MADE EASY

GATE 2025

Civil Engineering
Shift-2

Memory based

Questions & Solutions

Exam held on
16/02/2025 (Afternoon Session)

Corporate Office: 44-A/1, Kalu Sarai, New Delhi-110016
MADE EASY Centers: • Delhi • Hydrabad • Bhopal • Jaipur • Pune • Kolkata

9021300500

www.madeeasy.in

SECTION - A GENERAL APTITUDE

Q.1 Shopkeeper sells product at Rs. 192 per kg by Mixing product P and Q at a certain ratio.
P is Rs. 800 for 5 kg
Q is Rs. 800 for 4 kg
Find the mixing proportion of P/Q.

(a) $\frac{1}{4}$ (b)

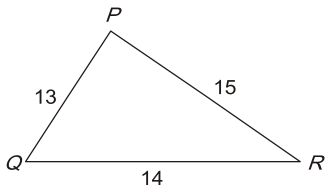
(c) (d)

Ans. **(a)**

$$\text{Rate of } P = 160 \text{ ₹/kg}$$
$$\text{Rate of } Q = 200 \text{ ₹/kg}$$
$$\frac{\text{Quantity of } Q_P}{\text{Quantity of } Q_q} = \frac{200-192}{192-160} = \frac{8}{32} = \frac{1}{4}$$

End of Solution

Q.2 Three village PQR located at distance showed



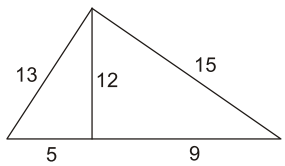
A road is proposed to be constructed between QR and P by joining P to QR. The shortest length of road to be constructed from P to QR is

(a) 10.5 (b) 12.5

(c) 11 (d) 12

Ans. **(d)**

$$h^2 + x^2 = 13^2 \quad \text{...(i)}$$
$$h^2 + (14 - x)^2 = 15^2 \quad \text{...(ii)}$$



After solving (i) and (ii)
We get $x = 5$ and $h = 12$

End of Solution

Q.3 The president along with the council of ministers _____ to visit India next week.

(a) is wishing (b) wish
(c) wishes (d) will wish

Ans. (c)

The president along with the council of ministers wishes to visit India next week.

End of Solution

Q.4 Even though I had planned to go skiing with my friends, I have to _____ at the last moment because of an injury.

(a) back on (b) back off
(c) back out (d) back down

Ans. (c)

End of Solution

■■■■

Foundation Courses for

ESE 2026 | GATE 2026

Tablet Course

- Pre-loaded full fledged recorded course
- Android OS based 10.5 inch Samsung tablet
- Internet access does not required
- Classes by senior faculties
- Validity: 2 Years
- Learn at your own pace
- Tablet is reusable for normal purpose after validity expires

Recorded Course

- Recorded Course
- Full fledged holistic preparation
- Classes by senior faculties
- Lectures can be watched anytime/ anywhere
- Courses are accessible on PC & Mac desktops/laptops/android/ iOS mobile devices.
- Learn at your own pace
- Validity: 1 year
- Internet connection required

Teaching Hours

- **GATE Exclusive** • CE, ME, EE : 800 to 900 Hrs. • EC, IN, CS, CH : 650-700 Hrs.
- **GATE + ESE** • CE, ME, EE, EC : 1100 to 1200 Hrs.
- **GATE + SES-GS** • CE, ME, EE : 1150 to 1250 Hrs. • EC, IN, CS, CH : 950-1050 Hrs.
- **GATE + ESE + SES-GS** • CE, ME, EE, EC : 1450 to 1550 Hrs.

Note : State Engineering Services Examination.

- The course is offered with a validity options of 1 year and 2 years.

Low Cost EMI Facility Available

Admissions open

For online courses, download the MADE EASY PRIME app now

Android iOS

Delhi Centre : 44-A/1, Kalu Sarai, Near Hauz Khas Metro Station, New Delhi-110016 • Ph: 9021300500

MADE EASY Centres : Delhi | Bhopal | Hyderabad | Jaipur | Kolkata | Pune **www.madeeasyprime.com**

SECTION - B TECHNICAL

Q.5 Order and degree of the differential equation :

$$\left(\frac{d^3y}{dx^3}\right)+\left(\frac{d^2y}{dx^2}\right)^6+\left(\frac{dy}{dx}\right)^4+y=0$$

(a) order 3 and degree 1 (b)

(c) (d)

Ans. (a)

Order = 3

Degree = 1

End of Solution

Q.6 For the matrix $A=\begin{bmatrix}6 & 8\\ 4 & 2\end{bmatrix}$, eigen value is

(a) –10 (b) 10

(c) 4 (d) 2

Ans. (a, d)

Given matrix, $A=\begin{bmatrix}6 & 8\\ 4 & 2\end{bmatrix}$

$$\lambda^2+8\lambda-20=0$$
$$\lambda^2+10\lambda-2\lambda-20=0$$
$$\lambda(\lambda+10)-2(\lambda+10)=0$$
$$\lambda=-10,\ 2$$

End of Solution

Q.7 If matrix $A=\begin{bmatrix}2 & 3 & 4\\ 1 & 4 & 5\\ 4 & 3 & 2\end{bmatrix}_{3\times3}$ then transpose of A is _____ .

