic, taintless or resistant to chemical and biological action as may be specified.

56. A simply supported beam having 200 mm width and 450 mm effective supports a total uniformly distributed load of 2,00,000 N. The nominal shear stress will be nearly

(a) 0.8 N/mm^2 (b) 1.1 N/mm^2
(c) 1.8 N/mm^2 (d) 2.2 N/mm^2

56. Ans: (b)

Sol:



Beam is symmetrically loaded hence support reactions are equal and half of the total load. It is equal to shear force.

$$R_A = R_B = V_u = \frac{200}{2} = 100 \text{ kN}$$

Nominal shear stress

$$\tau_v = \frac{V_u}{bd} = \frac{100 \times 10^3}{200 \times 450} = 1.1 \text{ N/mm}^2$$

57. Which of the following are correct for cover to reinforcement?

1. The reinforcement shall have a minimum clear cover of 20 mm or diameter of such bar whichever is more
2. At each end of reinforcing bar not less than 25 mm nor less than twice the diameter of such bar
3. Increased cover thickness may be provided when surface of concrete is exposed to the action of harmful chemicals.

(a) 1, 2 and 3 (b) 1 and 2 only
(c) 1 and 3 only (d) 2 and 3 only

57. Ans: (a)

Sol: As per SP - 34

At the end of reinforcing bar, cover of 25 mm (or) twice the diameter of bar whichever is greater is to be provided

Minimum cover for reinforcing bar in

(a) columns is 40 mm (or) diameter of bar whichever is greater
(b) In beam is 25 mm (or) diameter of bar whichever is greater
(c) In slab it is 15 mm (or) diameter of bar whichever is greater
(d) Any other reinforcement bar shall have a minimum cover of 15 mm (or) diameter of bar whichever is greater

In case of concrete, exposed to harmful chemicals, increased cover thickness may be provided.

58. A beam of size 250 mm width and 460 mm effective depth is subjected to limit state moment of 146 kNm. If M20 grade concrete and Fe 415 steel are used, the area of steel required will be

(a) 435 mm^2 (b) 935 mm^2
(c) 1100 mm^2 (d) 1235 mm^2

58. Ans: (c)

Sol: Factored B.M. m_u = 146 kN.m

Limiting moment of resistance of a singly reinforced beam

$M_{u\,lim} = 0.138\, f_{ck}\, bd^2 \rightarrow$ for Fe - 415
$= 0.138 \times 20 \times 250 \times 460^2$
$= 146$ kNm

$M_u = M_{u\,lim}$

$\therefore$ Balanced section

It is designed as singly reinforced beam

steel reinforcement for balanced section C = T

$0.36\, f_{ck}\, b \times u_{max} = 0.87\, f_y\, A_{st}$

$0.36 \times 20 \times 250 \times 0.48 \times 460 = 0.87 \times 415 \times A_{st}$

$A_{st} = 1100.789\ mm^2 \approx 1100\ mm^2$

59. Air permeability method is used to determine
(a) Soundness of cement
(b) Setting time
(c) Fineness of cement
(d) Resistance of cement

59. Ans: (c)

Sol: Air permeability method is used to determine fineness of cement.

60. Which of the following assumptions are correct for the lateral torsional buckling if an I-section beam?
1. The beam is initially distorted
2. Its behaviour is elastic
3. It is loaded by equal and opposite end moment in the plane of the web
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

60. Ans: (b)

Sol: The Lateral torsional buckling of an I-section is considered with the following assumptions
1. The beam is initially undistorted
2. Its behaviour is elastic (no yielding)
3. It is loaded by equal and opposite end moments in the plane of web
4. The load acts in the plane of web only (no external applied lateral (or) torsional loads)
5. The beam does not have residual stress
6. Its ends are simply supported vertically and laterally.

Statements 2 and 3 are right assumptions.

61. In an excavation of 3,000 cub.mtr of common earth for a canal project, 6 men can be effectively employed on the job. If an output of a man is taken as 100 cub.mtr per day, the duration of excavation activity will be
(a) 5 days (b) 6 days
(c) 7 days (d) 8 days

61. Ans: (a)

Sol: Output of man = 100 cubic mt per day

No. of men employed = 6

Output per day = 6 × 100

= 600 cubic mtr per day

No. of days = $\frac{3000}{600} = 5$

62. The project plan for construction
1. Clearly defines project's scope of work. It breaks down project objectives into clear, identifiable, attainable and verifiable goals
2. Identifies critical activities, thus enabling management of projects by exceptions
3. Provides the basis for co-ordinating the efforts of clients, consultants, architects, designers, quality surveyors, specialists, suppliers, contractors and project staff
(a) 1 and 2 only (b) 1, 2 and 3
(c) 1 and 3 only (d) 2 and 3 only

62. Ans: (b)

Sol: The project plan is a formal, approved document used to manage project execution.

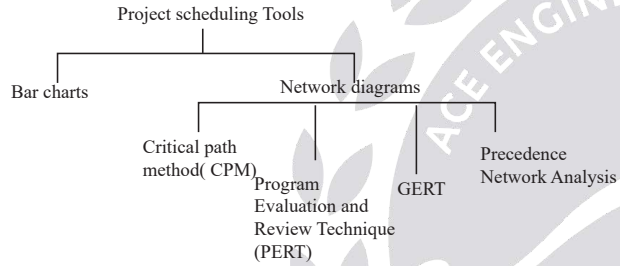
The project plan includes
1. Project charger
2. Project management approach/strategy
3. Scope statement
4. WBS (Work breakdown structure)
5. Cost estimates
6. Performance measurement baseline for technical scope and schedule and cost base line
7. Major milestones and target-dates
8. Risk management plan

The primary uses of the project plan are to document planning assumptions and decisions, facilitate communication among stakeholders and document approved scope, cost and schedule baselines.

63. Which one of the following techniques is not covered in Project Network Analysis?
(a) Critical Path Method
(b) Program Evaluation and Review Techniques
(c) Procedure Network Analysis
(d) Measurement Book

63. Ans: (d)

Sol:



64. Which of the following statements are correct for Network Critical Path?
1. The path of critical activities, which links the start and end events is critical path
2. It is the path of activities having zero float
3. It is the path of events having zero slack
4. The sum of the duration of the critical activities along a critical path gives the duration of the project
(a) 1, 2, 3 and 4
(b) 1, 2 and 3 only
(c) 1 and 4 only
(d) 2, 3 and 4 only

64. Ans: (a)

Sol: Critical path has zero float activities
Critical path has zero slack events
Critical path covers first and last events of a project network
Critical path duration = Project duration.

