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GATE 2020
Civil Engineering
Shift 1
Questions & Solutions- (Memory Based)

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1. In a 2D stress analysis, the state of stress at a point P is $[\sigma] = \begin{bmatrix} \sigma_{xx} & \tau_{xy} \\ \tau_{xy} & \sigma_{yy} \end{bmatrix}$. The necessary and sufficient condition for existence of the state of pure shear at point P.

A. $(\sigma_{xx} - \sigma_{yy})^2 + 4\tau_{xy}^2 = 0$

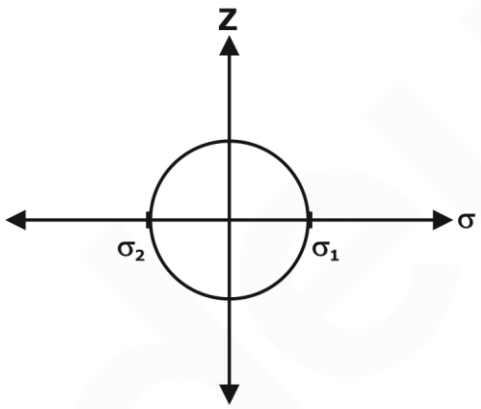
B. $\tau_{xy} = 0$

C. $\sigma_{xx} + \sigma_{yy} = 0$

D. $\sigma_{xx}\sigma_{yy} - \tau_{xy}^2 = 0$

Ans.

Sol.



$\sigma_1 = -\sigma_2$

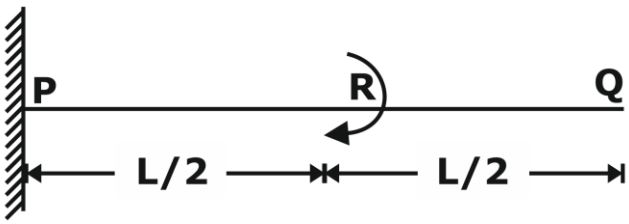
$$\sigma_1 = \frac{\sigma_{xx} + \sigma_{yy}}{2} + \text{Radius}$$

$$\sigma_2 = \frac{\sigma_{xx} + \sigma_{yy}}{2} - \text{Radius}$$

$$\frac{\sigma_{xx} + \sigma_{yy}}{2} + \text{Radius} = -\left[\left[\frac{\sigma_{xx} + \sigma_{yy}}{2}\right] - \text{Radius}\right]$$

$$\boxed{\sigma_{xx} + \sigma_{yy} = 0}$$

2. A cantilever beam PQ of uniform flexure rigidity is subjected to concentrated moment M at R.



Deflection at free end Q

A. $3ML^2/4EI$

B. $3ML^2/8EI$

C. $ML^2/4EI$

D. $ML^2/6EI$

Ans.

Sol. $\delta_R + \theta_R \cdot \frac{L}{2}$

$$= \frac{M\left(\frac{L}{2}\right)^2}{2EI} + \frac{M\frac{L}{2}}{EI} \times \frac{L}{2}$$

$$= \frac{3}{8}\frac{ML^2}{EI}$$

3. The probability that a 50 years flood may not occur at all during 25 years life of a project is _____?

Sol. T = 50 years

$$P = \frac{1}{T} = \frac{1}{50}$$

$$q = 1 - P = \frac{49}{50}$$

$$\text{Reliability} = q^n = \left(\frac{49}{50}\right)^{25} = 0.6034 = 60.34\%$$

4. The length of line segment SP is _____?

Segment	Length	Bearing
PQ	40 m	80°
QR	50 m	10°
RS	30 m	210°

Sol.

Segment	Length	Bearing	Lat.(lcosθ)	Dep. (lsinθ)
PQ	40	80	6.945	39.392
QR	50	10	49.250	8.682
RS	30	210	−25.980	−15
SP	l	θ	lcosθ	lsinθ

$\Sigma L = l\cos\theta + 30.215 = 0$

$\Sigma D = l\sin\theta + 33.081 = 0$

$l\cos\theta = -30.215$

$l\sin\theta = -33.081$

$l = \sqrt{(30.215)^2 + (33.081)^2}$

$l = 44.802$ m

5. An open transverse PQRST is surveyed using theodolite

Line	Northing (m)	Southing (m)	Easting (m)	Westing (m)
PQ	1/0.2	—	45.5	—
QR	80.6	—	—	60.1
RS	—	90.7	—	70.8
ST	—	105.4	55.5	—

If the independent co-ordinates (Northing, Easting) of station P are (400 m, 200 m), the independent coordinate of station T, are

A. 194.7, 370.1

B. 405.3, 229.9

C. 205.3, 429.9

D. 394.7, 170.1

Ans. D

Sol. $\Sigma L = 190.8 - 196.1 = -5.3$

$\Sigma D = 101 - 130.9 = -29.9$

P(400m, 200m)

Coordinate of T are = (400 – 5.3, 200 – 29.9)

= (394.7, 170.1)

