

1. Ans. A.

Time	0	1	2	3	4
(1) Ordinate lagged	0	5	12	25	41
(2) Lagged ordinate of 2 hr UH lag by 2hr	0	0	0	5	12
Ordinate 4hr $\left(\frac{1+2}{2}\right)$	0	2.5	6	15	26.5

Ordinate of 3 hour UH at 3-hr is =15 m3/s

2. Ans. C.

Due to UDL

$$\text{Vertical stress} = \frac{2q}{\pi z} \left[ \frac{1}{1 + \left( \frac{x}{z} \right)^2} \right]^2$$

$$\text{at } x=0; \text{ vertical stress } (\sigma_z) = \frac{2q}{\pi z}$$

$$\frac{\sigma_{z1}}{\sigma_{z2}} = \frac{z_L}{z_1} = \frac{4}{2} = 2$$

3. Ans. B.

By limit state method

4. Ans. C.

P. Regain of strength with time - THIXOTROPY
Q. Loss of strength due to cyclic loading - LIQUEFACTION
R. Loss of strength due to upward seepage - BOILING
S. Loss of strength due to remolding - SENSTIVITY

5. Ans. C.

Correction for elevation : 7 % increase per 300 m height

$$\text{So, correction} = \frac{7}{100} \times \frac{535}{300} \times 2000 = 249.7m$$

$$\therefore \text{Corrected length} = 2000 + 249.7 = 2249.7m$$

Correction for temperature :

$$\text{std. Atm temp} = \frac{2249.7}{100} \times 11.13 = 250.32m$$

$$= 15 - 0.0065 \times 535 = 11.52^\circ C$$

$$\Delta T = 22.65 - 11.52 = 11.13^\circ C$$

$$\text{Correction} = \frac{2249.7}{100} \times 11.13 = 250.32m$$

$$\therefore \text{Corrected length} = 2249.74 + 250.32 = 2500.02m$$

check: Total correction =

$$= \frac{2500.02 - 2000}{2000} \times 100$$

$$= 25\% < 35\%$$

**Solutions**

6. Ans. C.

$$\sigma_x = \sigma_y = \sigma_z = \sigma; \tau_{xy} = 0$$

For Mohr's Circle

Radius (R)

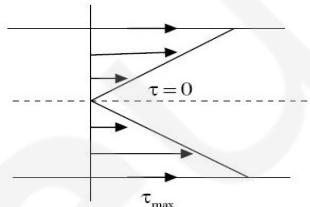
$$\sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = \sqrt{\left(\frac{\sigma - \sigma}{2}\right)^2 + 0^2} = 0$$

$$\frac{\sigma_x + \sigma_y}{2} = \frac{\sigma + \sigma}{2} = \sigma$$

7. Ans. C.

Bending moment at any point for two-hinged parabolic arch with uniformly distributed load is zero.

8. Ans. B.



We know that velocity variation,

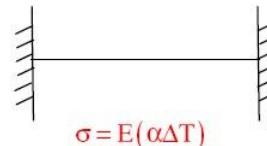
$$v = \frac{1}{2\mu} \left( \frac{-\partial p}{\partial x} \right) (ty - y^2)$$

$$\tau = \mu \frac{\partial u}{\partial y} = -\frac{1}{2} \left( \frac{\partial p}{\partial x} \right) (t - 2y)$$

$$y = 0 \Rightarrow \tau = \tau_{\max}$$

$$y = \frac{t}{2} \Rightarrow \tau = 0$$

9. Ans. A.

 $\alpha$  varies with  $\Delta T$  and does not depends upon the length of bar.

10. Ans. B.

Probability density functions of univariable exponential distributions

$$f(x) = \lambda e^{-\lambda x} \quad x \geq 0 \\ = 0 \quad \text{others}$$

Where  $\lambda$  is parameter

For Gaussian distribution

$$f(x) = \frac{1}{\sigma \sqrt{2\pi}} e^{-\frac{1}{2} \left( \frac{x-\mu}{\sigma} \right)^2}$$

where  $\mu$  and  $\sigma$  are parameters

11. Ans. D.

12. Ans. B.

In chemical kinetics, the order of reaction with respect to given substance is defined as the index or exponent to which its concentration term in the rate equation is raised.

$$r = k \cdot [A]^\alpha [B]^\beta$$

Order of reaction =  $\alpha + \beta$

For first order reaction,  $\alpha + \beta = 1$

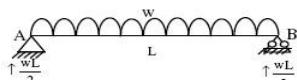
13. Ans. D.