65. Independent float is an amount of time by which the start of an activity may be delayed without affecting
1. The preceding or the following activity
2. The start of a following activity
3. The completion of the project
(a) 1 only (b) 2 only
(c) 3 only (d) 1,2 and 3

65. Ans: (d)

Sol: Independent float cannot affect
(i) Preceding activity
(ii) Succeeding (following) activity
(iii) Project completion time

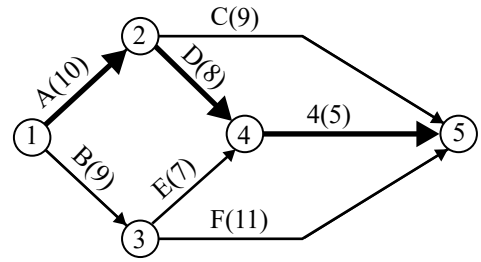
66. Consider the following activity for the total project:

Activity	Immediate Predecessors	Duration (Days)
A	-	10
B	-	9
C	A	9
D	A	8
E	B	7
F	B	11
G	D, E	5

The total project duration for the critical path will be
(a) 25 days (b) 23 days
(c) 21 days (d) 19 days

66. Ans: (b)

Sol:



Path	Duration
A - C	19
A - D - G	23
B - E - G	21
B - F	20

Critical path duration = 23 bars

67. By performing which of the following functions the construction manager can achieve the project goals?
1. Envisioning the task ahead
2. Setting targets and monitoring performance
3. Motivating the work force
4. Building the line supervisors team

(a) 1, 2 and 4 only (b) 1, 2 and 3 only
(c) 1, 3 and 4 only (d) 1, 2 3 and 4

67. Ans: (d)

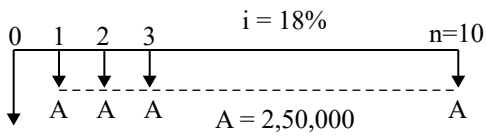
Sol: Construction manager plays a crucial role in planning, designing and executing the project work. He has to monitor the work progress through the supervisors.

68. The cost of the machine is Rs. 20,00,000, and if it is purchased under installment basis, the company has to pay 25% of the cost at the time of purchase and the remaining amount in 10 annual equal installments of Rs. 2,50,000 each. If rate of interest is 18% compounded annually the present worth of the machine will be

(a) Rs. 17,01,000 (b) Rs. 16,22,500
(c) Rs. 15,43,000 (d) Rs. 14,64,500

68. Ans: (b)

Sol:



$P = 0.25 \times 20,00,000$
$= 5,00,000$

Present worth = 5,00,000 + 2,50,000[P/A, 18%, 10]
= 5,00,000 + 2,50,000 × 4.4941
= 16, 23, 525

$$[P/A, 18\%, 10] = \frac{(1+i)^n - 1}{i(1+i)^n}$$

$$= \frac{(1+0.18)^{10} - 1}{0.18(1+0.18)^{10}}$$

$$= 4.4941$$

From interest tabes
[P/A, 18%, 10] = 4.4941

69. Which of the following relations are correct for determining different components of a bid price?
1. Bid price = Direct cost + Indirect cost + Mark up amount
2. Direct cost = Project overheads + Common plant and equipment cost + Common work men cost
3. Mark up amount = Profit + Contingency + Allowances for risks + General overheads

(a) 1, 2 and 3 (b) 1 and 2 only
(c) 1 and 3 only (d) 2 and 3 only

69. Ans: (c)

Sol: Direct cost does not include project overheads, hence Statement '2' is incorrect.

70. Resource smoothing is
(a) an optimization and economical utilization of resources
(b) An adjustment of resources with out affecting project duration
(c) A gradual increase in resources
(d) A gradual decrease in resources

70. Ans: (b)

Sol: Resource smoothing is a process in which the resources are allocated uniformly without affecting the project duration (critical path remains same).

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71. In PERT technique, the time estimate of activities and probability of their occurrence follow
(a) Binomial distribution (b) Normal distribution
(c) Poisson distribution (c) β distribution

71. Ans: (d)

Sol: In a PERT network,
Activity duration follows β-distribution and project duration follows normal distribution.

72. Indirect cost due to accidents includes
(a) Legal charges
(b) Medical expenses for the injured
(c) Compensation amount to the injured
(d) Over time payment to make up the loss of time

72. Ans: (d)

Sol: Indirect cost includes the non production time cost i.e. idle time cost of break down equipment/ machinery.

73. An oil of specific gravity 0.9 contained in a vessel. At a point the height of oil is 40 m and for the density of water = 1000 kg/m^3, the corresponding height of water at the point will be
(a) 28 m (b) 32 m
(c) 36 m (d) 40 m

73. Ans: (c)

Sol: **Given:**

$S_{oil} = 0.9 \Rightarrow \rho_{oil} = 900$ kg/m^3

$h_{oil} = 40$ m

$S_{water} = 1$ (or) $\rho_{water} = 1000$ kg/m^3

$h_{water} = ?$

$\rho_{oil} . g\, h_{oil} = \rho_{water} . g\, h_{water}$

$$\Rightarrow h_{water} = \frac{\rho_{oil}}{\rho_{water}} \times h_{oil}$$

$$= 0.9 \times 40 = 36 \text{ m}$$

74. When speed changes in case of centrifugal pump, which of the following points are correct?
1. The shape of the velocity triangle will remain same
2. Various angles will remain same
3. Magnitude of velocity will change proportionately
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

74. Ans: (d)

Sol: When centrifugal pump operates at different speed but under homologous condition then shape of velocity triangles remains same. Hence various angles will also remain same. Due to similarity of triangles all the velocity vectors will change proportionately.

Note:
If pump is not operating under homologous condition then only blade velocity vector will change proportionately and blade angles will remain same. Homologous conditions should be mentioned in the question.

75. Which one of the following is the use of flow net analysis in fluid mechanics?
(a) To determine the streamlines and equipotential lines
(b) To determine downward lift pressure above hydraulic structure
(c) To determine the viscosity for given boundaries of flow
(d) To design the hydraulic structure

75. Ans: (d)

Sol: Flownet method is used in soil mechanics as a first check for problems corresponding to flow under hydraulic structures like dams (or) sheet pile walls.

76. A jet propelled aircraft is flying at a speed of 1100 km/hour at t = 20°C, k = 1.4 and R = 287 J/kg K. The Mach number at a point on the jet will be nearly
(a) 0.3 (b) 0.5 (c) 0.7 (d) 0.9

76. Ans: (d)

Sol: V = 1100 km/hr

$= 1100 \times \frac{5}{18}$ m/s

= 305.5 m/s

K = 1.4

R = 287 J/kg. K

T = 20°C

= (20 + 273) K

= 293 K

M_a = ?

$$M_a = \frac{V}{C} = \frac{V}{\sqrt{KRT}} = \frac{305.5}{\sqrt{1.4 \times 287 \times 293}}$$

$$= \frac{305.5}{343}$$

$\Rightarrow M_a = 0.89$

77. When the drag force becomes equal to the weight of the body, the acceleration ceases and the net external force acting in the body becomes
(a) Zero and the body will move at constant speed
(b) Light and the body will move forward
(c) Zero and the body will move fast
(d) High and the body will move at constant speed

77. Ans: (a)

Sol: Given

$F_D = W_{body}$

a = 0

If acceleration is zero, then

F = M. a

F = 0

If acceleration is zero, then

$\frac{dV}{dt} = 0 \quad \Rightarrow V = \text{constant}$

$\therefore$ Net force = 0 & the body moves with constant velocity.

78. Which one of the following statements is correct regarding flow in open channel?
(a) The curve for kinetic energy is a parabola
(b) The curve for potential energy is a parabola
(c) Specific energy is asymptotic to the vertical axis
(d) At critical depth the specific energy is maximum

78. Ans: (a)

Sol: Kinetic energy (KE) = $\frac{1}{2}mV^2$

$$KE = \frac{1}{2}\frac{\omega}{g}V^2$$

$$\frac{KE}{\omega} = \frac{V^2}{2g}$$

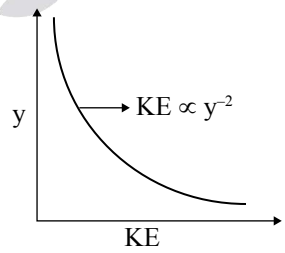
Kinetic energy per unit weight = $\frac{V^2}{2g}$

$$= \frac{Q^2}{A^2 2g}$$

For a given Q and rectangular channel

$$\frac{KE}{\omega} = \frac{Q^2}{b^2 y^2 2g}$$

$$\frac{KE}{\omega} = \frac{q^2}{2gy^2}$$



In specific energy curve

1. Kinetic energy curve is parabola
2. Potential energy line is linear.
3. Specific energy curve is assymptotical to potential energy line
4. Specific energy is minimum at critical state.

