

Solutions

General Aptitude

1. Ans. C. In if clause (type2) 'were' is in the past tense so the so main clause should be in the conditional clause (past tense). Therefore 'C' is the best answer

2. Ans. A. 'turned a deaf ear' means ignored

3. Ans. C. Where there is a will there is a way. It is a quotation

4. Ans. A.

x% of $y = \frac{x}{100} y = \frac{xy}{100}$ y% of $x = \frac{y}{100} y = \frac{xy}{100}$ (x% of y)+(y% of x) = $\frac{2}{100} xy = 2\%$ of xy

5. Ans. A. Let the original number be xy y---unit digit of **x + y = 12** _____(1) **10y + x = 10x + y + 54 9x - 9y = -54** _____(2)

Solving (1) & (2) we get, $\mathbf{x} = \mathbf{3}$ and $\mathbf{y} = \mathbf{9}$ So the number is 39

6. Ans. D.

let the deposited money in the company P is 8xAnd the deposited money in the company Q is 9xInterest after one year from the company

$$P = 8x \left(\frac{6}{100}\right)$$

Interest after one year from the company

$$Q = 9x \left(\frac{4}{100}\right)$$

Ratio of Interest

$$=\frac{\frac{8x \times 6}{100}}{\frac{9x \times 4}{100}} = \frac{4}{3}$$

7. Ans. D.

'Today, historians correlate greatness of a king at his time with the availability of evidence.' This statement leads to the best inference i.e. option 'D'

8. Ans. B.

From given facts, the following venn diagram is possible.



H = Humans M = Mammals E = Engineers BH = Build houses ∴

From above diagram, statement III is true.

9. Ans. D.

Lateral surface area of the square pyramid

A = a√a³ + 4h³
h → height
I → slanting height
l² =
$$\left(\frac{a}{2}\right)^{3}$$
 + h³ ⇒ h³ = $\left(l^{2} - \frac{a^{3}}{2}\right)$

 $A = a \sqrt{a^2 + 4\left(l^2 - \frac{a^2}{2}\right)} = a2l$

10. Ans. C.

Ananth covers 1/6 of the book in 1 hour. Bharath covers 1/4 of the book in 1 hour



Civil Engineering

1. Ans. A.

Median speed is the speed at the middle value in series of spot speeds that are arranged in ascending order. 50% of speed values will be greater than the median 50% will be less than the median.

Ascending order of spot speed studies are 32,39,45,51,53,56,60,62,66,79 Median speed

=
$$\frac{53+56}{2}$$
 == 54.5 km/hr

2. Ans. D.

$$f'(x) = 0 \Rightarrow 2x - 4 = 0$$

(stationary point) $f^{*}(x) = 2 > 0 \Rightarrow f(x)$ is minimum at and the minimum value is f(2)i.e.,

$$(2)^2 - 4(2) + 2 = 2$$

 \therefore The optimum value of f(x) is -2 (minimum)

3. Ans. C.





We know that $\Rightarrow P(x \cup y') = P(x) + P[(x \cup y)']$ $\Rightarrow 0.7 + 0.4 + 1 - P(x \cup y)$ $\Rightarrow P(x \cup y) = 0.7$

5. Ans. D.

(i)
$$\lim_{x \to -\infty} \frac{xy}{x^2 + y^2} = \lim_{y \to b} \left(\frac{0}{0^2 + y^2} \right) = 0$$

(i.e., put $x = 0$ and then $y = 0$)
(ii) $\lim_{x \to b} \frac{xy}{x^2 + y^2} = \lim_{x \to b} \left(\frac{0}{x^2 + 0} \right) = 0$
(i.e., put $y = 0$ and then $y = 0$)

(i.e., put $\mathbf{y} = \mathbf{0}$ and then $\mathbf{x} = \mathbf{0}$)

(iii)
$$\lim_{x \to 0} \frac{xy}{x^2 + y^2} = \lim_{x \to 0} \frac{x(m x)}{x^2 + m^2 x^2}$$