Ultimate bearing capacity =  $c \cdot N_c$

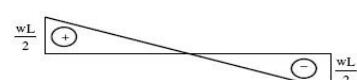
For pure clay  $N_c = 51.4 = (\pi + 2)$

$$\text{UBC} = (\pi + 2)C$$

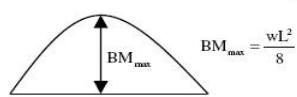
14. Ans. B.



SFD



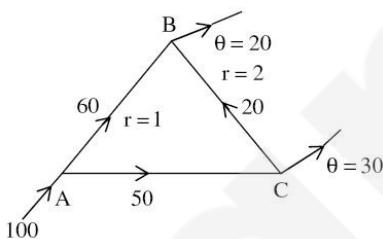
BMD



15. Ans. C.

If the discharge supplied at point A is equally divided so

$$Q_{AB} = Q_{AC} = 50 \text{ m}^3/\text{s}$$



$$\sum Q^n = 0$$

$$\Rightarrow 1 \times (50)^{1.8} - 2 \times (20)^{1.8} - r \times (50)^{1.8} = 0$$

$$\Rightarrow r \times (50)^{1.8} = 703.84$$

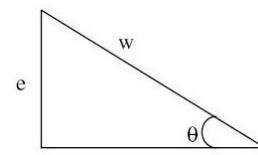
$$\Rightarrow r = 0.62$$

16. Ans. A.

$$\lim_{x \rightarrow \infty} \frac{\tan x}{x^2 - x} = \lim_{x \rightarrow \infty} \frac{\tan x}{x(x-1)}$$

$$= \lim_{x \rightarrow \infty} \frac{\tan x}{x} \cdot \lim_{x \rightarrow \infty} \frac{1}{(x-1)} = 1 \times -1 = -1$$

17. Ans. A.



$$\theta = \tan \theta = e$$

For no sliding

$$\frac{v^2}{gR} \leq \frac{\mu + \tan \theta}{1 + \mu \tan \theta}$$

$$\frac{v^2}{gR} \leq e + f$$

For stopped vehicle  $v=0$

$$f \geq -e$$

18. Ans. D.

Ethanoic acid not found in acid rain.

19. Ans. B.

Accuracy of EDM is generally stated in terms of constant instrument error and measuring error proportional to distance being measured.  $\pm (amm + bppm)$

The first part in this expression indicates a constant instrument error that is independent of length of line measured. Second component is distance related error.

20. Ans. C.

$$\text{Given } 3 \frac{\partial^2 \phi}{\partial x^2} + B \frac{\partial^2 \phi}{\partial x \partial y} + 3 \frac{\partial^2 \phi}{\partial y^2} + 4\phi \text{ is a parabolic}$$

By comparing with general form

$$A \frac{\partial^2 \phi}{\partial x^2} + B \frac{\partial^2 \phi}{\partial x \partial y} + C \frac{\partial^2 \phi}{\partial y^2} + F\left(\phi, x, y, \frac{\partial u}{\partial x}, \frac{\partial u}{\partial y}\right) = 0 \quad A=3;$$

$$B=B; C=3$$

Condition for parabolic is

$$B^2 - 4AC = 0$$

$$B^2 - 4(3 \times 3) = 0 \Rightarrow B^2 = 36$$

$$\therefore B^2 = 36$$

21. Ans. C.

Given P is inverse of Q

$$\Rightarrow PQ = QP = I$$

22. Ans. D.

By Poisson's distribution

$$p(h \geq 8) = e^{-8}$$

$$\lambda = \frac{900}{36500} = 0.256$$

$$p(h \geq 8) = e^{-8 \times 1/4} = 0.1354$$

23. Ans. B.

$f(x) = e^{-x-e^{-x}}$   $x \in (-\infty, \infty)$  is a continuous variable

$$g(x) = \int f(x)dx = \int e^{-x-e^{-x}} dx = \int e^{-x} \cdot e^{-e^{-x}} dx$$

Put  $e^{-x} = t$

$$-e^{-x} dx = dt$$

$$\therefore g(x) = \int e^{-t} (-dt) = -\left(\frac{e^{-t}}{-1}\right) = e^{-t} = e^{-e^{-x}}$$