79. Which one of the following statement is correct regarding critical state of flow through a channel section?
(a) Specific energy is a minimum for a given discharge
(b) Specific energy is a maximum for a given discharge
(c) The Froude number is greater than two
(d) The discharge is a minimum for a given specific force

79. Ans: (a)

Sol: At critical state
1. Specific energy is minimum at a given discharge
2. Froude number is 1
3. Discharge is maximum for given specific force

80. Which one of the following statement is correct regarding centrifugal pumps?
(a) The discharge is fluctuating and pulsating
(b) It is used for large discharge through smaller heads
(c) The efficiency is low
(d) It runs at low speed

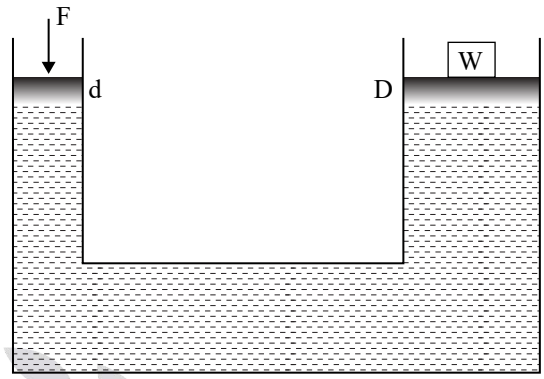
80. Ans: (b)

Sol: Centrifugal pump is suitable for large discharge and low head as compared to reciprocating pump.

81. A hydraulic press has a ram of 300 mm diameter and a plunger of 45 mm diameter. When the force applied at the plunger is 50 N, the weight lifted by the hydraulic press will be nearly
(a) 2133 N
(b) 2223 N
(c) 2316 N
(d) 2406 N

81. Ans: (b)

Sol:



d. 45 mm
F. 50 N

D. 300 mm
W . ?

$d = 45$ mm $\quad D = 300$ mm

$F = 50$ N $\quad W = ?$

$$\frac{F}{\frac{\pi}{4}d^2} = \frac{W}{\frac{\pi}{4}D^2}$$

$$W = F\left(\frac{D^2}{d^2}\right)$$

$$= 50\left(\frac{300}{45}\right)^2$$

$$= 2222.2 \text{ N} = 2223 \text{ N}$$

82. 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 head on turbine
(d) Inversely proportional to velocity of whirl at inlet and directly proportional to net head on turbine

82. Ans: (a)

Sol: Hydraulic efficiency (η_h) is defined as

$$\eta_h = \frac{\text{Runner power}}{\text{Hydraulic power}} = \frac{\rho Q V_{w1} u_1}{\rho g Q H}$$

$$\eta_h = \frac{V_{w1} u_1}{gH}$$

83. A turbine develops 7225 kW power under a head of 25 m at 135 rpm. The specific speed of the turbine will be nearly
(a) 245 rpm (b) 225 rpm
(c) 205 rpm (d) 185 rpm

83. Ans: (c)

Sol:
$$N_s = \frac{N\sqrt{P}}{H^{5/4}} = \frac{135\sqrt{7225}}{25^{5/4}} = 205.3$$

84. Which one of the following is an example of bodies where both drag and lift forces are produced?
(a) Hydrofiles
(b) A tall chimney exposed to wind
(c) Flow of water past a bridge pier
(d) Motion of aeroplanes, submarines, torpedoes

84. Ans: (d)

Sol: The geometry profile of aeroplanes, submarines and torpedoes are such that both the drag forces of lift forces are significant.

85. The relative humidity h is a measure of air's capacity, at its existing temperature, to absorb further moisture, and is defined by the relation
(a) $\frac{e}{e_s} \times 100$ (b) $\frac{e_s}{e} \times 100$
(c) $\frac{2e_s}{e} \times 100$ (d) $\frac{2e}{e_s} \times 100$

where: e = vapour pressure
e_s = saturation vapour pressure

85. Ans: (a)

Sol: Relative Humidity is the ratio of the actual vapour pressure to the saturation vapour pressure expressed on percentage

$$RH = \frac{\text{Actual vapour pressure}}{\text{Saturation vapur pressure}} \times 100$$

$$RH = \frac{e}{e_s} \times 100$$

86. Which one of the following is **not** a major deterrent in water harvesting through water tanks?
(a) Deforestation mainly due to population pressure in the catchments of tank systems
(b) Siltation
(c) Lack of maintenance and repairs and breaches of tank embankments
(d) Shallow depth of water tanks

86. Ans: (d)

Sol: Water tanks are generally of shallow depth of about 1 to 3 m

87. Which one of the following is ***not*** a basic requirement for any well screen?
(a) Resistance to corrosion, incrustation and deterioration
(b) Enough structural strength to prevent collapse
(c) Suitability for excessive movement of sand into the well
(d) Minimum resistance to flow of water into the well

87. Ans: (c)

Sol: **Well Screen Requirements:**
→ Sufficient column and collapse strength
→ Resistance to corrosion
→ Non clogging slots
→ Prevent entry of fine aquifer material into the well

88. Which one of the following methods is **not** the category of Geophysical methods of sub-surface investigation?
(a) Electrical resistivity method
(b) Electric logging
(c) Gamma-ray logging
(d) Electrical response surveying

88. Ans: (c)

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89. In which one of the following industries, the water requirement in kilo litres per unit of production is very high?
(a) Paper industry
(b) Steel industry
(c) Sugar industry
(d) Fertilizer industry

89. Ans: (b)

Sol: Steel Industry Consume more water than Paper, Fertilizer and Sugar Industry for every 1 tonne of raw material used.

90. In drip irrigation system, which one of the following emitters is ***not*** based on definitions by American Society of Agricultural Engineers (ASAE)?
(a) Emitter
(b) Pulsating emitter
(c) Long path emitter
(d) Multi-outlet emitter

90. Ans: (b)

Sol: Laminar flow regimes with long flow path & low discharges turbulent flow exist in long path and multi exit emitters with relatively high discharges and in nozzle or vortex type emitters.

As pressure dissipation is most important characteristics of good emitters - long path emitters.

- Nozzle or orifice type
- Leaking lateral type

For other purposes like discharge lateral connection, water distribution served by them.

∴ The one NOT given by ASAE is pulsating emitter.

91. A Persian wheel with an average discharge of 230 litre/minute irrigates 1 hectare wheat crop in 50 hours. The average depth of irrigation will be nearly
(a) 4 cm (b) 5 cm
(c) 6 cm (d) 7 cm

91. Ans: (d)

Sol: Q = 230 *l*it/min

Time = 50 hrs

Volume = Q × t

$= 230 \times 60 \times 50$ *l*it

$= 690{,}000$ lit

$= 690\ m^3$

Area = 1 ha = $10^4\ m^2$

$$\text{Depth} = \frac{690\ m^3}{10^4\ m^2}$$

$= 0.069$ m

$= 6.9$ cm $\simeq$ 7 cm

92. Which one of the following is ***not*** the main cause for soil salinity and sodicity?
(a) Irrigation mismanagement
(b) Poor land levelling
(c) Use of heavy machinery, resulting in no soil compaction
(d) Leaching without adequate drainage

92. Ans: (c)

Sol: Main cause for soil salinity and sodicity are

- Irrigation mis management like over irrigation, improper drainage system.
- Poor land levelling will make soil more saline.
- Teaching without adequate soil drainage system.
- Sea water intrusion in to coastal lands

Only odd answer is (c) of heavy machinery

93. Which one of the following is ***not*** the major factor influencing seepage from a canal?
(a) Characteristics of the soil traversed by the canal system
(b) Area wetted by the canal
(c) Location of the canal
(d) Frequencies of canal usage

93. Ans: (c)

Sol: Characteristics of Soil: Transversed by canals will influence seepage.