6. A fully submerged infinite sandy slope has an inclination of 30° with the horizontal. γ_{sat} and effective angle of internal friction of sand are 18 kN/m^3 and 38°, γ_ω = 10 kN/m^3 seepage is parallel to slope. FOS against shear failure_____

Sol. $FOS = \frac{\gamma_{sub}}{\gamma_{sat}} \frac{\tan\phi}{\tan\beta}$

$FOS = \frac{(18-10)}{18} \times \frac{\tan 38^\circ}{\tan 30^\circ} = 0.6014$

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7. SPT was conducted at every 1.5 m, interval upto 30m depth. At 3m depth, the observed no. of hammer blows for 3 successive 150mm penetration were 8, 6 and 9. SPT N-value at 3 m depth is

A. 15

B. 23

C. 17

D. 14

Ans. A

Sol. Blows for first 150 mm is not noted. There after for next 300 mm penetration number of blows are counted.

∴ SPT value = 9 + 6 = 15

8. In drained triaxial test, a sample of sand fails at σ_d = 150 kPa under confining stress of 50 kPa, find internal angle of friction_____?

Sol. σ_3 = 50

σ_1 = 200(50 + 150)

We know that

$$\sigma_1 = \sigma_3\left(\frac{1+\sin\phi}{1-\sin\phi}\right) + 2C\sqrt{\frac{1+\sin\phi}{1-\sin\phi}}$$

For sand C = 0

$$200 = 50\left(\frac{1+\sin\phi}{1-\sin\phi}\right)$$

$$4 = \frac{1+\sin\phi}{1-\sin\phi}$$

$4 - 4\sin\varphi = 1 + \sin\varphi$

$5\sin\varphi = 3$

$$\phi = \sin^{-1}\left(\frac{3}{5}\right)$$

$$\phi = 36.86°$$

9. In a homogeneous unconfined aquifer of area 3 km^2, water table elevation 102m. After natural recharge of Volume 0.9 million cubic meter, the weight rose to 103.2m. After this recharge ground water pumping took place and water table dropped down to 101.20m. The Volume of ground water pumped after the natural recharge is _____

Sol. Volume of water coming = 0.9×10^6 m^3

$$\text{Height of water} = \frac{0.9\times10^6}{3\times10^6} = 0.3\text{m}$$

$$n = \text{Porosity} = \frac{V_V}{V_T}$$

$$n = \frac{0.3}{1.2} = 0.25$$

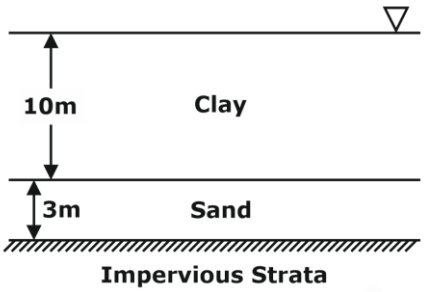
Now pumping

Volume = Area × Height

$= 3 \times 10^6 \times 2 \times 0.25$

$= 1.5 \times 10^6\ m^3$

10. A fill of 2m thick sand with unit weight of 20 kN/m^3 is placed above the clay layer to accelerate the rate of consolidation of clay, $C_V = 9 \times 10^{-2}$ m^2/yr. $m_V = 2.2 \times 10^{-4}$ m^2/kN. The settlement of clay layer, 10 year after the construction is _____



Sol. $\Delta\bar{\sigma} = 40kw / m^2$

$\sigma H = mv\ \mu o \times D\bar{\sigma}$

$= 2.2 \times 10^{-4} \times 10 \times 40$

= 088 m

= 88mm → Total consolidation

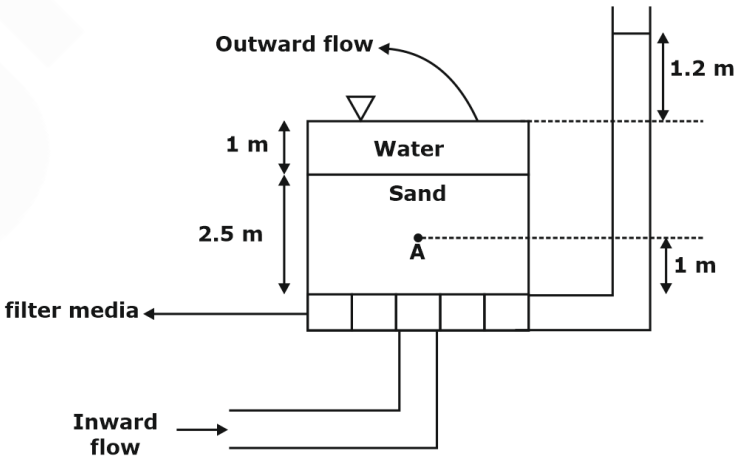
$$T_V = \frac{c_v t}{d^2} = \frac{9 \times 10^{-2} \times 10}{5^2} = .036$$

Tv = π/4u^2 V < 60%

U = 21.4%

After layer statement = .214 × 88 = 18.8 mm

11. Water flows in upward direction in a tank through 2.5m thick sand layer. The e and G of sand are 0.58 and 2.7. Sand is fully saturated γ_w is 10 kN/m^3. Effective stress at point A, located 1 m above the base of tank is _____?