(a) $A^T=\begin{bmatrix}2 & 1 & 4\\ 3 & 4 & 3\\ 4 & 5 & 2\end{bmatrix}$ (b)

Ans. (a)

$$A=\begin{bmatrix}2 & 3 & 4\\ 1 & 4 & 5\\ 4 & 3 & 2\end{bmatrix}$$

$$A^T=\begin{bmatrix}2 & 1 & 4\\ 3 & 4 & 3\\ 4 & 5 & 2\end{bmatrix}$$

End of Solution

Q.8 $x^3 - \frac{15}{2}x^2 + 18x + 20 = 0$

Ans. (Sol.)

$$x^3 - \frac{15}{2}x^2 + 18x + 20 = 0$$

$$f(x) = x^3 - \frac{15}{2}x^2 + 18x + 20$$

$$f'(x) = 3x^2 - 15x + 18$$

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

$$x = 2,\ 3$$

$$f''(x) = 6x - 15$$

$$f''(x)\big|_{x=2} = 6 \times 2 - 15 = -3 < 0$$

$x = 2$ Local maxima

$$f''(x)\big|_{x=3} = 6 \times 3 - 15 = 3 > 0$$

$x = 3$ Local minima

$$f(x) = x^3 - \frac{15}{2}x^2 + 18x + 20$$

$$f(2) = (2)^3 - \frac{15}{2}(2)^2 + 18\times 2 + 20$$

$$= 8 - 30 + 36 + 20 = 34$$

$$f(3) = (3)^3 - \frac{15}{2}(3)^2 + 18\times 3 + 20$$

$$= 27 - 67.5 + 54 + 20 = 33.5$$

End of Solution

Q.9 If $\frac{dy}{dx} = e^{x-y}$ then the value of $y(0)$ is

(a) $\ln(e^x + c)$ (b) $\ln(e^x - c)$

(c) (d)

Ans. (a)

$$\frac{dy}{dx} = e^{x-y}$$

$$\frac{dy}{dx} = e^x \cdot e^{-y}$$

$$\frac{dy}{dx} = e^x dx$$

$$e^y = e^x + c$$

$$\ln(e^y) = \ln(e^x + c)$$

$$y = \ln(e^x + c)$$

End of Solution

MADE EASY

ANNOUNCING

FOUNDATION COURSES for ESE 2026 & GATE 2026

The foundation batches are taught comprehensively which cover the requirements of all technical-syllabus based examinations.

- Classes by experienced & renowned faculties.
- Comprehensive & updated study material.
- Exam oriented learning ecosystem.
- Concept practice through workbook solving.
- Efficient teaching with comprehensive coverage.
- Similar teaching pedagogy in offline & online classes.
- Systematic subject sequence and timely completion.
- Regular performance assessment through class tests.

Commencement Dates :

Offline Batches at Delhi
18 Feb 2025

Teaching Hours

GATE Exclusive
- CE, ME : 950 to 1000 Hrs.
- EE : 800 to 850 Hrs.
- EC, IN, CS : 650-700 Hrs.

GATE + ESE
- CE, ME, EE, EC: 1200-1250 Hrs.

Live-Online Batches
Evening : 18 Feb (All)
Morning : 27 Feb (CE)

Teaching Hours

GATE Exclusive
- CE, ME, EE : 750 to 800 Hrs.
- EC, IN, CS : 650-700 Hrs.

GATE + ESE
- CE, ME, EE, EC : 1050 to 1100 Hrs.

More batches to be announced in Mar, Apr, May 2025

Note : Courses with SES (State Engineering Services) are also available.

Low Cost EMI Facility Available | **Admissions Open**

Delhi Centre : 44-A/1, Kalu Sarai, Near Hauz Khas Metro Station, New Delhi-110016 • Ph: 9021300500

MADE EASY Centres : Delhi | Bhopal | Hyderabad | Jaipur | Kolkata | Pune **www.madeeasy.in**

Q.10 The free flow speed of a highway is 100 kmph and its capacity of 4000 vehicles per hour. Assume speed density relation is linear. For a traffic volume of 2000 vehicles per hour, the possible speeds are

(a) 14.64 kmph (b) 85.36 kmph
(c) 7.22 kmph (d) 65.20 kmph

Ans. **(a, b)**

Given:

Free mean speed, $V_f = 100$ kmph

Capacity, $q_{max} = 4000$ veh/hr

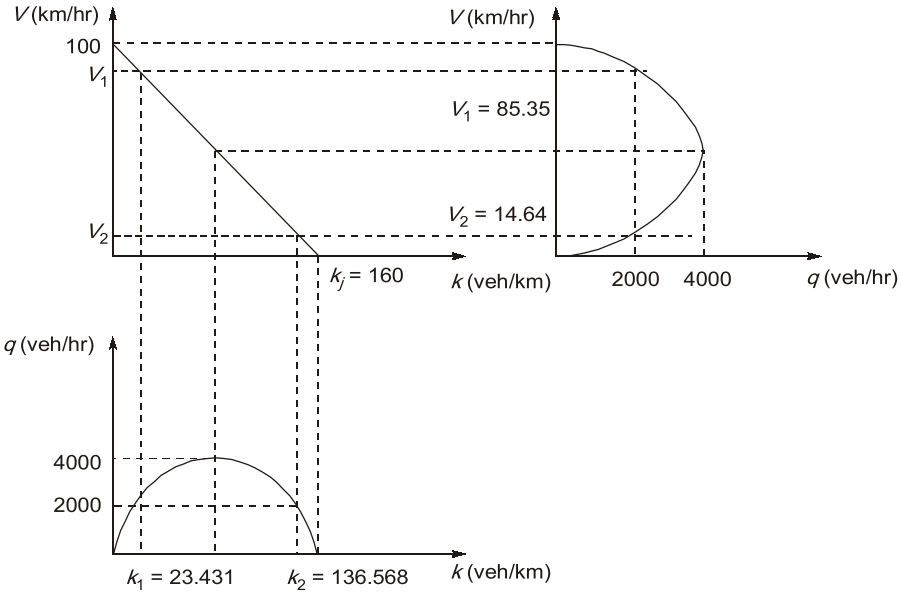
Possible speed, V_1, $V_2 = ?$

Speed density relation is linear

$$q_{max} = \frac{1}{4} k_j V_f$$

$$4000 = \frac{1}{4} \times 100 k_j$$

$$k_j = 160 \text{ veh/km}$$



Now, $q = vk$ $\quad \because \quad v = v_f\left(1 - \frac{k}{k_j}\right)$

$$q = v_f\left(k - \frac{k^2}{k_j}\right)$$

$$2000 = 100\left(k - \frac{k^2}{160}\right)$$

On solving $k_1 = 23.431$ veh/km

$k_2 = 136.568$ veh/km

Velocity of traffic flow at $k_1 = 23.431$ veh/km

$$V_{1(k_1 = 23.431)} = 100\left(1 - \frac{23.431}{160}\right) = 85.355 \text{ km/hr}$$

Velocity of traffic flow at $k_2 = 136.568$ veh/km

$$V_{2(k_2 = 136.568)} = 100\left(1 - \frac{136.568}{160}\right) = 14.645 \text{ km/hr}$$

Hence, the correct options are (a) and (b).

End of Solution

Q.11 On a two lane highway, a horizontal curve of radius 300 m is provided the design speed is 80 kmph. If the longest wheel base of vehicle expected on this highway 6 m then the extra widening required _____ m.

Ans. **(0.606)**

Given:

Two lane highway

Number of lanes, $n = 2$

Radius of curve, $R = 300$ m

Design speed, $v = 80$ km/hr

Longest wheel base of vehicle, $l = 6$ m

Extra widening, $W_e = ?$

As per IRC

Extra widening, $W_e = W_m + W_{ph}$

$$= \frac{nl^2}{2R} + \frac{v}{9.5\sqrt{R}}$$

$$= \frac{2 \times 6^2}{2 \times 300} + \frac{80}{9.5\sqrt{300}}$$

$$W_e = 0.606 \text{ m}$$

End of Solution

Q.12 The recommended minimum traffic growth and design period is considered for structural design of flexible pavement for national highway in India as per IRC 37 : 2018 is _____ (in %) and _____ (in year).

(a) 7, 20 (b) 7, 30

(c) 5, 20 (d) 5, 30

Ans. **(c)**

As per IRC 37 : 2018.

For structural design of flexible pavement for national highway in India.

Minimum traffic growth = 5%

Design period = 20 years

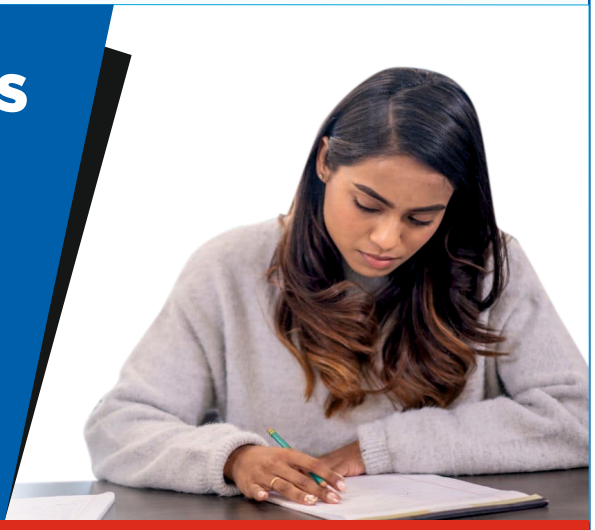
End of Solution

MADE EASY

Conventional Questions Practice Programme for ESE Mains 2025

Offline **Live-Online**

Admissions Open



Batches commencing from **24 FEB 2025**

Course includes Mains Test Series (12 tests)

Commencing from **15 June 2025**

Note : Solo Mains Test Series is also available.

This course is offered in offline mode at Delhi Centre.