Area wetted also influence seepage from a canal, frequencies of canal usage also control seepage. The only factor that does not control

94. Which of the following are the causes of failure of weirs?

1. Rupture of floor due to uplift
2. Rupture of floor due to suction caused by standing wave
3. Scour on the upstream and downstream of the weir

(a) 1 and 2 only (b) 1 and 3 only
(c) 1, 2 and 3 (d) 2 and 3 only

94. Ans: (c)

Sol: Main cause of failures are

1. Piping/ground water seeping out of
2. Rupture of floor due to uplift
3. Rupture of floor due to suction caused by standing waves (Hydraulic jump formed at the downstream of weir)
4. Scour on the upstream and downstream of the weir (occurs due to contraction of natural water way)

95. Which of the following are the principal factors influencing the choice of a particular method of lining?

1. Availability and cost of the material at the site or within easy reach
2. Velocity of flow in the channel
3. Cost of maintenance

(a) 1 and 2 only (b) 1 and 3 only
(c) 1, 2 and 3 (d) 2 and 3 only

95. Ans: (c)

Sol: Material used for canal lining

- Water tightness
- Hydraulically efficient
- Strong and durable
- Less initial cost
- Less maintenance cost
- Resist against growth of weed
- Should withstand high velocity

Out of given choices 1, 2, 3 all three are correct.

96. Which of the following are the objectives for river training?

1. High flood discharge may pass safely and quickly through the reach
2. To make the river course stable and reduce bank erosion to minimum
3. To check flow through canal
4. To provide a sufficient draft for navigation as well as good course for it

(a) 1, 2 and 3 only (b) 1, 3 and 4 only
(c) 1, 2 and 4only (d) 2, 3 and 4 only

96. Ans: (c)

Sol: The objectives of river training works are

i) High flood discharge may pass safely and quickly through the reach
ii) Sediment load may be transported efficiently
iii) To make river course stable and minimize bank erosion
iv) To provide a sufficient draft for navigation as well as good course for it.
v) To fix direction of flow through certain defined reach

Out of given objectives 1, 2 & 4 only correct

97. The transition region between unsaturated zone and saturated zone is called

(a) Capillary fringe (b) Water table
(c) Yadose water zone (d) Confining bed

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Networks	5 Q	Networks	6 Q	DS,PL& Algorithm	10 Q	SOM	5 Q	SOM	6 Q
Control System	5 Q	Control System	6 Q	DBMS	5 Q	FM & HM	5 Q	FM & HM	5 Q
Analog Electronics	4 Q	Analog Electronics	5 Q	Computer Networks	5 Q	Geo Technical Engg.	7 Q	TOM	6 Q
Digital Electronics	5 Q	Digital Electronics	5 Q	Operating System	6 Q	Environmental	7 Q	Machine Design	4 Q
Electrical Machines	8 Q	Signal & Systems	5 Q	Computer Organization	4 Q	Transportation	4 Q	Thermal	7 Q
Power System	7 Q	EDC & VLSI	5 Q	Theory of Computation	6 Q	RCC& STEEL	6 Q	Heat Mass Transfer	4 Q
Power Electronics	6 Q	Communications	8 Q	Digital Electronics	4 Q	Surveying	6 Q	Production	8 Q
Engg. Maths	5 Q	Engg. Maths	5 Q	Engg. Maths	5 Q	Engg. Maths	5 Q	Engg. Maths	5 Q
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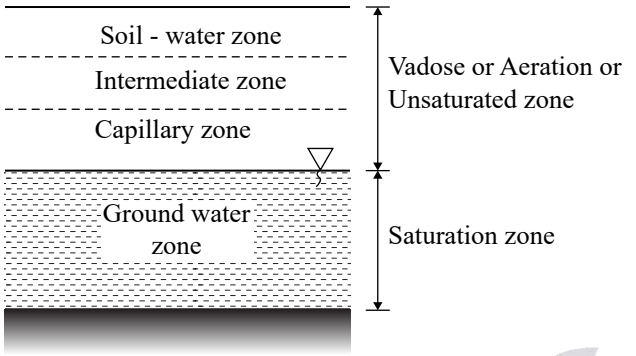
97. Ans: (a)

Sol:



98. Which of the following chemical parameters are associated with the organic content of water?
    1. Biological Oxygen Demand (BOD)
    2. Chemical Oxygen Demand (COD)
    3. Total Organic Carbon (TOC) and Total Oxygen Demand (TOD)

    (a) 1 and 2 only (b) 1 and 3 only
    (c) 2 and 3 only (d) 1, 2 and 3

98. Ans: (c)

Sol: Chemical parameters associated with organic content of water are
1. TOC & TOD
2. COD

BOD is a measure of biodegradable organic matter present in sewage.

99. When chlorine is dissolved in water, it reacts to form hypochlorous acid and hypochlorite ions. At pH < 5, chlorine exists in water as
    (a) Elemental or molecular chlorine
    (b) Remains in the form of hypochlorous acid
    (c) Remains int he form of hypochlorite ions
    (d) Remains int he form of both hypochlorous acid and hypochlorite ions

99. Ans: (a)

Sol: At pH < 5 chlorine does not dissolve in water and remain as elemental chlorine only.
At pH > 5 chlorine dissolve and produce HOCl and OCl^- in water.

100. Reactive substances are
    (a) Unstable under normal conditions. They can cause explosions and/or liberate toxic fumes, gases, and vapors when mixed with water
    (b) Easily ignited and burn vigorously and persistently
    (c) Liquids with pH less than 2 or grater than 12.5, and those that are capable of corroding metal containers
    (d) harmful or fatal when ingested or absorbed

100. Ans: (a)

Sol: Reactive substances are those that spontaneously under go chemical reaction with water.

101. The noise value of sound waves depends upon
    1. The frequency of sound waves
    2. The intensity of sound waves
    3. The time of exposure of sound waves

    (a) 1 and 2 only (b) 1 and 3 only
    (c) 2 and 3 only (d) 1, 2 and 3

101. Ans: (d)

Sol: The noise valve of sound waves depends on intensity and frequency of sound waves. Frequency in turn depends on time.

102. Which one of the following type of treatments will be used for neutralization of alkaline effluent?
    (a) Lime stone treatment
    (b) Caustic lime treatment
    (c) Carbon dioxide treatment
    (d) Hydrochloric acid treatment

102. Ans: (c)

Sol: CO_2 reduces the pH of water by forming carbonic acid. Therefore to neutralize alkaline effluent it is treated with CO_2 gas.

103. Flocculation is the process of
(a) Gently mixing the water and coagulant allowing the formation of large particles of floc
(b) Removing relatively large floating and suspended debris
(c) Flow, which is slowed enough so that gravity will cause the floc to settle
(d) Mixture of solids and liquids collected from the settling tank are dewatered and disposed of

103. Ans: (a)
Sol: Flocculation is the growth of destabilized colloidal particles into a lump of large flocculant substances.