Sol.

Taking 2 as datum

	PH	VH	DH	TH
2	4.7	0	0	4.7
1	0	0	3.5	3.5
A	x	0	1	$4.7 - 0.48 = 4.22$

$x + 0 + 1 = 4.22$

$x = 3.22$

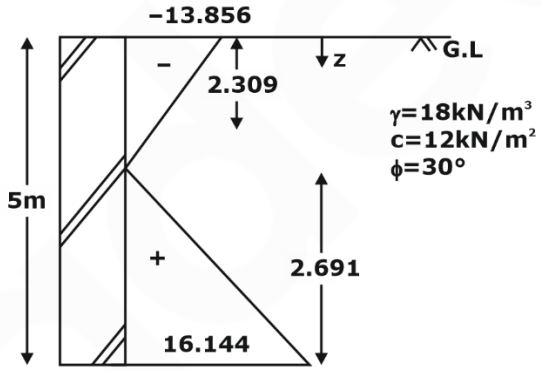
$i = \frac{hc}{c} = \frac{1.2}{2.5} = .48$

$\bar{\sigma}_A = \sigma - u$

$\bar{\sigma}_A = 8.925 kw/m^3$

12. A vertical retaining wall of 5 m height has to support soil of γ = 18 kN/m^3 effective Cohesion = 12 kN/m^2 effective Friction angle 30°. As per Rankine assuming that tension crack has occurred the lateral active thrust on wall per m length is _____

Sol.



$ka = \frac{1-\sin 30}{1+\sin 30} = \frac{1-.5}{1+.5} = \frac{.5}{1.5} = 1/3$

Depth of tension crack $\frac{2c}{\gamma\sqrt{ka}} = \frac{2\times 12}{18\sqrt{1/3}} = 2.309$

$\sigma_H = ka\sigma_v - 2c\sqrt{ka}$

$\sigma_H = \frac{1}{3}\times 18 \times z - 2 \times 12 \times \sqrt{1/3}$

$\sigma_H = 6z - 13.856$

σ_H AT TOP (z = 0) = − 13.856

σ_H AT BOTTOM (z = 5) = 16.144

Net thurst $= \left[\frac{0+16.144}{2}\right] \times 2.69 \times 1$

= 21.72 kw/m

13. Which option is not correct ?

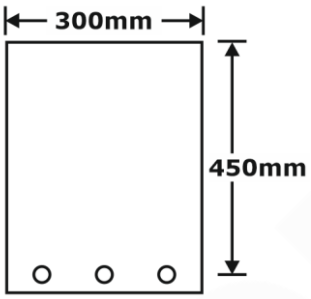
A. The Boussinesq stress value is higher than westerguard (Beneath the load)

B. For triaxial test normally consolidated clay value of cohesion is 0.

C. For IL (liquidity index) >1 It is under plastic resistance

Sol. For IL > 1 is in under liquid condition not plastic.

14. The singly reinforced beam is made of M25 grade concrete and Fe500 steel. Total cross-sectional area of steel is 945 mm^2. As per LSM, the design moment capacity of beam section is _____ kN-m



Ans. 158.277

Sol. A_{st} = 942 mm^2, f_{ck} = 25 N/mm^2

For Fe500 → $x_{u,max}$ = 0.46d

= 0.46 × (450)

$x_{u,\,max}$ = 207 mm

Finding actual depth of neutral axis

C = T

$0.36\, f_{ck}.\, b.x_u = 0.87\, f_y.\, A_{st}$

→ $0.36 \times 25 \times 300 \times x_u = 0.87 \times 500 \times 942$

x_u = 151.766 mm

$A_s\, x_u < x_{u,max}$ → The section is under reinforced section

M_u = M.R = $0.36 f_{ck}.\, b.\, x_u\, (d - 0.42\, x_u)$

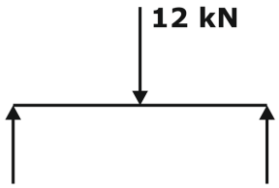
= $0.36 \times 25 \times 300 \times 151.766 \times (450 - 0.42 \times 151.76)$

M_u = 158.277 kN-m

15. A Simply supported prismatic concrete beam of rectangular cross section span 8m is pre-stressed with effective prestress force of 600 kN. Balanced load of 12kN is applied at the centre. Eccentricity is zero at support and varies linearly to value 'e' at mid span required value of e is _____?

Ans. 40 mm

Sol.



$$M = \frac{Wl}{4} = \frac{12 \times 8}{4} = 24kN - m$$

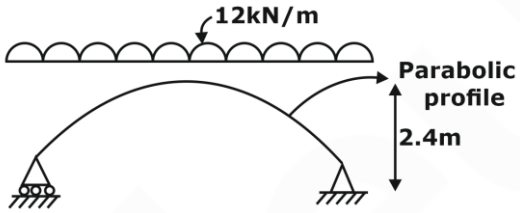
M = P.e

24 kN-m = 600 kN × e

→ e = 0.04 m

→ e = 40 mm

16. A planar elastic structure is subjected to UDL



Neglect Self weight, Maximum BM is _____?