(i.e., put **y = mx**)

$$=\lim_{x\to\infty}\left(\frac{m}{1+m^2}\right)=\frac{m}{1+m^2},$$

which depends on `m'. Hence, the limit does not exists.



$$(5)-(7)$$
 = Total float = $t_a - t_c = 0$
 $(11)-(12)$ = Total float = $t_a - t_c = 0$

11. Ans. D. For pure clays, the bearing capacity is independent of the footing width.



12. Ans. C. For quick sand conditions

i =
$$\frac{G-1}{1+e}$$
 ⇒ G = i(1+e)+1
Given porosity η = 30% = 0.3
e = $\frac{n}{1-n} = \frac{0.3}{1-0.3} = \frac{0.3}{0.7} = 0.43$

13. Ans. B.

$$\frac{10 \text{ m}}{\overline{\sigma}_{c}} = \frac{16 \text{kN}}{\sigma_{c}} + \frac{16$$

 σ_{c}

Over consolidation ratio $\vec{\sigma} = 10 \times (16 - 10)$ $= 10 \times 6$ $= 60kN / m^3$ OCR $= \frac{90}{50} = \frac{9}{5} = 1.5$

14. Ans. B. **4** = $\frac{2.75}{4} \times 100 = 68.75\%$

 $\phi_{\rm p} = 100 - \phi_{\rm p} = 31.25\%$

Now, **4** = Pressure head at point × 100 Total head

$$\Rightarrow$$
 31.25 = $\frac{h}{4} \times 100 \Rightarrow h = 1.25 m$

15. Ans. A. $\Delta h = 100 \text{ cm}, A = 1000 \text{ km}^3$ n = 0.25, r = 0.05 $\therefore Porosity(\eta) = Sp.yield(y) + Sp Retention(r)$ $\Rightarrow y = 0.25 - 0.05 = 0.20$ Amount of water drained out $= y \times A \times \Delta h = 0.2 \times 1000 \times 10^{-2}$

16. Ans. C. Newtonian fluid - Curve 2 Pseudo plastic fluid - Curve 4 Plastic fluid - Curve 5 Dilatant fluid - Curve 3

17. Ans. D. The atmospheric layer closest to the earth surface is troposphere . 18. Ans. C. Total area of settling tank required,

$$A = \frac{Q}{V} = \frac{1500}{20} = 75 \text{ m}^2$$

Since no. of tanks = 2 So, area of each tank

$$=\frac{75}{2}$$
 = 37.5 m²
 $\frac{\pi d^2}{2}$ = 37.5 ⇒ d = 6.91m

19. Ans. C. Since each household gets water = 540 L/day So, total treated water = $540 \times 4=2160$ L/day Let bypass flow rate is QL/day So,

$$75 = \frac{Q \times 42.0 + (2160 - Q) \times 0}{2160}$$

⇒ 2160 × 75 = Q × 420
⇒ Q = 385.71 L / day

20. Ans. C. Faintest sound that a normal healthy individual can hear **20 µpa**

21. Ans. C.

Radius of Radius of relative stiffness, $L = \left[\frac{Eh^3}{12k(1-\mu^2)}\right]^{\frac{1}{4}}$

Statement -1: False

Directly proportional to modulus of elasticity and also µ

(∴ As µ increases L decreases)

Statement - 2: False

22. Ans. A. If Veh/day ranges from 3000 to 6000, min. 15% of traffic to be surveyed

23. Ans. D. For optimal flight planning for a photogrammetric survey both side lap and end lap should be considered.

w
$$E$$

Departure =
$$1.\sin 30 = 10 \times \sin 30 = 10 \times \frac{1}{2}$$



Tangent length
=
$$\mathbf{R}.\operatorname{tan}\left(\frac{\Delta}{2}\right) = \mathbf{R}.\operatorname{tan}\left(\frac{60}{2}\right)$$