104. In solid waste management, waste utilization is achieved by
(a) Recover, Reclamation and Reproduce
(b) Reuse, Reclamation and Recycling
(c) Recover, Recycling and Reproduce
(d) Reuse, Reproduce and Recycling

104. Ans: (b)
Sol: In solid waste management waste utilization is achieved by Reuse, Recycling and Reclamation.

105. The frequency range for hearing the sound by a human ear is int he range of
(a) 20 Hz – 200 kHz (b) 10 Hz – 20 kHz
(c) 20 Hz – 20 kHz (d) 10 Hz – 20 Hz

105. Ans: (c)
Sol: Frequency of sound audible to human ear is 20 Hz to 20000 Hz i.e. 20 Hz to 20 kHz.

106. Physiological responses accompanying response and other noise exposures include:
1. A vascular response characteristic by peripheral vasoconstriction, changes in heart beat rate and blood pressure
2. Various glandular charges such as increased output of adrenaline evidenced by chemical changes in blood
3. Slow, deep breathing
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

106. Ans: (a)
Sol: Physiological response, accompanying response and other noise exposures include changes in heart beat rate and blood pressure.

107. Electrostatic precipitators are used for removal of
1. Gaseous contaminants
2. Liquid contaminants
3. Particulate contaminants
(a) 1 only (b) 2 only
(c) 3 only (d) 1, 2 and 3

107. Ans: (c)
Sol: Electrostatic precipitators are used to separate particulate matter from flue gas (dirty gas).

108. Which one of the following type of ecology is dealt with autecology?
(a) Synecology
(b) Community ecology
(c) Ecosystem ecology
(d) Individual species ecology

108. Ans: (d)
Sol: Autecology is the study of individual species ecology.

109. A soil sample has a porosity of 40% and the specific gravity of solid is 2.70. If the soil is 50% saturated, the unit weight will be nearly
(a) 22 kN/m³ (b) 20 kN/m³
(c) 18 kN/m³ (d) 16 kN/m³

109. Ans: (c)
Sol: n = 40%, G = 2.7, S = 50%

$$e = \frac{n}{1-n} = \frac{0.4}{1-0.4} = \frac{0.4}{0.6} = 0.667$$

Take $\gamma_w = 9.81\ kN/m^3$

$$\gamma = \gamma_w\left[\frac{G + e.S}{1+e}\right]$$

$$= 9.81\left[\frac{2.7 + 0.667 \times 0.5}{1 + 0.667}\right] = 17.85\ kN/m^3$$

Say $18\ kN/m^3$

110. Oven dry mass of a pat of clay is 10.8 gm and mass of mercury displaced on immersion is 84.2 gm. If the specific gravity of solids is 2.72 and the density of the mercury is 13.6 g/cm³, the shrinkage limit of the soil will be nearly
(a) 12% (b) 15%
(c) 18% (d) 21%

110. Ans: (d)

Sol: $W_d = 10.8$ gm, $G = 2.72$

Volume of soil sample is equal to volume mercury displaced.

$$= \frac{\text{Mass of mercury displaced}}{\text{density of mercury}}$$

$$V = \frac{84.2}{13.6} = 6.19\ cm^3$$

For soil, $\gamma_d = \frac{W_d}{V} = \frac{10.8}{6.19} = 1.745\ gm/cm^3$

Dry state,

$$G_m = \frac{\gamma_d}{\gamma_w} = \frac{1.745}{1} = 1.745$$

$$w_s = \left[\frac{1}{G_m} - \frac{1}{G}\right]100$$

$$= \left[\frac{1}{1.745} - \frac{1}{2.72}\right]100 = 20.6\%$$

Say 21%

111. The suitability number of a backfill for $D_{50} = 1$ mm, $D_{20} = 0.5$ mm and $D_{10} = 0.08$ mm will be nearly
(a) 16 (b) 18
(c) 20 (d) 22

111. Ans: (d)

Sol: Given:

$D_{50} = 1$ mm

$D_{20} = 0.5$ mm

$D_{10} = 0.08$ mm

Suitability number, for rating a backfill given by Brown (1997)

$$S_N = 1.7\sqrt{\frac{3}{(D_{50})^2} + \frac{1}{(D_{20})^2} + \frac{1}{(D_{10})^2}}$$

Where

D_{50}, D_{20} & D_{10} are diameter in mm

$$= 1.7\sqrt{\frac{3}{1^2} + \frac{1}{0.5^2} + \frac{1}{0.08^2}}$$

$$= 21.7 \simeq 22$$

112. The porosity of a soil n is
(a) $\frac{e}{1+e}$ (b) $\frac{e}{1-e}$
(c) $\frac{e+1}{e}$ (d) $\frac{e-1}{e}$

where: e = Void ratio

112. Ans: (a)

Sol: $n = \frac{e}{1+e}$

113. A coarse-grained soil has a void ratio of 0.78 and specific gravity as 2.67. The critical gradient at which a quick sand condition occurs will be
(a) 0.62 (b) 0.74
(c) 0.82 (d) 0.94

113. Ans: (d)

Sol: $e = 0.78$, $G = 2.67$

$$i_c = \frac{G-1}{1+e} = \frac{2.67-1}{1+0.78} = 0.94$$

114. Which of the following assumptions of the Rankine theory of lateral earth pressure are correct?
1. The soil mass is semi-infinite, homogeneous, dry and cohesionless
2. The ground surface is a plane which may be horizontal or inclined
3. The wall yields about the base and thus satisfies and deformation condition for plastic equilibrium

(a) 1 and 2 only (b) 1 and 3 only
(c) 1, 2 and 3 (d) 2 and 3 only

114. Ans: (c)

Sol: Rankine's theory Assumptions:

1 Soil is homogeneous, semi – infinite, dry and cohesionless.

2 Ground (or) Top surface is plane which may be horizontal (or) inclined.

3 For plastic equilibrium condition, failure should occur at all points in soil mass which is theoretical. So, it is assumed as local states of plastic equilibrium in a soil mass can be created by rotating a retaining wall about its base either away (or) into the backfill.

115. The ratio of the horizontal stress to the vertical stress is called coefficient of
(a) Active earth pressure
(b) Passive earth pressure
(c) Earth pressure
(d) Plastic earth pressure

115. Ans: (c)

Sol: $\sigma_h = K.\sigma_v$

$$\therefore K = \frac{\sigma_h}{\sigma_v}$$

K = Coefficient of earth pressure

116. A bed consists of compressible clay of 4 m thickness with previous sand on top and impervious rock at the bottom. In a consolidation test on an undisturbed specimen of clay from this deposit 90% settlement was reached in 4 hours. The specimen was 20 mm thick. The time for the building founded over this deposit to reach 90% of its final settlement will be
(a) 91 years (b) 82 years
(c) 73 years (d) 64 years

116. Ans: (c)

Sol: Consolidation test specimen:

Thickness, $H_1 = 20$ mm

Drainage path, $d_1 = \frac{H_1}{2} = 10$ mm (usually double drained in consolidation test)

$t_1 = 4$ hrs

Field clay:

Thickness, $H_2 = 4$ m

$d_2 = H_2 = 4$ m $= 4000$ mm (Single drained, given)