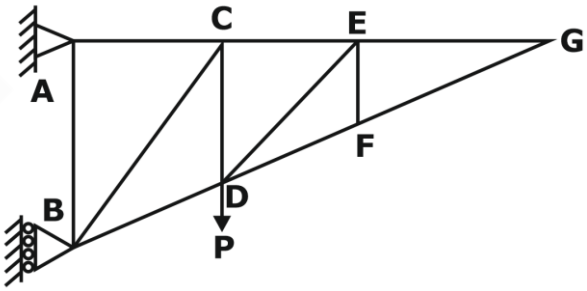
Ans. 0

Sol. When the shape of arch follows the shape of bending moment diagram of the same span of simply supported beam with the same load then at every point in the arch B.M = 0. The resistance to external loads of such arches are by axial thrust.

Here due to U.D.L, B.M.D on a simply supported beam is parabolic and the shape of arch is also parabolic.

So B.M = 0

17. What is the no. of zero force members?



A. 6

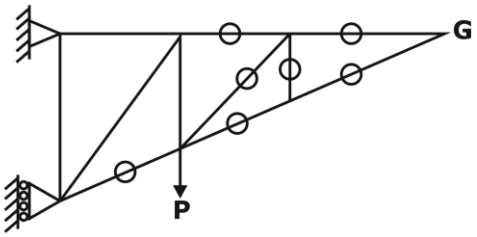
B. 7

C. 8

D. 9

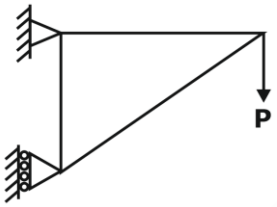
Ans. B

Sol. Using Golden Rules -1 & 2,



No. of zero force members = 7

Idealized structure



18. Distributed loads of 50 kN/m may occupy any position on the grid. Maximum negative bending movement is_____?

A. 56.25

B. 150

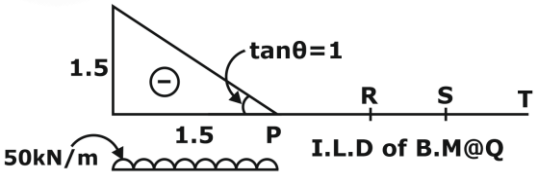
C. 93.75

D. 22.50

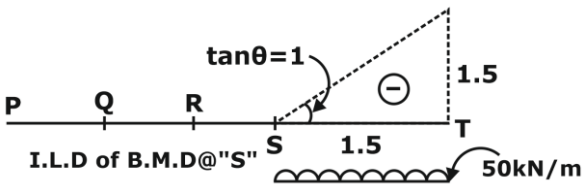
Ans. A

Sol. Max –ve B.M (Hog) is possible at "Q" or @ "S"

So draw I.L.D of B.M @ B.M @ Q, using muller Breslau's principle



Max –ve B.M@ Q = $50 \times \left\{\frac{1}{2} \times 1.5 \times 1.5\right\} = 56.25\ \text{kN} - \text{m}$



So, maximum negative bending moment is 56.25 kN-m

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19. The Los Angeles test of stone aggregate is done for

A. Specific gravity

B. Abrasion resistance

C. Crushing strength

D. Soundness

Ans. B

Sol. Los Angels test in done to check the abrasion resistance of coarse aggregate as Per IS:2386 (Part IV)-1963.

Specific gravity of coarse aggregate_____ Using wire basket equipment, using IS:2386

Crushing strength deals with resistance to compressive action of aggregate

Soundness is a test to Judge the durability of stone aggregate against weathering actions

20. During the process of hydration of cement due to increase in C_2S content in cement clinker, the heat of hydration

A. Does not change

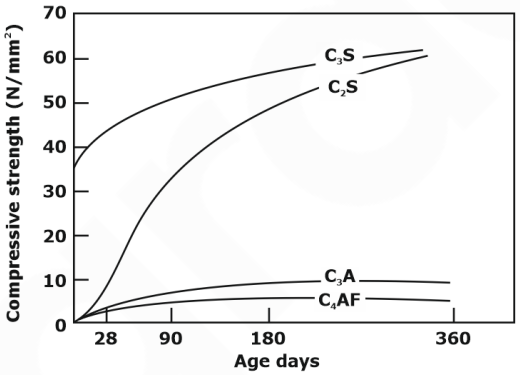
B. Initially decrease then increase in later ages

C. Decrease

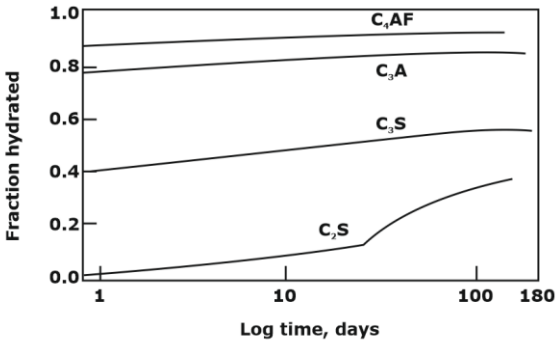
D. Increase

Ans. B

Sol.