Key Features:

- Classes by senior faculties
- Comprehensive coverage
- Discussion on important questions
- Improvement of 'answer presentation'
- Updated ESE Mains Workbooks
- Mains Test Series is included

Duration: 300-350 Hrs | 80-90 days

Timing : 7 days/week | 4 hours/day

Streams: CE, ME, EE, E&T

Fee: ₹18,000 + GST For Outsiders | ₹14,000 + GST For **MADE EASY Students** (Foundation, RIB and Mains Course)

Fee is same for Offline & Live-online Batches

- **Test series is available at all MADE EASY Centres.**

Delhi Centre : 44-A/1, Kalu Sarai, Near Hauz Khas Metro Station, New Delhi-110016 • Ph: 9021300500

MADE EASY Centres : Delhi | Bhopal | Hyderabad | Jaipur | Kolkata | Pune **www.madeeasy.in**

Q.13 Match List-I with List-II and select the correct answer using the codes given below the lists

List I	List II
P. Vehicle damage factor	1. Stability of subgrade soil
Q. Passenger car unit	2. Capacity of roadway
R. Perception reaction time	3. Stopping sight distance
S. California bearing ratio	4. Flexible pavement

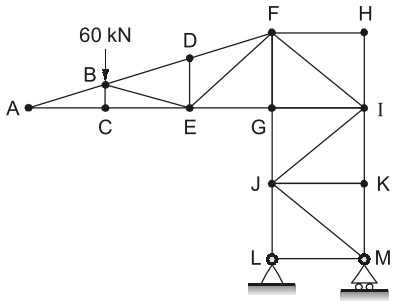
Codes:

	P	Q	R	S
(a)	4	3	2	1
(b)	4	2	3	1
(c)	1	2	4	3
(d)	2	1	4	3

Ans. (b)

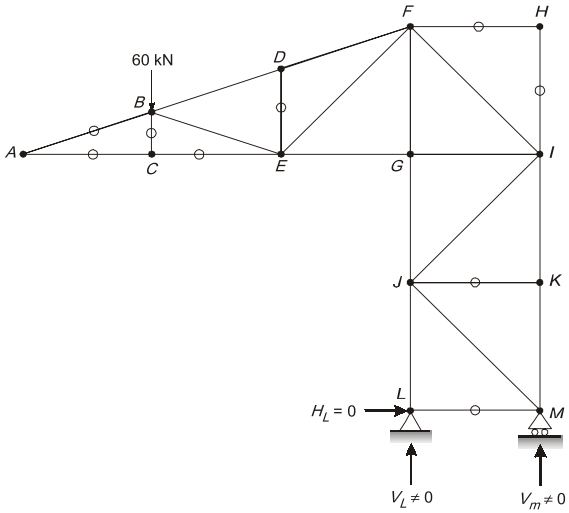
End of Solution

Q.14 In the pin jointed truss shown in the figure the members that carry zero force are identified. Which of the following options is/are zero force members.



(a) F I
(b) J K
(c) E G
(d) B C

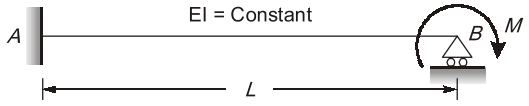
Ans. (b, d)



Force in members AB, AC, BC, CE, DE, FH, HI, JK and LM are zero.
Hence, $F_{JK} = 0$; $F_{BC} = 0$; $F_{FI} \neq 0$; $F_{EG} \neq 0$
Hence, the correct options are (b) and (d).

End of Solution

Q.15 The figure shows a propped cantilever beam with uniform flexural rigidity (EI) and subjected to a moment (M). Consider force and displacement in upward direction as positive. Find the upward vertical reaction at the propped end support. If the support B sinks by Δ in downward direction



(a) $\frac{2}{3}\frac{M}{L} - \frac{3EI\Delta}{L^3}$

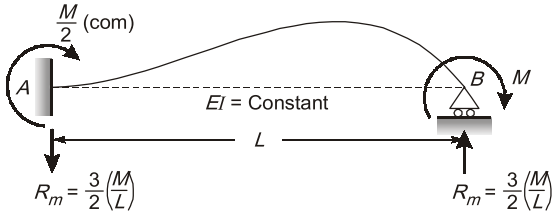
(b) $\frac{3}{2}\frac{M}{L} - \frac{3EI\Delta}{L^3}$

(c) $\frac{M}{L} - \frac{3EI\Delta}{L^3}$

(d) $\frac{M}{L} - \frac{8EI\Delta}{L^3}$

Ans. **(b)**

Reaction due to moment,

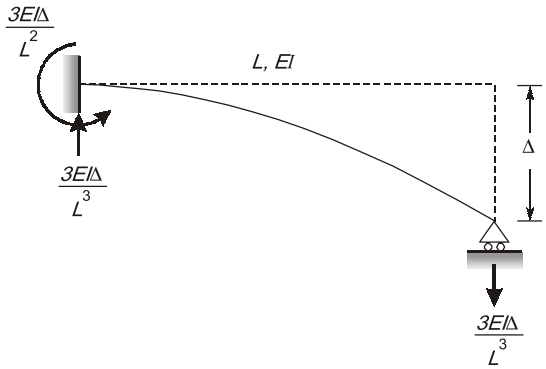


Deflection at $B = 0$

$$\frac{ML^2}{2EI} - \frac{R_m L^3}{3EI} = 0$$

$$R_m = \frac{3}{2}\left(\frac{M}{L}\right)$$

Reaction at propped end due to sinking of support.



MADE EASY PRIME

UPPSC-AE 2024 Exam

Live Online Program

Prelims Specific Course

Streams : • CE • ME • EE

Batches Going On | Admissions Open

Subjects that have already been taught will be made available in recorded-mode.