$t_2 = ?$

$t \propto d^2$

$$\frac{t_2}{t_1} = \left[\frac{d_2}{d_1}\right]^2$$

$$\frac{t_2}{t_1} = \left[\frac{4000}{10}\right]^2$$

$t_2 = 64 \times 10^4$ hours

$= 73$ years

117. A 30 cm square bearing plate settles by 8 mm in the plate load test on cohesionless soil when the intensity of loading is 180 kN/m^2. The settlement of a shallow foundation of 1.5 m square under the same intensity of loading will be nearly
(a) 30 mm (b) 26 mm
(c) 22 mm (d) 18 mm

117. Ans: (c)

Sol: $B_P = 0.3$ m, $S_P = 8$ mm

$B_F = 1.5$ m, $S_F = ?$

For cohesionless soil,

$$\frac{S_F}{S_P} = \left[\frac{B_F(B_P + 0.3)}{B_P(B_F + 0.3)}\right]^2$$

$$\frac{S_F}{8} = \left[\frac{1.5(0.3 + 0.3)}{0.3(1.5 + 0.3)}\right]^2$$

$S_F = 22.2$ mm

118. When the observed value of N exceeds 15, the corrected penetration number N_c as per Terzaghi and Peck recommendation in the silty fine sands will be

(a) $15 - \frac{1}{2}(N_R - 15)$ (b) $15 - \frac{1}{2}(N_R + 15)$

(c) $15 + \frac{1}{2}(N_R - 15)$ (d) $15 + \frac{1}{2}(N_R + 15)$

Where: N = Penetration number, and

N_R = Recorded value

118. Ans: (c)

Sol: It is the dilatancy correction formula.

119. A canal of 4 m deep has side slopes of 1 : 1. The properties of the soil are c = 15 k N/m^2, $\phi = 15°$, e = 0.76 and G =2.7. Taylor's stability number for that sudden draw down = 0.136. The factor of safety with respect to cohesion in the case of sudden draw down will be

(a) 0.64 (b) 1.43

(c) 2.22 (d) 3.01

119. Ans: (b)

Sol: $H = 4$ m, $C = 15$ kN/m^2, $e = 0.76$, $G = 2.70$

$S_n = 0.136$

$$\gamma_{sat} = \gamma_w\left[\frac{G + e}{1 + e}\right]$$

$$= 9.81\left[\frac{2.70 + 0.76}{1 + 0.76}\right] = 19.3 \text{ kN/m}^3$$

For sudden draw down, $F_C = \frac{C}{S_n \gamma_{sat}.H}$

$$= \frac{15}{0.136 \times 19.3 \times 4}$$

$$= 1.43$$

120. The stability or shear strength of fine grained soils can be increased by draining them with the passage of direct current through them. This process is known as

(a) Electro -osmosis

(b) Zeta potential

(c) Electro-chemical hardening

(d) Consolidation

120. Ans: (a)

Sol: Electro -Osmosis is one of the ground modification technique used for low permeable soils it is used for dewatering of fine grained soils. The water in the pores of soil will flow out due to the ions with positive charge that are created by applying a direct current. It improves shear strength of clayey soils.

121. The combined correction for curvature and refraction for a distance of 3400 mm will be nearly

(a) 0.2 m (b) 0.4 m

(c) 0.6 m (d) 0.8 m

121. Ans: (d)

Sol: $C = 0.06735D^2$

$= 0.06735 \times 3.4^2$

$= 0.77856$ m

$\simeq 0.8$ m

122. A 100 m tape is suspended between the ends under a pull of 200 N. If the weight of the tape is 30 N, the correct distance between the tape ends will be nearly

(a) 100.5 m (b) 100 .3 m

(c) 100.1 m (d) 99.9 m

122. Ans: (d)

Sol: P = 200 N; W = 30 N

L = 100 m

$$\frac{W^2L}{24p^2} = \frac{30^2 \times 100}{24 \times 20}$$

$$= 0.09375\text{m}\ (-)$$

C .D = 100 – 0.09375

= 99.906 m ≃ 99.9 m

123. In horizontal distance measurement, the basic formula for distance in stadia tachometry has an additive constant. An anallatic lens is inserted in the tachometer to make this additive constant zero. This lens is

(a) Convex lens inserted between object glass and diaphragm

(b) Plano-convex lens between object glass and diaphragm

(c) Plano-convex lens between diaphragm and eye piece

(d) Convex lens inserted between diaphragm and eye piece

123. Ans: (b)

Sol: Anallatic lens or unalterable lens are an additional Plano -convex lens provided between object glass and the of tacheometer diaphragm to make the multiplying constant (K) = 100 and Additive constant (C) = 0. It has the draw back that -it reduces the brightness of the image by the increased absorption of the light in the telescope but it is used to make the calculations are easy to calculate the Horizontal distance.

124. If the LMT is $8^h\ 12^m\ 16^s$ AM at 38° 45' W longitude, the GMT will be

(a) $11^h\ 12^m\ 16^s$ AM

(b) $10^h\ 47^m\ 16^s$ AM

(c) $9^h\ 29^m\ 46^s$ AM

(d) $5^h\ 29^m\ 46^s$ AM

124. Ans: (b)

Sol: LMT: $8^h\ 12^m\ 16^s$ AM

38° 45' W longitudinal

GMT = L.M.T ± longitude of W/E

+ve for West

-ve for East

$$38°\ 45'\ \text{W} = \frac{38°}{15} = 2\text{h}$$

15° → 1 hr

15′ → 1 m

15″ → 1s

$$\frac{(8 \times 60 + 45)}{15} = 35\ \text{m}$$

38° 45′ = 2 hr 35 m

∴ GMT = 8h 12m 16s

(+)2h 35m 0s

10h 47m 16s AM

125. A section line AB appears to be 10.16 cm on a photograph for which the focal length is 16 cm. The corresponding line measures 2.54 cm on a map, which is to a scale $\frac{1}{50,000}$. The terrain has an average elevation of 200 m above mean sea level. The flying altitude of the aircraft above mean sea level during photograph will be

(a) 1800 m (b) 2000 m

(c) 2200 m (d) 2400 m

125. Ans: (c)

Sol:

$$\frac{\text{P.D}}{\text{M.D}} = \frac{\text{P.S}}{\text{M.S}}$$

$$\frac{10.16}{2.54} = \frac{\text{P.S}}{\left(\frac{1}{50,000}\right)}$$

$$\text{P.S} = \frac{1}{50,000} \times \frac{10.16}{2.54} = \frac{1}{12,500}$$

$$S = \frac{f}{H-h} \Rightarrow \frac{1}{12,500} = \frac{16 \times 10^{-2}}{H-200}$$

$\Rightarrow H = 200 = 2000$

$\therefore H = 2200$ m

126. If back sight and foresight distances are balanced
1. The difference in elevation between two points can be directly calculated by taking difference of the two readings
2. No correction for the inclination of the line of sight is necessary

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

126. Ans: (c)

Sol: By balancing backsight and foresight , error due to non-parallism of line of collimation, combined error due to curvature and refraction will also be eliminated.

127. A railway curve of 1350 m radius is to be set out to connect two tangents. If the design speed is 110 kmph and the rate of change of acceleration is 0.3 m/s^3, the shift of the circular curve will be nearly
(a) 0.18 m (b) 0.16 m
(c) 0.14 m (d) 0.12 m

127. Ans: (b)

Sol: R = 1350 m; V = 110 kmph

$\alpha = 0.3$ m/s^3

$$L = \frac{\upsilon^3}{R\alpha} \text{ or } L = \frac{V^3}{14R}$$

$$L = \frac{110^3}{14 \times 1350} = 70.4232 \text{ m}$$

$$\text{Shift} = S = \frac{L^2}{24R} = \frac{70.4232^2}{24 \times 1350}$$

$= 0.1531$ m

$\simeq 0.16$ m

128. A theodolite is called a transit theodolite, when its telescope can be revolved through a complete revolution about its
(a) Vertical axis in an inclined plane
(b) Horizontal axis in an inclined plane
(c) Vertical axis in a horizontal plane
(d) Horizontal axis in a vertical plane

128. Ans: (d)

Sol: Transiting/plunging/reversing is the one in which a telescope can be rotated in a vertical plane by 180°about Horizontal axis (plane). If a theodolite is made with transiting provision, it is called as transit vernier theodolite.