24. Ans. C.

Total 8 number of spectral bands presents in the satellite Landsat-7

25. Ans. A.

It is single drainage

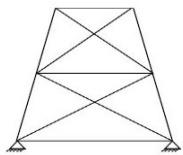
26. Ans. A.

$$D_{se} = r - 3$$

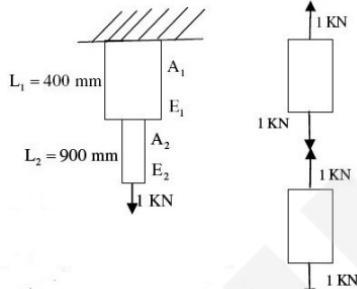
R = number of support reactions = 4

$$D_{se} = 4 - 3 = 1$$

$D_{se}$  = number of double diagonals = 2



27. Ans. C.



$$\text{Strain Energy} = \sum \frac{U^2 L}{2AE}$$

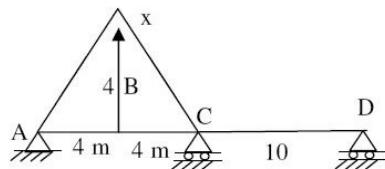
$$\frac{1000^2 \times 400}{2 \times 100 \times 2 \times 10^5} + \frac{1000^2 \times 900}{2 \times 60 \times 3 \times 10^5} = 10 + 25$$

$$= 35 \text{ Nmm}$$

28. Ans. A.

By muller Breslau principle

ILD for moment at C



$$x - 0 = 4$$

$$x = 4$$

Load is acting at point B

$$BM = 50 \times 4 = 200 \text{ kN-m}$$

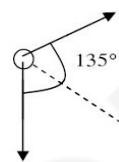
29. Ans. B.

$$P = 10 \text{ kN}, e = 15 \text{ cm}, r_1 = r_2 = r_3 = r_4 = 5 \text{ cm}$$

$$F_d = \frac{P}{4} = \frac{10}{4} = 2.5 \text{ kN}$$

Force in bolt 1 due to moment

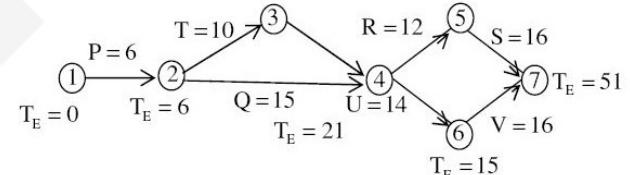
$$F_s = \frac{Pr_1}{\sum r^2} = \frac{10 \times 15 \times 5}{4 \times (5)^2} = 7.5 \text{ kN}$$



$$FR = \sqrt{(2.5)^2 + (7.5)^2 + 2 \times 2.5 \times 7.5 \cos 135^\circ} \approx$$

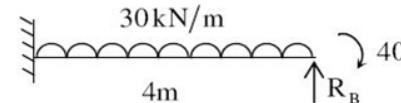
30. Ans. B.

Activity on arrow (AoA) diagram:



Time along path 1-2-4-6-7  
= 6+15+14+16 = 51 days

31. Ans. B.



$$M_{BA} = \frac{4EI\theta_A}{6} + \frac{2EI\theta_A}{6} + \frac{wl^2}{12}$$

$$\Rightarrow M_{BA} = 0 + 0 + \frac{30 \times 16}{12} = 40$$

$$M_{BC} = \frac{3EI\theta_B}{6} + \bar{M}_{FBC} = 0$$

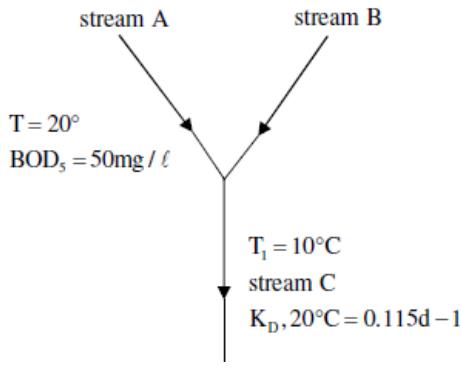
$$M = M_{BA} + M_{BC}$$

$$\Rightarrow M = M_{BA} = 40$$

$$\Rightarrow \frac{WL^4}{8EI} + \frac{ML^2}{2EI} = \frac{R_B \times L^3}{3EI}$$

$$\Rightarrow \frac{30 \times 4}{8} + \frac{40}{2 \times 4} = \frac{R_B}{3} \Rightarrow R_B = 60 \text{ kN}$$