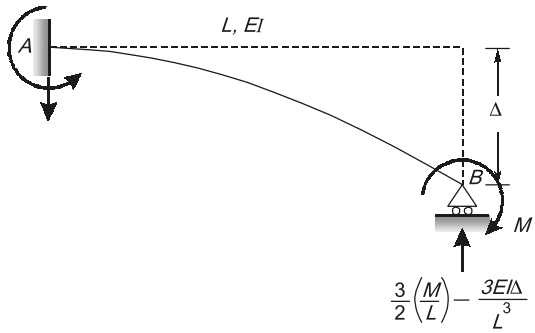
Features:

- 360-degree coverage of the UPPSC-AE 2024 Prelims Specific Course syllabus.
- Structured and effective curriculum aligns with the UPPSC-AE.
- Quality teaching with a clear and concise approach.
- Prelims-specific workbook with a wide range of practice question sets.
- Exam simulated Online test series for UPPSC AE Prelims exam.
- Dedicated doubt chat facility with faculty members.
- Live Classes + accessibility to watch recorded classes 2 times. Subjects that have already been taught will be made available in recorded-mode.
- Option to opt course "with book" or "without books".

Delhi Centre : 44-A/1, Kalu Sarai, Near Hauz Khas Metro Station, New Delhi-110016 • Ph: 9021300500

MADE EASY Centres : Delhi | Bhopal | Hyderabad | Jaipur | Kolkata | Pune **www.madeeasyprime.com**

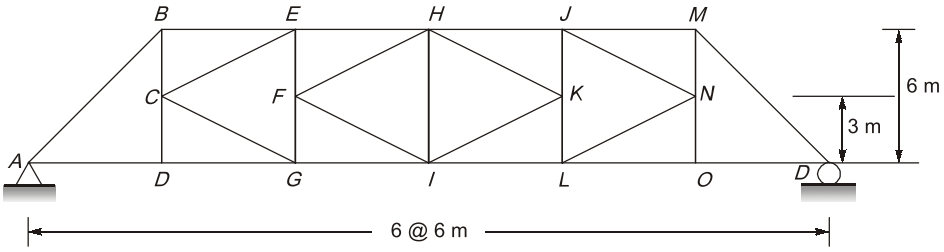
Net reaction at propped end is



$$(R_B)_{net} = \frac{3}{2}\left(\frac{M}{L}\right) - \frac{3EI\Delta}{L^3}$$

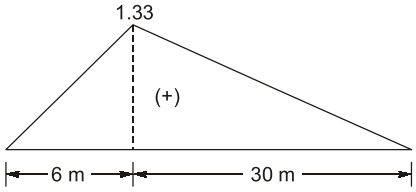
End of Solution

Q.16

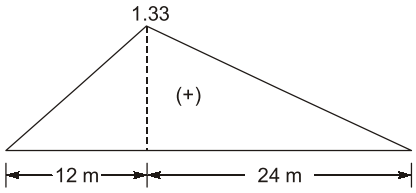


ILD for force in member GI.

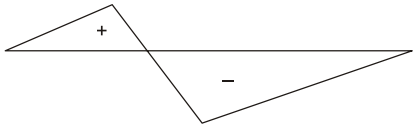
(a)



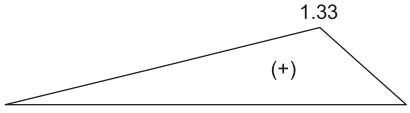
(b)



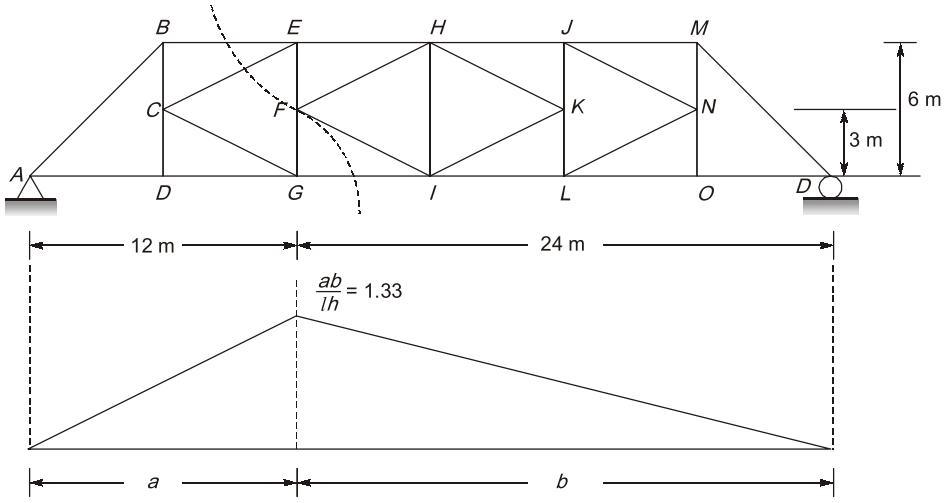
(c)



(d)



Ans. (a)



here, $a = 12$ m, $b = 24$ m,
$l = 6 \times 6 = 36$ m
$h = 6$ m (Bottom member are in tension)

$$\frac{ab}{lh} = \frac{12 \times 24}{36 \times 6} = 1.33$$

End of Solution

Q.17 A circular tube of thickness 10 mm and diameter 250 mm is welded to a flat plate using 5 mm fillet weld all along circumference. Assume Fe410 steel and shop welding. As per IS 800 : 2007, find the torque in N-mm that can be applied.