129. Stalactites and stalagmites are features of
(a) Stream erosion developed in limestone region by specific chemical reaction
(b) Ground water deposition in caves formed by precipitation from dripping water rich in calcium carbonate
(c) Marine erosion and deposition formed along coastal regions by selective erosion followed by deposition by waves
(d) A centripetal drainage in which streams from different directions flow towards a common central basin

129. Ans: (b)

Sol: The two most commonly known cave deposits are stalactites and stalagmites. These are variously shaped deposits, generally rod like in appearance and structure and made up commonly from calcium carbonate deposited from dripping ground water.

Stalactites are the cone shaped pillar of calcium carbonate, hang down from the roof of the cave.
Stalagmites are also ground water deposits of the same category as the stalactites but are made by deposition from the carbonate-rich droplets from ground upwards.

130. Which of the following statements with reference to isogonic line are correct in magnetic declination?
1. It is drawn through the points of same declination.
2. It does not form complete great circle
3. It radiates from north and south magnetic regions and follow irregular paths
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

130. Ans: (d)

Sol: Isogonic line is the line drawn through the points of same declination the distribution of earth magnetism is not regular and consequently isogonic lines do not form completely great circles, but radiating from the north and south magnetic regions they follow irregular paths.

131. Mountains resulting from the depression or elevation of blocks of the earth crust on a large scale due to faulting and these elevated structures are commonly called
(a) Fault block mountains (b) Volcanic mountains
(c) Relict mountains (d) Residual mountains

131. Ans: (a)

Sol: Faulting always results in relative displacement of blocks of the crust of the earth along a plane of rupture. Sometimes this displacement is lateral in character and at other time it is vertical or oblique in nature.

132. A little gap is left between the head of the glaciated valley and the mass of the glacier ice. This gap is known as
(a) Bergs -chrund (b) Arete
(c) Horn (d) Cirque

132. Ans: (a)

Sol: In cirques, a little gap is generally left between the head of the glaciated valley and the mass of the glacier ice. This gap is known as the "bergs-chrund".

133. The sight distance available on a road to a driver at any instance depends on
1. Features of the road ahead
2. Height of the driver's eye above the road surface
3. Height of the object above the road surface
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

133. Ans:(d)

Sol: Sight distance available on a road depend on
(a) Feature of road i.e. gradient etc
(b) Height of driver's eye above road surface
(c) Height of object eye above road surface
(d) Speed of the vehicle
(e) efficiency of brakes etc.

134. Consider the following data
Design speed = 96 kmph
Speed of overtaken vehicle = 80 kmph
Reaction time for overtaking = 2 sec
Acceleration = 2.5 kmph/sec
The safe overtaking sight distance on a two-way traffic road will be nearly
(a) 646 m (b) 556 m
(c) 466 m (d) 376 m

134. Ans: (a)

Sol: Design speed V = 96 kmph = 26.67 m/sec; speed of overtake vehicle, V_b = 80 kmph = 22.22 m/sec
Acceleration = 2.5 km ph/sec

$$= 2.5 \times \frac{5}{18} \text{ m/sec}^2$$

$d_1 = V_b t = 22.22x\ 2 = 44.44$ m/sec

$$d_2 = V_b T + \frac{1}{2} a T^2$$

$$T = \sqrt{\frac{4s}{a}}$$

$S = 0.7V_b + l$ (l = 6m)
= 0.7 x 22.22 + 6
= 21.56 m

$$\therefore T = \sqrt{\frac{4 \times 21.56}{2.5 \times \frac{5}{18}}} = 11.14 \text{ sec}$$

$$d_2 = (22.22 \times 11.14) + \left(\frac{1}{2} \times 2.5 \times \frac{5}{18} \times 11.14^2\right)$$

$= 290.62$ m

$d_3 = VT$

$= 26.67 \times 11.14$

$= 297.07$ m

Overtaking sight distance

$= 44.44 + 290.62 + 297.07$

$= 632.12$ m

135. Which one of the following statements is correct?
(a) The ratio of load on wheel to contact area or area of imprint is called as contact pressure
(b) The ratio of load on wheel to contact pressure is called as rigidity factor
(c) The value of rigidity factor is more than three for an average tyre pressure of 7 kg/cm^2
(d) Rigidity factor does not depend upon the degree of tension developed in walls of tyres

135. Ans: (a)

Sol:

- Contact pressure is the pressure exerted by wheel on the ground. i.e., ratio of wheel load to contact area.
- Rigidity factor is the ratio of contact pressure to tyre pressure. i.e. it depends on tension developed in walls of tyres.
- For a tyre pressure of 7 kg/cm^2 ; rigidity factor = 1

136. Which one of the following is not the correct type of critical load position in pavement slab design for the load on the pavement surface?
(a) Interior loading
(b) Edge loading
(c) Eccentric loading
(d) Corner loading

136. Ans: (c)

Sol: The critical load positions considered in design of rigid pavement are
(a) corner loading
(b) edge loading
(c) interior loading

137. Which of the following statements are correct regarding Westergaard's concept for temperature stresses?
1. During the day, the top of the pavement slab gets heated under the sun light when the bottom of the slab becomes hot
2. During summer season as the mean temperature of the slab increases, the concrete pavement expands towards the expansion joints
3. Due to frictional force at the interface, compressive stress is developed at the bottom of the slab as it tends to expand

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

137. Ans: (b)

Sol: The temperature on top surface will be more than that of bottom surface during the day time.

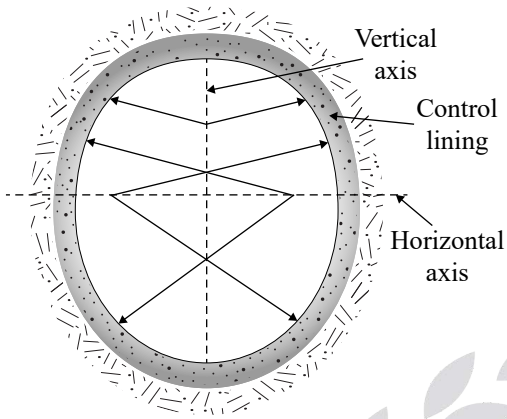
138. Which of the following advantages are correct regarding Poly-centric shape tunnel?
1. It can be conveniently used for road and railway traffic
2. The number of centres and lengths of radii cannot be fixed
3. It can resist external and internal pressure due to its arch action.

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

138. Ans: (c)

Sol: Polycentric shape tunnel is an extended form of Horse-shoe shaped tunnel. It is made of curves of different radii and centres. It provides sufficient flat pase for traffic movement. Hence it is conveniently used for road and railway traffic.

Due to its arch shape, it can resist external and internal pressure.