= R tan 30° = 0.557 R

26. Ans. B.

$$(AB) = \begin{pmatrix} 1 & 2 & -3 & a \\ 2 & 3 & 3 & b \\ 5 & 9 & -6 & c \end{pmatrix}$$

$$(R2 - 2R1); (R3 - 5R1)$$

$$\approx \begin{pmatrix} 1 & 2 & -3 & a \\ 0 & -1 & 9 & b - 2a \\ 0 & -1 & 9 & c - 5a \end{pmatrix}$$

$$(R3 - R2)$$

$$\approx \begin{pmatrix} 1 & 2 & -3 & a \\ 0 & -1 & 9 & b - 2a \\ 0 & 0 & (c - b - 3a) \end{pmatrix}$$

$$(c-b-3a) = 0$$

$$3a+b-c = 0$$

27. Ans. B.
Mean of f(x) is

$$E(x) = \int_{-\pi}^{5} x \left(\frac{x}{a} + 1\right) dx + \int_{5}^{\pi} x \left(\frac{-x}{a} + 1\right) dx$$

$$= \left(\frac{x^{3}}{3a} + \frac{x^{2}}{2}\right)_{-\pi}^{5} + \left(\frac{-x^{3}}{3a} + \frac{x^{2}}{2}\right)_{5}^{\pi} = 0$$
Variance of f(x) is $E(x^{3}) - \left\{E(x)\right\}^{2}$ where
 $E(x^{3}) = \int_{-\pi}^{5} x^{3} \left(\frac{x}{a} + 1\right) dx + \int_{5}^{\pi} x^{3} \left(\frac{-x}{a} + 1\right) dx$

$$= \left(\frac{x^{4}}{4a} + \frac{x^{3}}{3}\right)_{-\pi}^{5} + \left(\frac{-x^{4}}{4a} + \frac{x^{3}}{3}\right)_{5}^{\pi} = \frac{a^{3}}{6}$$
Next, mean of g(x) is



$$E(x) = \int_{a}^{b} x \cdot \left(\frac{-x}{a}\right) dx + \int_{b}^{a} x \cdot \left(\frac{x}{a}\right) dx = 0$$

Variance of $g(x)$ is $E(x^{2}) - \{E(x)\}^{2}$, where
 $E(x^{2}) = \int_{-a}^{b} x^{2} \cdot \left(\frac{-x}{a}\right) dx + \int_{b}^{a} x^{2} \cdot \left(\frac{x}{a}\right) dx = \frac{a^{3}}{2}$
 \Rightarrow Variance is $\frac{a^{3}}{2}$

 \therefore Mean of f(x) and g(x) are same but variance of f(x) and g(x) are different.

Given curves $x^2 = 4y$...(1) and $y^2 = 4x$...(2) Diff (1), (2) w.r.to 'x', we get $2x = 4 \frac{dy}{dy} = (\frac{dy}{dy}) = 0 = m and(aax)$

$$2x = 4 \frac{-\gamma}{dx} \Rightarrow \left(\frac{-\gamma}{dx}\right)_{[0,0]} = 0 = m_1 \text{ and } (\text{say})$$
$$2y \frac{dy}{dx} = 4 \Rightarrow \left(\frac{dy}{dx}\right)_n \Rightarrow \infty = m_2 (\text{say})$$

$$\mathbf{m}_{z} = \frac{1}{\mathbf{m}'},$$

$$\text{Let}$$

$$\mathbf{tan}_{\theta} = \left| \frac{\mathbf{m}_{1} - \mathbf{m}_{z}}{\mathbf{1} + \mathbf{m}_{1}\mathbf{m}_{z}} \right| = \left| \frac{\mathbf{m}_{1}\mathbf{m}' - \mathbf{1}}{\mathbf{m}' + \mathbf{m}_{1}} \right| = \left| \frac{\mathbf{0} - \mathbf{1}}{\mathbf{0} + \mathbf{0}} \right| = \infty$$

$$\Rightarrow \theta = \frac{\pi}{2} = 90^{\circ},$$

 $x^2 - 8y \Rightarrow y - \frac{x^2}{8}$ Parabola is At the point of intersection, we have

$$\frac{x^{2}}{8} = 8 \Rightarrow x = -8,8 \text{ and } y = 8 \ge y = \frac{x^{2}}{8}$$