(a) 130.2 (b) 65.1
(c) 70.1 (d) 156.2

Ans. (b)

Given,

diameter of circular plate (d) = 250 mm
size of fillet weld (S) = 5 mm
thickness of circular plate = 10 mm
thickness of flat plate = 5 mm
f_u = 410 N/mm^2
For shop welding, γ_{mw} = 1.25

MADE EASY PUBLICATIONS

UPPSC-AE 2024 EXAM

Postal Package

On the latest UPPSC-AE syllabus & pattern

Only Prelims Package	Prelims + Mains Package
• CE • ME • EE • AE (Common for all)	• CE • ME • EE (Seperate)

Prelims Package : 13 Books (12 Printed + 1 E-book)

Fee : 4,000/-

- 6 Volumes of Engg. Aptitude Books (covering 22 subjects) : Contain theory, solved examples and practice questions.
- 1 Practice Book of Engg. Aptitude containing solved practice Qs.
- 1 Book each containing theory, PYQs and practice questions of : Geography | Indian Polity | Indian History | GK & Misc.
- 1 book of General Hindi containing theory, PYQs and practice Qs.
- E-copy of Current Affairs covering latest developments along-with practice questions.

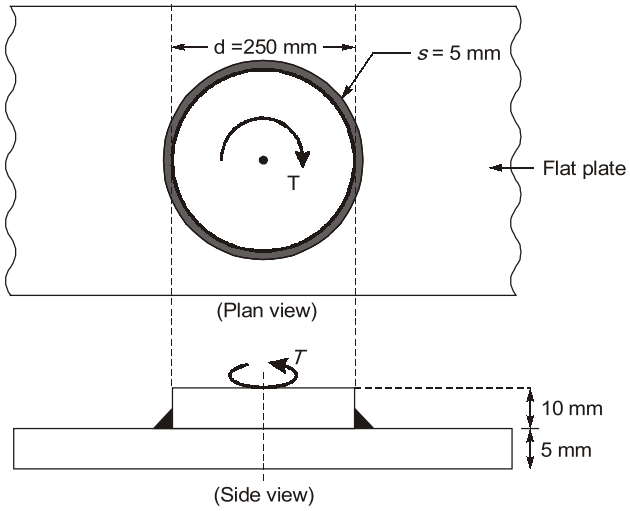
Prelims + Mains Package

Fee : 10,000/-

- 6 Volumes of Engg. Aptitude Books (covering 22 subjects) : Contain theory, solved examples and practice questions.
- 1 Practice Book of Engg. Aptitude containing solved practice Qs.
- 1 Book each of : • Geography • Indian Polity • Indian History • GK & Misclleanous; containing theory, PYQs and practice Qs.
- 1 Book of General Hindi containing theory, PYQs and practice Qs.
- E-copy of Current Affairs covering latest developments along-with practice questions.
- Technical Theory Books : Contain theory, solved examples and practice questions.
- 1 Practice Book of Technical Subjects : Contains 2000+ Questions with detailed solutions.
- 1 PYQ of Technical Papers : Contains subjectwise/yearwise step by step solutions.

Address : 44-A/4, Kalu Sarai, Near Hauz Khas Metro Station, New Delhi-110016

9021300500 **www.madeeasypublications.org**



Throat thickness, $t_t = 0.75 = 0.7 \times 5 = 3.5$ mm

$$Z_P = \frac{J}{r} = \frac{Ar^2}{r} = Ar$$

$$Z_P = (\pi d t_t) \times \frac{d}{2} = \frac{\pi d^2 t_t}{2}$$

The maximum torque that can be applied on plate is

$$T = (f_s \times Z_p)$$

$$T = \left(\frac{f_u}{\sqrt{3}\gamma_{mw}}\right) \times \left(\frac{\pi d^2 t_t}{2}\right)$$

$$= \frac{410}{\sqrt{3} \times 1.25} \times \frac{\pi \times 0.25^2 \times 3.5}{2}$$

$$T = 65.07 \text{ N-mm} \simeq 65.1 \text{ N-mm}$$

End of Solution

Q.18 For a reinforced rectangular concrete section of width 350 mm and total depth 600 mm, effective cover of 40 mm is provided with the following details

- Stress block is rectangular upto neutral axis from the top fibre.
- Area of stress block, C = 0.36 $f_{ck} b x_u$
- Depth of neutral axis do not change
- $\epsilon_c = 0.0035$

Find moment of resistance (in kNm). Take grade of concrete as M20 and steel as Fe415. Take area of tension reinforcement, $A_{st} = 800$ mm^2

Ans. (145.2)

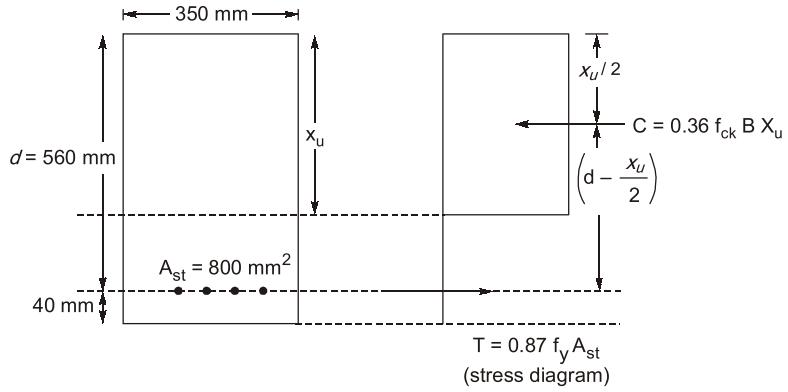
Given, width of beam $B = 350$ mm

effective depth $d = 600 - 40 = 560$ mm

$f_{ck} = 20$ N/mm^2

$f_y = 415\ \text{N/mm}^2$

$A_{st} = 800\ \text{mm}^2$



Limiting depth of NA

$$x_{ulim} = k.d = 0.48 \times 560 = 268.8\ \text{mm}^2.$$

Actual depth of NA

$$x_u = \frac{0.87 f_y A_{st}}{0.36\ f_{ck} B} = \frac{0.87 \times 415 \times 800}{0.36 \times 20 \times 350}$$