32. Ans. C.



$$BOD_5 = BOD_U \times (1 - 10^{-K_d \cdot t})$$

$$\Rightarrow (BOD_U)_A = \frac{50}{1 - 10^{-0.115 \times 5}} = 68.13 \text{ mg/l}$$

$$K_d, 10^\circ\text{C} = K_d, 20^\circ\text{C} \times (1.135)^{10-20}$$

$$= 0.115 \times (1.135)^{-10} = 0.0324$$

$$(BOD_U)_A = (BOD_U)_B$$

$$So, (BOD_U)_C = 6.13 \text{ mg/l}$$

C,

$$(BOD_5)_{10^\circ\text{C}} = BOD_U (1 - 10^{-K_d, 10 \times t})$$

$$= 68.13 \times (1 - 10^{-0.0324 \times 5})$$

$$= 21.21 \text{ mg/l}$$

33. Ans. A.

$$f(t) = 3t^2$$

$$m.Q = 3t^2$$

$$m \frac{dv}{dt} = 3t^2$$

$$m.dv = 3t^2 dt$$

$$m \int_{1.5}^v dv = \int_0^2 3t^2 dt$$

$$2 \times (v - 1.5) = 3 \cdot \frac{t^3}{3} \Big|_0^2$$

$$2(v - 1.5) = 3 \times \frac{2}{3} = 8$$

$$v - 1.5 = 4$$

$$v = 5.5 \text{ m/s}$$

34. Ans. B.

From graph it is easily concluded that  
 $s = 1800 \text{ vph}$  and average stopped delay per vehicle =  
28.125 seconds

35. Ans. B.

$f(x) = a + bx$   $0 \leq x \leq 1$  is a valid probability density function

i.e.,

$$\int_0^1 f(x) dx = 1$$

$$\int_0^1 (a + bx) dx = 1$$

$$\left[ ax + \frac{bx^2}{2} \right]_0^1 = 1 \Rightarrow a + \frac{b}{2} = 1$$

$$\Rightarrow 2a + b = 2$$

a = 0.5, b = 1 satisfies the above relation

36. Ans. B.

$$F.O.S = \frac{\gamma_{sub} \cdot \tan \phi}{\gamma_{sat} \cdot \tan \beta}$$

$$1 = \frac{(21 - 9.8) \tan \phi}{21 \times \tan(20^\circ)} \Rightarrow \tan \phi = \frac{21 \times \tan 20}{(21 - 9.81)}$$

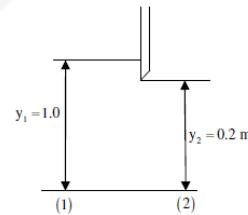
$$\tan = 0.683$$

$$\phi = 34.335$$

37. Ans. A.

Given Energy loss is zero

$$\Rightarrow E_1 = E_2$$



$$y_1 + \frac{V_1^2}{2g} = y_2 + \frac{V_2^2}{2g}$$

$$Q = AV$$

$$V = \frac{Q}{A}$$

$$y_1 + \frac{Q_1^2}{2g \cdot A_1^2} = y_2 + \frac{Q_2^2}{2g \cdot A_2^2}$$

$$y_1 - y_2 = \frac{Q_2^2}{2g \cdot A_2^2} - \frac{Q_1^2}{2g \cdot A_1^2}$$

$$Q_1 = Q_2 = Q$$

$$1 - 0.2 = \frac{Q^2}{2g} \left[ \frac{1}{A_2^2} - \frac{1}{A_1^2} \right]$$

$$0.8 = \frac{Q^2}{2g} \left[ \frac{1}{0.2^2} - \frac{1}{1^2} \right]$$

$$Q = 0.82 \text{ m}^3 / \text{s}$$

**38. Ans. D.**

P. Non-modular outlet - Outlet discharge depends on the water levels in both the supply canal as well as the receiving water course.
Q. Semi-modular outlet - Outlet discharge depends only on the water level in the supply canal
R. Modular outlet - Outlet discharge is fixed and is independent of the water levels in both the supply canal as well as the receiving water course

**39. Ans. A.**

$$\text{Let } A = \begin{bmatrix} 5 & -1 \\ 4 & 1 \end{bmatrix}$$

Characteristic equations is

$$\lambda^2 - 6\lambda + 9 = 0 \Rightarrow \lambda = 3, 3$$

Eigen value 3 has multiplicity 2.