∴ Required area is $\int_{x=-8}^{8} \left(8 - \frac{x^{2}}{8}\right) dx$

$$= 2\int_{0}^{8} \left(8 - \frac{x^{2}}{8}\right) dx \left(\because 8 - \frac{x^{2}}{8} \text{ is even function}\right)$$

$$= 2\left[8x - \frac{x^{3}}{24}\right]_{0}^{8} = \frac{256}{3} = 85.33 \text{ Sq. units}$$

30. Ans. B. The quadratic approximation of f(x) at the point x = 0 is

$$f(x) = f(0) + \frac{x}{11}f'(0) + \frac{x^2}{21}f''(0)$$
$$= (-5) + x \cdot \{0\} + \frac{x^2}{2}\{-6\} = -3x^2 - 5$$











37. Ans. C.

 $p^2 > 4gd$

This question can be solved by trick, Option (B) and (D) are not dimensionally correct.









44. Ans. B.



As per Teraghis for local shear failure $C_m = \frac{2}{3}C' = \frac{2}{3} \times 35$ $\phi_m = \tan^{-1}\left(\frac{2}{3}\tan\phi\right)$ $q_m = C_mN_c + q(N_q - 1) + \frac{1}{2}B_{,y}N_c$ $q_m = \left(\frac{2}{3}c\right)N_c + q(N_q - 1) + \frac{1}{2}B_{,y}N_c$ $\phi_m = \tan^{-1}\left(\frac{2}{3}\tan\phi\right) = \tan^{-1}\left(\frac{2}{3}\tan 28.63\right)$ $= \tan^{-1}(0.3639)$

45. Ans. A. For exerted by jet in X-direction $F_v = pa(V - v)^2 \times sin\theta$

=
$$10^3 \times \frac{\pi}{4} \times (0.02)^2 \times (10)^2 \times \sin 30^\circ$$

= 15.71N

Taking moment about hinge, F. × 0.1 = F × 0.2

$$\Rightarrow F = \frac{F_x}{2} = \frac{15.71}{2} = 7.85N$$



46. Ans. B.

	Time	Ordinate of 1 hr UH	Lag	Ordiinate of 2h DRH	Ordinate of 2h UH
	10:00	0		0	0
	11:00	3	0	3	1.5
	12:00	12	3	15	7.5
	01:00	8	12	20	10
	02:00	6	8	14	7
	03:00	3	6	9	4.5
	03:00	3	6	9	4.5
	04:00	0	3	3	1.5
			0	0	0

Flow of river = rainfall excess \times ordinate of 2-h UH + Base flow

47. Ans. A.

The maximum height of hump **AZ** is given by **E=E___+AZ___**

$$\Rightarrow y + \frac{q^{2}}{2qy^{2}} = \frac{3}{2}y_{c} + \Delta z_{max}$$

$$q = \frac{Q}{B} = \frac{6}{3} = 2m^{2}/s, y = 0.5m$$

$$y_{c} = \left(\frac{q^{2}}{g}\right)^{1/3} = \left(\frac{2^{2}}{9.81}\right)^{1/3} = 0.74m$$
So, $0.5 + \frac{(2)^{2}}{2 \times 9.81 \times (0.5)^{2}} = \frac{3}{2} \times 0.74 + \Delta z_{max}$

$$\Rightarrow \Delta z_{max} = 0.205 \text{ m}$$

48. Ans. C.
Energy equation,

$$H = \frac{P}{A} + \frac{V^2}{2g} + h_{\perp}$$

$$\Rightarrow 500 = \frac{V^2}{2g} + 0.05 \times \frac{V^2}{2g}$$

$$\Rightarrow V = \sqrt{\frac{2 \times 10 \times 500}{1.05}} = 97.59 \text{ m/s}$$
Water power