$$x_u = 114.619\ \text{mm}$$

$\because$ $x_u < x_{ulim}$

$\therefore$ section is under reinforced

$$M_u = C \times LA$$

$$= 0.36 f_{ck} B x_u \left(d - \frac{x_u}{2}\right)$$

$$= 0.36 \times 20 \times 350 \times 114.619 \left(560 - \frac{114.619}{2}\right)$$

$$= 145.197 \times 10^6\ \text{N-mm}$$

$$M_u \simeq 145.2\ \text{kNm}$$

End of Solution

Q.19 A rectangular section of effective depth 500 mm is provided with 2 legged vertical stirrups of diameter 10 mm and center to center spacing of 100 mm. If grade of steel used is Fe415 then the shear force taken by vertical stirrups (in kN) is ____.

Ans. (283.57)

Given 2 legged vertical stirrups of diameter (ϕ = 10 mm)

c/c spacing S_v = 100 mm

$f_y = 415\ \text{N/mm}^2$

effective depth d = 500 mm

Spacing for vertical shear stirrups

POSTAL Packages

MADE EASY PUBLICATIONS

- CSE
- ESE
- GATE
- UPPSC-AE
- SSC-JE
- RRB-JE

Our Postal Book Packages cater to the needs of college-going students, working professionals, and individuals unable to join classroom courses. These books, offered by MADE EASY, are designed to be compact, comprehensive, and easily understandable. We have put our efforts to ensure error-free content, incorporating smart and shortcut techniques specifically tailored for solving numerical problems.

Revised and updated study materials

Helpline : 8860378004

Salient Features of Postal Study Package

- Complete syllabus coverage aligned with latest pattern/syllabus.
- Detailed theory and practice exercises.
- Latest and updated study material
- Step by step solutions
- Ample no. of practice questions with PYQs.
- Emphasis on technical and non technical sections both.
- Subject-wise theory objective and conventional practice sets.
- Proven track record of student success.

For online purchase, Visit : www.madeeasypublications.org

For offline purchase, visit in-person at any MADE EASY center.
Books will be sent to your provided address.

Note 1 : Books are usually sent in two or more packages.
Note 2 : Current Affairs for ESE will be sent 1 month prior to the examination.

Address : 44-A/4, Kalu Sarai, Near Hauz Khas Metro Station, New Delhi-110016
9021300500 **www.madeeasypublications.org**

$$S_v = \frac{0.87 f_y A_{sv} \times d}{V_s}$$

where;

$V_s = (\tau_V - \tau_C)\, bd$

$\tau_v = \dfrac{V_u}{bd}$ (Nominal shear stress)

V_s = shear force resisted by shear stirrups

$$V_s = \frac{0.87 f_y A_{sv} d}{S_v} = \frac{0.87 \times f_y \times 2 \times \frac{\pi}{4}\phi^2 \times d}{S_v}$$

$$= \frac{0.87 \times 415 \times 2 \times \frac{\pi}{4} 10^2 \times 500}{100}$$

$V_s = 283568$ N

$V_s \simeq 283.57$ kN

End of Solution

Q.20 After applying the correction for elevation and temperature the runway length is 700 m. The corrected runway length for an effective gradient of 1% is ___ m.

(a) 700 (b) 720

(c) 840 (d) 740

Ans. **(c)**

Given:

Corrected length after applying elevation and temperature correction,

l = 700 m

Gradient = 1%

For every 1% gradient, runway length increase by 20%.

Therefore corrected runway length = $700 + 700 \times \frac{20}{100}$

= 700 × 1.2 = 840 m

End of Solution

Q.21 Which of the following statement(s) is/are correct?

Statement I : Fly Ash and silica fumes can be used as mineral admixture

Statement II : According to IS code the Moist curing time will increase on addition of mineral admixtures

(a) I and II (b) I only

(c) II only (d) Neither I nor II

Ans. (a)

Statement I and statement II both are correct.

S-I : Both Flyash and silica fumes are artificial admixture as Pozzolanic materials are supposed to be artificial mineral admixture.

S-II : As soon as an admixture is added rate of hydration decreases slightly which in turn increases curing time of concrete.

OPC $\rightarrow$ 7 to 10 days of curing

With mineral admixture $\rightarrow$ Minimum 10 days of curing.

Hence, the correct option is (a).