Contribution of Cement Compounds to Strength of Cement



Rate of Hydration of Pure Cement Compounds

Due to increase in C_2S content, early age strength of cement is reduced indicating @ early ages like till 7 to 14 days,

The evolution of heat of hydration is less @ early ages. But increase in C_2S content contribute to later age strength i.e., rate of gain of strength in more @ later ages (after 7 to 14 days), indicating increase in heat of hydration at later ages.

21. A rectangular channel of width 4 m having flow rate of 6 m^3/sec. Manning's constant for open channel flow is 0.02, take g as 9.81 m/s^2. The critical velocity of rectangular channel is _____ ?

Sol. $\text{Velocity} = \frac{\text{Discharge}}{\text{Area}} = \frac{Q}{b.y} = \frac{q}{y}$

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

$V_c^3 = qg$

Also, $q = V_c \times y_c$

$V_c^3 = V_c y_c g$ or $V_c^2 = g y_c$

$\therefore V_c = \sqrt{g y_c}$

$$\text{Now, } y_c = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{\left(\frac{6}{4}\right)^2}{9.81}\right) = 0.612 \text{ m}$$

$$\left\{\therefore q = \frac{Q}{B}\right\}$$

$\therefore V_c = \sqrt{9.81 \times 0.612} = 2.44$ m/sec.

22. A floating body in liquid is in a state of equilibrium if its —

A. Metacentre is above the center of gravity

B. Metacentre is below the center of gravity

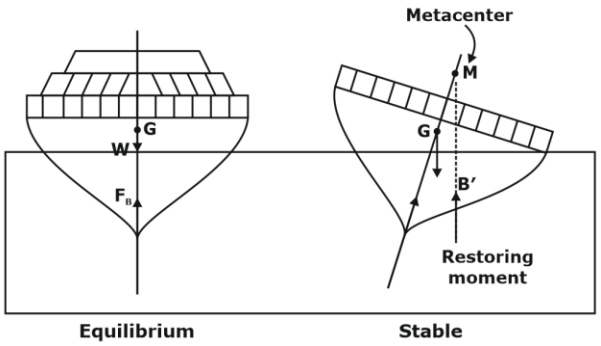
C. Center of gravity is below the center of buoyancy

D. Metacenter coincides with the center of gravity

Ans. A

Sol. A measure of stability for floating bodies is the metacentric height GM, which is the distance between centre of gravity G and the metacentre M.

A floating body is stable if point M is above G, and thus GM is positive.



23. Velocity of flow is proportional to the first power of hydraulic gradient in Darcy's law. The law is applicable to

A. Turbulent flow in porous media.

B. Transitional flow in porous media.

C. Laminar flow in porous media.

D. Laminar as well as turbulent flow in porous media.

Ans. C

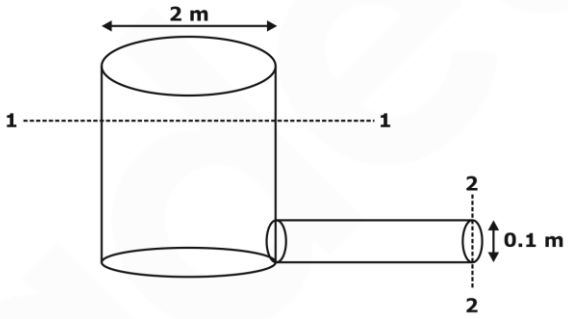
Sol. The simplest form of Darcy's law states that

$$V = \frac{Q}{A} = -K\frac{\partial h}{\partial \ell}$$

Since the velocity in laminar flow is proportional to the first power of the hydraulic gradient (Poiseuille's law), it is reasonable to apply Darcy's law to laminar flow in porous media.

24. A circular water tank of 2 m diameter, has circular orifice of diameter 0.1 m at bottom. Water enter the tank at 20 l/s and escape through orifice. C_D for orifice = 0.8, neglect friction loss and g = 9.81 m/s^2. Height of water level in the tank at steady rate is _____.

Sol.



Apply bernoulli's equation at section 1-1 and 2-2, we get

$$\frac{p_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{\rho_2}{\rho g} + \frac{V_2^2}{2g} + z_2$$

$$\frac{V_1^2}{2g} + z_1 = \frac{V_2^2}{2g}$$

$$z_1 = \frac{V_2^2 - V_1^2}{2g}$$

$$V_1 = \frac{Q}{A} = \frac{0.02}{\frac{\pi}{4}\times 2^2} = 6.36\times 10^{-3}\ \text{m/s}$$

$$V_2 = C_d\frac{Q}{a} = \frac{0.8\times 0.02}{\frac{\pi}{4}\times 0.1^2} = 2.038\ \text{m/s}$$

$$z_1 = \frac{(2.038)^2 - (6.36\times 10^{-3})^2}{2\times 9.81}$$

z_1 = 0.211 m = 21.1 cm

25. Q = 12m^3/sec, B = 6m. Hydraulic jump is formed. upstream depth = 30 cm, g = 9.81 m/s^2, ρ_w = 1000 Kg/m^3. Energy loss in jump ?