Eigen vectors corresponding to

$$\lambda = 3 \text{ is } (A - 3I)X = 0$$

$$\begin{pmatrix} 5-3 & -1 \\ 4 & 1-3 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} 2 & -1 \\ 4 & -2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$R_2 \rightarrow R_2 - 2R_1 \Rightarrow \begin{pmatrix} 2 & -1 \\ 0 & 0 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$e(A) = 1$$

Number of linearly independent eigen vectors corresponding to eigen value  $\lambda = 3$  is  $n - r = 2 - 1 = 1$

where n= no. of unknowns, r= rank of  $(A - \lambda I)$

$\therefore$  One linearly independent eigen vector exists corresponding to  $\lambda = 3$

**40. Ans. A.**

Liquidity Index

$$(I_L) = 1 - I_c$$

$$I_c = \frac{w_L - w}{w_L - w_p}$$

$$= \frac{60 - 18}{60 - 25} = \frac{6}{5}$$

$$I_L = 1 - \frac{6}{5} = -\frac{1}{5} = 0.2$$

Activity =

$$\frac{I_p}{\% clay} = \frac{w_L - w_p}{\% clay} = \frac{60 - 25}{25} = \frac{7}{5} = 1.4$$

**41. Ans. D.**

$$\frac{d\theta}{dt} + \theta = 1 \text{ and } \theta = 0 \text{ at } t=0$$

Comparing with first order linear differential equations

$$\frac{dQ}{dt} + pQ = q \text{ Where } p = 1; q = 1$$

$$I.F = \int_e pdt = e^t$$

$$Q(IF) = \int 1.(IF)dt + c$$

$$Qe^t = \int e^t dt + c$$

$$Q.e^t = e^t + c$$

$$Q=0 \text{ at } t=0$$

$$\Rightarrow 0.1 = 1 + c \Rightarrow c = -1$$

$$\therefore Q.e^t = e^t - 1 \Rightarrow Q = 1 - e^{-t}$$

**42. Ans. B.**

Use the momentum conservation and energy conservation principle.

Range of answer will be 2.50 to 3.75

**43. Ans. D.**

$$\text{Stress} = 1200 \text{ N/mm}^2$$

$$\frac{P}{A} = 1200$$

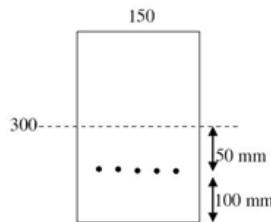
$$P = 1200 \times (3 \times 50)$$

$$= 18 \times 10^4 \text{ N}$$

$$f_c = \frac{P}{A} + \frac{P_e}{I} y$$

$$= \frac{18 \times 10^4}{150 \times 300} + \frac{18 \times 10^4 \times 50 \times 50}{150 \times \frac{300^3}{12}}$$

$$= 4 + 1.33 = 5.33 \text{ N/mm}^2$$



Loss due to elastic deformation

$$m.f_c = 6 \times 5.33 = 31.98$$

Prestress force

$$= 31.98 \times 3 \times 50 = 4797 \text{ N} = 4.8 \text{ kN}$$

**44. Ans. C.**

Kinematic viscosity

$$= 10^{-6} \text{ m}^2/\text{s}$$

$$\frac{\mu}{\rho} = 10^{-6} \text{ m}^2/\text{s}$$

$$\mu = 10^{-6} \times 1000 = 10^{-3} \text{ N-S/m}^2$$

Settling velocity

$$(V_s) = \frac{(\gamma_s - \gamma_w) \cdot d^2}{18\mu}$$

$$V_s = \frac{(9810 \times 3 - 9810) \times (2 \times 0.01 \times 10^{-3})^2}{18 \times 10^{-3}}$$