Water power



$$= \frac{1}{2} mv_1^2$$

= $\frac{1}{2} \times 10^3 \times \frac{\pi}{4} \times (0.15)^2 \times (97.59)$
= 8212.5kw

Power generated = 7% × WP 0.8 × 8212.5 = 6570kw

49. Ans. D.

Seepage velocity = $\frac{100}{100}$ = 1m / day Discharge Velocity = n × seepage velocity = 0.15×1=0.15 m / day

 $i = \frac{h}{L} = \frac{3}{100}$ V = k,i \Rightarrow 15 = k × $\frac{3}{100}$ ⇒ k = 5 m / day

50. Ans. A. Total hardness = Mg/L of Ca²⁺ and mg²⁺ = 4.1×50 = 20 mg/L as Caco₃ Alkalinity = 3.3×50 = 165 mg/L as CaCo₃ NCH = TH-Alkalinity = 205-165 = 40 mg/L

51. Ans. C.

 $L_{ab} = L_{ab} - 20 \log_{10} \left(\frac{60}{30} \right)$ = 74 - 20 log₁₀ 2 = 67.9dB

52. Ans. A. Given $(BOD)_{3} = 200 \text{ mg/L}$ $k_{5} = 0.22 / \text{day}$ $(BOD)_{2} = ?$ $(BOD)_{3} = L_{5} (1 - e^{-k_{5} \cdot t})$ $200 = L_{5} (1 - e^{-k_{5} \cdot t})$ $L_{5} = \frac{200}{1 - e^{-5.56}} = \frac{200}{0.483} = 413.95$ $(BOD)_{3} = L_{5} (1 - e^{-k_{5} \cdot t}) = 413.95$ $(1 - e^{-5.25 \cdot t}) = 276.158 \text{ mg/L}$

53. Ans. A. Given y₁ = **0.30**, y₂ = **0.25**, y₃ = **0.25**

Total cycle time (L) = 10By Webster method $(C_b) = \frac{1.5L+5}{1-v}$ Cycle time $(C_{s}) = \frac{1.5L + 5}{1 - (y_{1} + y_{2} + y_{3})}$ $C_{\rm b} = \frac{1.5 \times 10 + 5}{1 - (0.3 + 0.25 + 0.25)}$ $=\frac{15+5}{1-.08}=\frac{20}{0.2}=100s$ $G_1 = \frac{(C-L)(y_1)}{\Sigma v} = \frac{(100-10) \times 0.30}{0.8}$ = 33.75 sec # 34 sec $G_{2} = \frac{(C-L)(y_{1})}{\Sigma y} = \frac{(100-10) \times 0.25}{0.8}$ = 28.125 sec # 28 sec $G_s = \frac{(C-L)y_s}{\Sigma v} = \frac{(100-10) \times 0.25}{0.8}$ = 28.125 sec = 28 sec 54. Ans. A. Downward gradient, N = -3%f = 0.35 $S_{b} = \frac{(v_{i})^{2} - (v_{f})^{2}}{2\sigma(f - N)}$ But $v_i = 100 \times \frac{5}{18} = 27.77 \text{m/s}$ $v_f = 50 \times \frac{5}{18} = 13.88 \text{m} / \text{s}$ $S_{b} = \frac{27.77^{2} - 13.88^{2}}{2 \times 9.81(0.35 - 3/100)}$ $S_{h} = 92.14 \text{ m}$

55. Ans. A. Relief displacement is given by, $d = \frac{rh_2}{H-h}$

d = 112.5 - 82.40 = 30.1 mm $\Rightarrow 30.1 = \frac{h \times 112.5}{700 - 250}$ $\Rightarrow h = 120.4 \text{m}$