A. 114.2 MW

B. 114.2 KW

C. 141.2 J/S

D. 141.2 hp

26. As per IRC86-1983, desirable minimum width of median for an urban area is _____ . (in integer)

Sol. As per IRC, for urban area the width of median varies from 0.9 m to 5 m. whereas for rural areas, the width varies from 3 m to 5m.

27. Gradient 4.5%, radius 100 m, Compensated grade is equal to _____ ?

Sol. According to IRC

$$\text{Grade compensation} = \left.\begin{matrix}\frac{30+R}{R}\\ \frac{75}{R}\end{matrix}\right\}_{\text{minm.}}$$

$$\text{Now, } \frac{30+100}{100} = 1.3\%$$

$$\frac{75}{100} = 0.75\%$$

Compensated grade = 4.5 – 0.75 = 3.75%

But, according to IRC the minimum value of compensated grade is 4%. Therefore answer is 4%.

28. Aqueous chlorine reacts rapidly with water to form Cl^-, HOCL and H^+. The most active disinfectant in the chlorination process is

$$(aq.)Cl + H_2O \rightleftharpoons Cl^- + HOCl + H^+$$

A. HOCl

B. H^+

C. H_2O

D. Cl^-

Ans. A

Sol. HOCl is 80 times more active than OCl^- as it is very unstable. The amount or sum of HOCl and OCl is known as free available chlorine.

29. A water supply scheme transport 10 MLD water through a 450 mm diameter pipe for a distance of 2.5 km. A chlorine dose of 3.5 mg/l is applied at the starting point. It is demand to increase the flow rate from 10 MLD to 13 MLD in the pipeline. Assume exponent for cone, n = 0.86 with this increased flow in order to attain the same level of disinfection, the chlorine dose to be applied at starting point ?

A. 3.95

B. 4.4

C. 5.55

D. 4.75

Ans. D

Sol. In the disinfection process we have the relationship

$tc^n = k$

where, t = time required to kill all organism

c = concentration of disinfectant

K = constant

$\therefore t_1c_1^n = t_2c_2^n$

$\Rightarrow$ we know, $Q = \frac{V}{t} \Rightarrow t = \frac{V}{Q}$

$\therefore \frac{V}{Q_1}C_1^n = \frac{V}{Q_2}c_2^n$

$\Rightarrow \frac{1}{10}(3.5)^{0.86} = \frac{1}{13} \times (c)^{0.86}$

$\Rightarrow$ c = 4.75 mg/l

30. SOR (Surface overflow rate) of primary settling tank (discrete) is 20000 l/m^2 per day. $\nu = 1.01 \times 10^{-2}$ cm^2/s. G = 2.64. The minimum diameter of particle that will be removed with 80% of efficiency.

Sol. According to stoke's law

$V_s = \frac{(G-1)gd^2}{18\nu}$

$\Rightarrow V_s = \frac{(2.64-1) \times 9.81 \times d^2}{18 \times 1.01 \times 10^{-2} \times 10^{-4}}$

$\Rightarrow V_s = 884950.49\ d^2$

Also, Efficiency = 80% = $\frac{V_s}{SOR} = \frac{V_s}{2.31 \times 10^{-4}}$

$\Rightarrow V_s = 0.8 \times 2.31 \times 10^{-4} = 1.85 \times 10^{-4}$

$\Rightarrow \sqrt{\frac{1.85 \times 10^{-4}}{884950.49}} = d$

$= d = 1.44 \times 10^{-5}$ m = 0.144 μm

31. The value of $\lim_{x\to\infty} \frac{x^2-5x+4}{4x^2+2x}$ is _____ .

A. 1/2

B. 1/4

C. 0

D. 1

Ans. B

Sol. $\lim_{x\to 0} \frac{x^2-5x+4}{4x^2+2x} = \frac{4}{0} = 0$

Applying L's Hospital rule

$\lim_{x\to 0} \frac{f^1(x)}{f^1(x)} = \frac{2x-5}{8x+2} = -ve$

So again applying L's Hospital rule

$\lim_{x\to 0} f''(x) = \frac{2}{8} = \frac{1}{4}$

32. The true value of ln(2) is 0.69. If the value of ln(2) is obtained by linear interpolation between ln(1) and ln(6), the percentage of absolute error is

A. 84

B. 69

C. 48

D. 35

Ans. D

Sol. Linear interpolation formula:

$Y - Y_1 = \left(\frac{Y_2 - Y_1}{x_2 - x_1}\right)(x - x_1)$

Here Y = ln (2) = 0.69 x = 2

Y_2 = ln(6) = = 1.79 x_2 = 6

Y_1 = ln(1) = 0 x_1 = 1

% of absolute error $= \left(\frac{\ln(6)-\ln(1)}{6-1}\right) \times (2-1) \times 100$

$= \left(\frac{1.79-0}{6-1}\right) \times 100$

= 35.8%

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33. The area of an ellipse represented by equation $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is

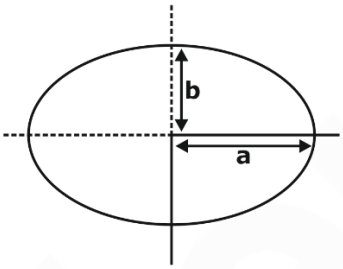
A. $\frac{\pi ab}{4}$

B. $\frac{4\pi ab}{3}$

C. ⊓ab

Ans. C

Sol. Equation of ellipse is $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$



Major axis = 2a

Minor axis = 2b

Area of ellipse for standard equation is ⊓ ab.