$$= 4.36 \times 10^{-4} \text{ m/s} = 0.436 \text{ mm/s}$$

45. Ans. D.

Equivalent sound power level

$$= 10 \log_{10}^{L_i} 10^{10}$$

$$= 10 \log \left[ 10^{\frac{60}{10}} + 10^{\frac{69}{10}} + 10^{\frac{70}{10}} + 10^{\frac{79}{10}} \right]$$

$$L_{eq} = 79.9 \text{ dB}$$

46. Ans. D.

Approximation value by Euler's Method:

$$\frac{du}{dt} = 3t^2 + 1; u(0) = 0; h = \Delta t$$

$$u(2) = u(0) + hf(0,0), f(u,t) = 3t^2 + 1$$

$$= 0 + 2(0+1) = 2$$

Exact value:

$$du = (3t^2 + 1)dt \text{ (variable separable)}$$

$\Rightarrow u = t^3 + t + c$  is solution

$$u(0) = 0 \Rightarrow 0 = c$$

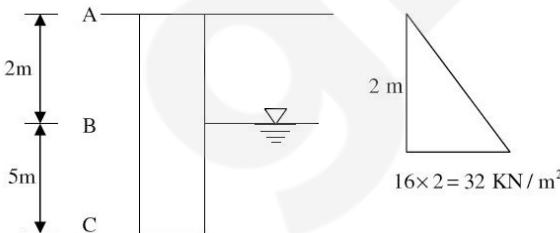
$$u = t^3 + t$$

$$U(2) = 8 + 2 = 10$$

$\therefore$  absolute error

$$= |10 - 2| = 8$$

47. Ans. C.



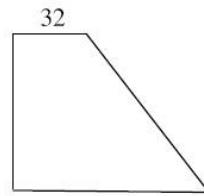
$$\text{Average stress in } AB = \frac{32}{2} = 16 \text{ KN/m}^2$$

$$\theta_{sf} = K \times \sigma_{avg} \times \tan \theta \times AS_1$$

$$= 1 \times 16 \times \tan 23^\circ \times (3 \times 2) = 40.75 \text{ KN}$$

BC:

Effective stress variation



77.95

$$\sigma_{avg} = \frac{32 + 77.95}{2} = 54.97 \text{ KN/m}^2$$

$$A_{BC} = 3 \times 5 = 15 \text{ m}^2$$

$$\theta_{sf} = K \sigma_{avg} \times \tan \theta \times A$$

$$= 1 \times 54.97 \times \tan 23^\circ \times 15 = 350 \text{ KN}$$

Total axial frictional resistance =  $350 + 40.75 = 390.75 \text{ KN}$

48. Ans. D.

answer will be in the range of 17.9 to 18.1

49. Ans. C.

$$v = 60 \text{ km/hr} = 60 \times \frac{5}{18} = 16.67 \text{ m/s}$$

$$R = 120 \text{ m}; f = 0.15; e + f = \frac{v^2}{gR}$$

$$e + 0.15 = \frac{16.67^2}{9.81 \times 120} = 0.236$$

$$e = 0.236 - 0.15 = 0.086 = \frac{1}{11.6}$$

$$\text{At } e = 0; e + f = \frac{v^2}{gR}$$

$$f = \frac{v^2}{gR} = 0.236 \cong 0.24$$

50. Ans. B.

$$P_{cr} = \frac{\pi EI}{l_{eff}^2}$$

For column -1; One end is fixed and other is free

$$l_{eff} = 2l$$

$$P_{cr(1)} = \frac{\pi EI}{4l^2}$$

For column-2

One end is fixed and other is pinned.

$$l_{eff} = \sqrt{l^2 + l^2} = \sqrt{2}l$$

$$P_{cr(2)} = \frac{\pi EI}{(\sqrt{2}l)^2}$$

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

$$\Rightarrow \frac{P_{cr(2)}}{P_{cr(1)}} = \frac{\frac{2\pi EI}{l^2}}{\frac{\pi EI}{4l^2}} = 8$$

51. Ans. A.

Line Bearing Back bearing Diff

Line	Bearing	Back Bearing	Diff
PQ	46°15'	226°15'	1800
QR	108°15'	286°15'	1780
RS	201°30'	20°30'	1810
ST	321°45'	141°45'	1800

So, local attraction at only R

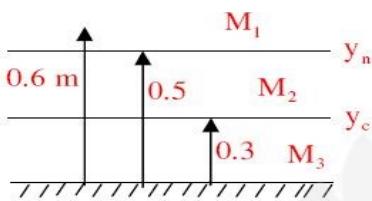
52. Ans. C.