Polycentric tunnel

139. Which one of the following statement is correct regarding Journal friction?
(a) Caused due to the wave action of rails
(b) The amount does not depend upon the type of bearing
(c) For roller bearings, it varies from 0.5 to 1.0 kg per tonne
(d) For couple boxes, it lubricates by hard grease from 0.5 kg to 1.0 kg per tonne

139. Ans: (c)

Sol: Journal friction is x type of resistance offered by friction between internal parts of locomotives and wagons. It is also friction between metal surface of rail and wheel, moving at a constant speed.
It depends on type of bearing, lubricant used, temperature and condition of bearing etc.
In case of roller bearing, it varies from 0.5 to 1 kg/ tonne.

140. For the construction of a 640 m long B.G. railway track by using a sleeper density of M + 5, and the length of each rail is 12.8 m, the number of sleepers required will be
(a) 1000 (b) 900
(c) 800 (d) 700

140. Ans: (b)

Sol: Length of each rail = 12.8 m
Sleeper density = M+5
= 12.8 + 5 = 17.8
i.e. number of sleepers required fro one rail = 17.8 say 18 No's
Number of rails in 640 m long BG track

$$= \frac{640}{12.8} = 50$$

Number of sleepers required = 50 × 18 = 900

141. Which one of the following statement is correct regarding ballast used for railway tracks?
(a) The minimum depth of ballast for B.G. section is 20 cm - 25 cm
(b) The quantity of stone ballast required for one metre length of track is 0.53 m^3 for B.G. section
(c) For M.G. section the width of ballast is 1.83 m
(d) The minimum depth of ballast for N.G. section is 10 cm

141. Ans: (a)

Sol: As per Indian railway Board,
Minimum depth of ballast for BG track = 200 mm = 20 cm
Quantity of stone ballast for BG track = 1.02 to 1.12 m^3/ metre run
Width of ballast for MG track = 2.3 m = 230 cm
Minimum depth of ballast for NG track = 150 mm = 15 cm

142. Which one of the following statement is correct?
(a) The radius of transition raises from infinity to a selected minimum in order to attain full super elevation and curvature gradually
(b) The compound curve is an arc of circle
(c) The radius of transition curve is constant for entire length
(d) The horizontal curves are provided whenever there is a change in gradient

142. Ans: (a)

Sol: Transition curves are provided to change the horizontal alignment gradually i.e. from straight to curve i.e. radius of transition curves varies from infinity to radius of circular curve.

It is also provided to gradually introduce the super elevation, centrifugal force, extra widening.

Compound curve is a combination of two (or) more simple circular unless of different radii.

Whenever there is a change is gradient, vertical curves are provided.

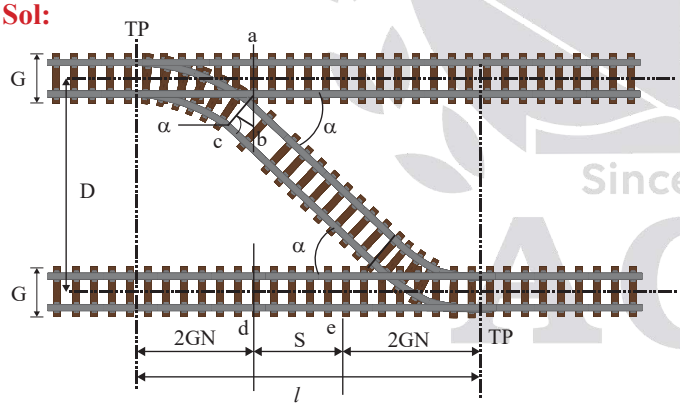
143. A cross-over occur between two Metre Gauge parallel tracks of same crossing number 1 in 12 with straight intermediate portion between the reverse curves and the distance between the centres of tracks is 3.5 m. If the value of G is 1 m, the intermediate straight distance will be nearly

(a) 12 m (b) 15 m

(c) 18 m (d) 21 m

143. Ans: (c)

Sol:



Grossing number = 1 in 12

Gauge G = 1 m

Centre to centre distance between tracks = D = 3.5 m

Intermediate straight distance

$= (D - G)N - G\sqrt{1 + N^2}$

$= (3.5 - 1)12 - 1\sqrt{1 + 12^2}$

$= 30 - 12.04 = 17.958 \text{ m} \simeq 18 \text{ m}$

144. Which one of the following is the correct standard for provision of curves on railway track?

(a) Cant excess on B.G. shall not be allowed to exceed 105 mm

(b) Minimum radius of vertical curves for group A, Broad Gauge track is 4,000 m

(c) The minimum value of super elevation according to Railway Board is $\frac{1}{10}$ the of gauge

(d) The speed potential of curve is given by formula $E = \frac{V^2}{127\,R}$ where, E is super elevation in mm

144. Ans: (b)

Sol:

- Max allowable cant excess for BG tracks is 75 mm
- Minimum radius of vertical curve of BG track:
  For group A is 4000 m
  For group B is 3000 m
  For group C, D, E is 2500 m.
- Maximum value of super elevation $\sim \frac{1}{10}$ of the gauge
- Speed potential of curve is its maximum speed $= 0.27\sqrt{(C_a + C_d) \times R}$
  C_a = Actual cant , C_d = Cant Deficiency, R = Radius of curve

Directions:

Each of the next Six (06) items consists of two statements, one labelled as the 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the codes given below.

Codes:

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)

(b) Both statement (I) ans 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

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AIR 9 — B. SREEKAR — IN

AIR 9 — ATULYA JYOTI — PI

AIR 10 — GEETH GEORGE — EE

AIR 10 — ASIF KHAN — CE

AIR 10 — MAHESH SINGH YADAV — ME

AIR 10 — GARVIT GUPTA — XE

AIR 10 — MANMOHAN ARORA — PI

AIR 10 — SHUBHAM PANDE — PI

and many more...

	TOP 10	TOP 100
CE	5	44
ME	6	60
EE	7	71
EC	9	74
CS	5	28
IN	10	74
PI	10	49

145. **Statement (I):** Finer grinding of cement results in early development of strength.
Statement (II): The finer the cement, the higher is the rate of hydration.

145. Ans: (a)

146. **Statement (I):** Pozzolana is added to cement to increase early strength.
Statement (II): It reduces the heat of hydration.

146. Ans: (d)

147. **Statement (I):** Coarser the particles, less is optimum moisture content.
Statement (II): The specific surface area of coarser particle is less

147. Ans: (a)

148. **Statement (I):** A reverse curve consists of two arcs with their centres of curvature on opposite sides of the curve.
Statement (II): Super-elevation can be provided conveniently at the intersection point of the two arcs.

148. Ans: (c)

Sol:

- A reverse curve consists of two arcs of the same or different curvatures but with centres of curvatures on opposite sides of the curve.
- Super elevation cannot be provided conveniently at the intersection points of the two arcs.

Hence Statement (I) is true Statement (II) is false.

149. **Statement (I):** The counter interval depends upon the nature of the ground whether it is undulating or flat.
Statement (II): In a hilly terrain or undulating ground a smaller interval is adopted, otherwise the contours will come too close for plotting due to the steep slope.

149. Ans: (c)

Sol: In hilly terrain the contour interval is kept large
If not the spacing between the contour lines will get less and it looks crowded.

150. **Statement (I):** Geodetic survey cannot be done for works requiring high precision.
Statement (II): The curvature of earth is accounted for measurements in Geodetic survey.

150. Ans: (d)

Sol: It is the division as surveying in which the curvature of the earth is taken into account.
It is move accurate .

Hearty Congratulations to our **ESE-2019 Top Rankers**

and
many more...

Total Selections in **Top 10: 33 | EE : 9 | E&T : 8 | ME : 9 | CE : 7**