34. $\begin{bmatrix}1 & 3 & 2\\ 2 & 2 & -3\\ 4 & 4 & -6\\ 4 & 5 & 2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}\begin{bmatrix}1\\ 1\\ 2\\ 1\end{bmatrix}$

The value of x_3 is _____ .

Sol. Solving the above matrix by multiplication

$x_1 + 3x_2 + 2x_3 = 1$ .....(1)

$2x_1 + 2x_2 - 3x_3 = 1$ .....(2)

$4x_1 + 4x_2 - 6x_3 = 2$ .....(3)

$2x_1 + 5x_2 + 2x_3 = 1$ .....(4)

Solving equation (1) and (2) eliminating x_1 we get,

$$\begin{array}{r} 2x_1 + 6x_2 + 4x_3 = 2 \\ 2x_1 + 2x_2 - 3x_3 = 1 \\ \hline - \quad - \quad + \quad - \end{array}$$

$$4x_2 + 7x_3 = 1 \quad .....(5)$$

Solving equation (3) and (4) eliminating x_1, we get

$$\begin{array}{r} 4x_1 + 4x_2 - 6x_3 = 2 \\ 4x_1 + 10x_2 + 4x_3 = 2 \\ - \quad - \quad - \quad - \\ \hline -6x_2 + 10x_3 = 0 \end{array} \quad \text{.....(6)}$$

Solving equation (5) and (6) we get

$4x_2 + 7x_3 = 1$

$-6x_2 - 10x_3 = 0$

$$\begin{array}{r} 24x_2 + 42x_3 = 6 \\ -24x_2 - 40x_3 = 0 \\ \hline 2x_3 = 6 \end{array}$$

$x_3 = 3$

35. For the ordinary differential equation $\frac{d^2x}{dt^2} - 5\frac{dx}{dt} + 6x = 0$,

Initial condition $x(0) = 0$ and $\frac{dx}{dt}(0) = 10$. The solution of given differential equation is

A. $-10e^{2t} + 10e^{3t}$

B. $10e^{2t} + 10e^{3t}$

C. $5e^{2t} + 6e^{3t}$

D. $-5e^{2t} + 6e^{3t}$

Ans. A

Sol. $\frac{d^2x}{dt^2} - \frac{5dx}{dt} + 6x = 0$

$D^2 - 5D + 6 = 0$

$D^2 - 3D - 2D + 6 = 0$

$D(D - 3) - 2(D - 3) = 0$

$D = 2, 3$

Solution will be, $x = C_1e^{3t} + C_2e^{2t}$

Applying boundary condition

$x(0) = 0$

$C_1 + C_2 = 0 \rightarrow (1)$

$$\frac{dx}{dt} = 3C_1e^{3t} + 2c_2e^{2t}$$

$$\frac{dx}{dt}(0) = 10$$

$10 = 3\,c1 + 2c2 \rightarrow (2)$

Form equation (1) and (2)