$$y_n = 0.5m$$

$$y_c = \left( \frac{q^2}{g} \right)^{1/3}$$

$$Q = \frac{1}{n} \cdot A \cdot R^{2/3} \cdot S^{1/2} \left( R = \frac{A}{P} = \frac{B \cdot y}{B} = y \right)$$

$$= \frac{1}{0.04} \times (1 \times 0.5) \times (0.5)^{2/3} \cdot (0.0016)^{1/2} = 0.315 m^3 / s$$



$$q = \frac{Q}{B} = \frac{0.315}{1} = 0.315$$

$$y_c = \left( \frac{0.315}{9.81} \right)^{1/3} = 0.318m$$

$y_n > y_c \Rightarrow$  mild slope

53. Ans. A.

$$\sigma_c = 100 kPa; \sigma_d = 80 kPa$$

$$\sigma_1 = \sigma_c + \sigma_d = 100 + 80 = 180 kPa$$

$$\sigma_3 = \sigma_c = 100 kPa$$

$$\bar{\sigma}_1 = 180 - 50 = 130 kPa$$

$$\bar{\sigma}_3 = 100 - 50 = 50 kPa$$

For normally consolidated clay  $c=0$

$$\bar{\sigma}_1 = \bar{\sigma}_3 N_\phi + 2c \sqrt{N_\phi}$$

$$\bar{\sigma}_1 = \bar{\sigma}_3 \left( \frac{1+\sin\phi}{1-\sin\phi} \right)$$

$$130 = 50 \left( \tan^2 \left( 45 + \frac{\phi}{2} \right) \right)$$

$$\tan \left( 45 + \frac{\phi}{2} \right) = \sqrt{\frac{130}{50}} = 1.6124$$

$$\Rightarrow 45 + \frac{\phi}{2} = 58.193$$

$$\phi = 2(58.193 - 45) = 26.387 = 26.4$$

54. Ans. C.

$$\text{Food hydrograph peak} = 200 m^3 / s$$

$$\text{Baseflow} = 20 m^3 / s$$

$$\text{Excess rainfall } 2\text{cm}, \phi = 0.4 \text{cm/h}$$

$$\text{Effective rainfall} = 2 - 0.4 \times 2 = 1.2 \text{cm}$$

$$\text{Peak of DRH} = 200 - 20 = 180 m^3 / s$$

let peak of UH be  $Q_p$

$$\text{So, } Q_p \times 1.2 = 180$$

$$\Rightarrow Q_p = 150 m^3 / s$$

55. Ans. A.

$$\text{Mass of oven dry aggregate } W_a = 1000 g$$

$$\text{Mass of water in saturated surface dry aggregate} = w_w$$

$$\text{So, } w_a + w_w = 1025$$

$$\Rightarrow w_w = 25 g$$

$$\text{Mass of saturated surface dry aggregate under water} = 625 g$$

$$\Rightarrow w_a - v_a \rho_w = 625 g (v_a \text{ vol of aggregate})$$

$$\Rightarrow V_a = \frac{1000 - 625}{1} = 375 CC$$

$$\text{Volume of void } (v_v) = \text{vol of water } v_w = \frac{w_w}{p_w} = 25 CC$$

$$\therefore \text{Bulk density of aggregate } \rho_{ba} = \frac{w_a}{v_a + v_v}$$

$$= \frac{1000}{375 + 25} g / cc$$

$\therefore$  Bulk specific gravity of aggregate

$$\frac{\rho_{ba}}{\rho_w} = \frac{2.5}{1}$$

water absorption =

$$\frac{w_w}{w_a} \times 100 = \frac{25}{1000} \times 100 = 2.5\%$$



OR

$$\begin{aligned}P &= 30\text{min} \times 2 = 60 \text{ min} \\Q &= 20\text{min} \times 3 = 60 \text{ min} \\R &= 60\text{min} \times 1 = 60 \text{ min} \\P &= 15\text{min} \times 4 = 60 \text{ min}\end{aligned}$$

$$M_1 P Q = 2 \text{ hrs}$$

$$M_2 P S = 2 \text{ hrs}$$

65. Ans. B.

Metro construction has to be done carefully considering its impact on the foundations of existing buildings.

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