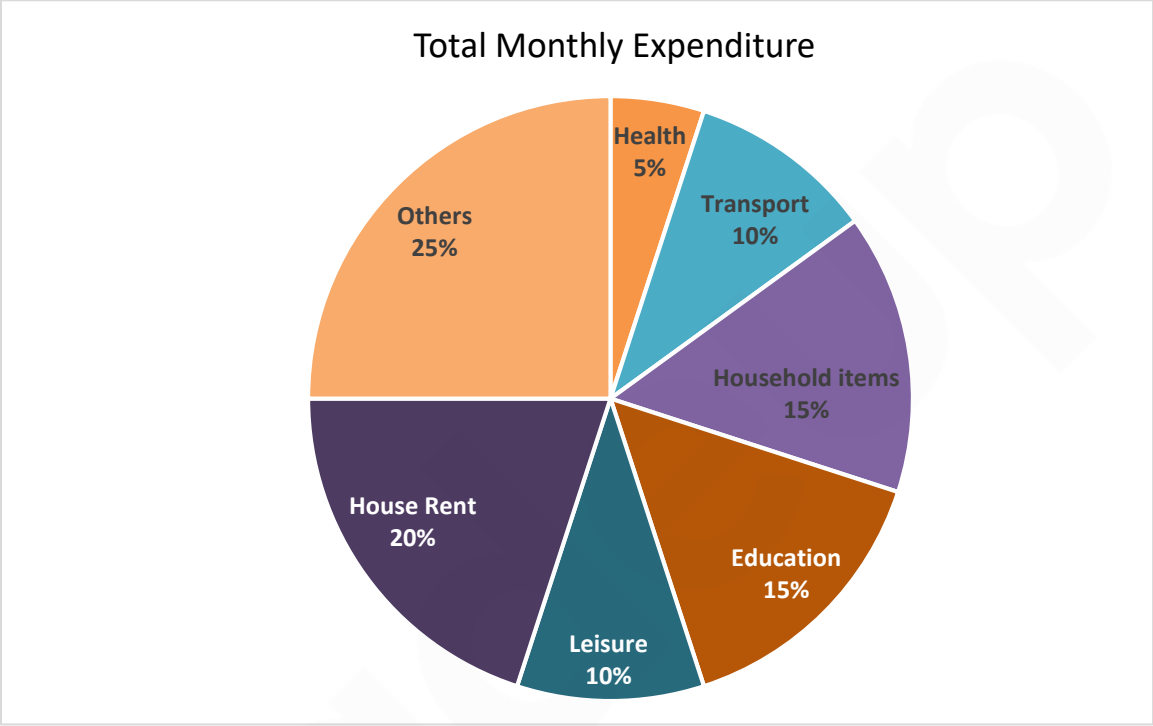
$C_1 = 10$ $C_2 = -10$

So, final solution becomes, $x = 10e^{3t} - 10e^{2t}$

Or

$x = -10e^{2t} + 10e^{3t}$

36. The total monthly expenditure of a family is shown in a pie chart. Find the extra money spent on education as compared to transport (in %)



A. 55

B. 50

C. 100

D. 33.33

Ans. B

Sol. Extra money spent on education as compared to transport $= \left(\frac{15-10}{10}\right) \times 100$

= 50%

37. Fuse : Fusion :: use : ?

A. User

B. Usage

C. Uses

D. Usion

Ans. B

Sol. Fuse : Fusion :: use : **Usage**

38. Insert seven number between 2 and 34 such that the resulting sequence including 2 and 34 is in A.P. The sum of those seven inserted numbers is

A. 124

B. 130

C. 120

D. 126

Ans. D

Sol. As per the given question, the sequence of given AP is, 2 _ _ _ _ _ _ _ 34

In this sequence first term (a) = 2

Last term (tn) = 34

So, as per the relation,

$t_n = a + (n - 1) d$

n → number of terms

d → common difference

$34 = 2 + (9 - 1) d$

$d = 4$

So, the A.P. becomes, 2, 6, 10, 14, 18, 22, 26, 30, 34

Sum of 7 terms between 2234 is 126

39. His hunger for reading is insatiable, he reads indiscriminately. He is most certainly a/an _____ reader.

A. all round

B. voracious

C. wise

D. precocious

Ans. B

Sol. His hunger for reading is insatiable, he reads indiscriminately. He is most certainly a/an **veracious** reader.

40. Unit place in 26591749^{110016} is

A. 6

B. 1

C. 3

D. 9

Ans. B

Sol. The unit digit in the power of 9 can be found by,

$9^1 = 9$ → unit digit is 9

$9^2 = 81$ → so, unit digit is 1

$9^3 = 729$ → unit digit is 9

$9^4 = 6561$ → unit digit is 1

So, from the above sequence, if follows that 9 power, if even the unit digit will be 1. and if 9 power, is odd unit digit will be 9 As per the question, 26591749^{110016}

The answer of unit digit will be 1.

41. If 0, 1, 2 ……8,9 are coded as O,P,Q …….W,X then 45 is coded as
    A. TS
    B. SS
    C. ST
    D. SU

Ans. C

Sol.

0	1	2	3	4	5	6	7	8	9
O	P	Q	R	S	T	U	V	W	X

So, 45 → ST

42. Sum of two positive number 100, after subtracting 5 from each number product of resulting number is 0, one of the original number is
    A. 95
    B. 85
    C. 80
    D. 90

Ans. A

Sol. Let one positive number be a other positive number = 100 – a product of number after subtracting 5 from each number = (a – 5) × (95 – a) = 0

⇒ 95 a – a^2 – 475 + 5 a = 0

⇒ a^2 – 100 a + 475 = 0

⇒ a^2 – 95 a – 5a + 475 = 0

⇒ a(a – 95) – 5 (a – 95) = 0

⇒ a = 5 a = 95

From, the options given 95 is the answer.

43. It is a common criticism that most of the academicians live in their _____, so they are not aware of the real life challenge
    A. ivory tower
    B. homes
    C. glass palaces
    D. big flats

Ans. A

Sol. It is a common criticism that most of the academicians live in their **ivory tower**, so they are not aware of the real life challenge

44. 5 friends P,Q,R,S and T went camping at night, they had to sleep in a row in tent. P,Q and T did not wanted to sleep next to R, as he snored loudly. P and S avoided Q, as he usually hugged people during sleep. After listening to each friends problems, in what order they slept?

Sol. The correct answer will be,

Q, T, P, S, R

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