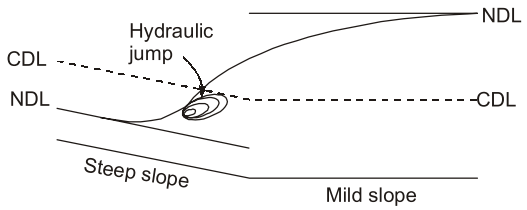
End of Solution

Q.22 Hydraulic Jump is formed when slope of the channel changes from

(a) Mild to steep (b) Steep to steeper

(c) Mild to zero slope (d) Steep to mild

Ans. (d)



Hydraulic jump is formed in an open channel when flow change from super critical ($F_r > 1$) to sub critical ($F_r < 1$).

End of Solution

Q.23 A very wide rectangular channel is having depth of flow as 1 m and bed slope as 0.0001. If Manning's n is 0.02, g is 9.81 m/s^2, then the critical depth of flow (in m) is _____.

Ans. (0.294)

Given : Bed slope, $s = 0.0001$; Manning's coefficient, $n = 0.02$; Depth of flow (y) = 1 m, $g = 9.81$ m/s^2; Critical depth (y_c) = ?

For very wide rectangular channel ($B >> y$)

$$\text{Hydraulic radius, } R = \frac{A}{P} = \frac{By}{B+2y} \simeq y = 1 \text{ m} \qquad (\because\ B + 2y = B)$$

$$\text{Critical depth of flow, } y_c = \left(\frac{q^2}{g}\right)^{1/3} \qquad \text{...(i)}$$

Now, Discharge, $Q = A \times v$

$$Q = By \times \frac{1}{n} R^{2/3} S^{1/2}$$

Foundation Courses for JE and AE Exams

Mode: Live-Online

Civil Engineering	Mechanical Engineering	Electrical Engineering	Non-technical Section

These foundation batches are taught comprehensively which cover the requirements of technical and non-technical syllabus of Junior Engineer and Assistant Engineer level exams.

Duration of Foundation Course : 1 Year

Features

- Classes by renowned faculties
- Comprehensive coverage of all subjects
- Class PDF notes
- Doubt Sessions on Telegram
- Lectures will be in Hinglish
- 1 Year Course validity
- Concept Practice Book in PDF
- Dedicated for all AE and JE Exams
- Technical and Non- Technical
- Monthly LIVE Guidance Session
- Get Physical books and Study material (Optional)
- 700+ teaching hours

9021300500 www.madeeasyprime.com

$$q = \frac{y}{n} R^{2/3} S^{1/2} \qquad \because \quad q = \frac{Q}{B}$$

$$q = \frac{1}{n} y \times y^{2/3} \cdot S^{1/2}$$

$$q = \frac{1}{n} \times y^{5/3} \times S^{1/2}$$

$$q = \frac{1}{0.02} \times (1)^{5/3} \times (0.0001)^{1/2}$$

$$q = 0.5 \text{ m}^3/\text{sec/m}$$

From equation (i), critical depth of flow

$$y_c = \left(\frac{0.5^2}{9.81} \right)^{1/3}$$

$$y_c = 0.294 \text{ m}$$

End of Solution

Q.24 For a 3 hr flood hydrograph, Peak discharge is given as = 180 m^3/sec and Base flow is given as 30 m^3/sec. If infiltration index, ϕ is 0.2 cm/hr and rainfall is given as 6.6 cm, then peak of 3 hr unit hydrograph is _____ m^3/sec.

Ans. **(25)**

Peak discharge = 180 m^3/s
Base flow = 30 m^3/s
ϕ-index = 0.2 cm/hr
R = 6.6 cm

Peak of 3 hr unit hydrograph,

$$Q_P = \frac{\text{Peak discharge} - \text{Base flow}}{R - \phi t}$$

$$= \frac{180 - 30}{6.6 - 0.2 \times 3} = \frac{150}{6} = 25 \text{ m}^3/\text{s}$$

End of Solution

Q.25 Given: $S = 0.67$, $e = 0.6$, $w = 0.15$, $G = 2.67$, $\gamma_w = 9.81$ kN/m^3, volume of soil = 5 m^3, weight of water required to make the soil fully saturated is

Ans. **(6.11)**

Initial water content, $w_1 = 0.15$
Let water content be w_2
After full saturation, $Se = w_2 G_s$

$$w_2 = \frac{e}{G_s} = \frac{0.6}{2.67} = 0.2247$$

Now, $$w_2 - w_1 = \frac{\Delta \text{Weight of water}}{\text{Weight of solid}} = \frac{w}{w_s}$$

Also, $$w_s = V_s G \cdot \gamma_w = \left(\frac{V_T}{1+e}\right) G \cdot \gamma_w$$

$$\Rightarrow \quad 0.2247 - 0.15 = \frac{w}{\frac{5}{1.6} \times 2.67 \times 9.81}$$

$$w = 0.0747 \times 3.125 \times 2.67 \times 9.81$$
$$= 6.11 \text{ kN}$$

End of Solution

Q.26 Which of the following statements is/are INCORRECT?

(a) The effective stress in liquified soil is almost zero.

(b) As the depth of GWT above the ground surface increases the effective stress in the soil decreases.

(c) The earth pressure at any point in the soil under all conditions is always smaller than the vertical effective stress at the point.

(d) Bulking of the moist sand is due to the capillary action in the sand.

Ans. (b, c)

End of Solution

Q.27 The head difference between upstream and downstream end of a flow net is 9 m. The number of equipotential drop between upstream and downstream side is 10. If the length of the flow field near the toe is 1 m and the saturated unit weight of soil below the dam is 21 kN/m^3, then what is the factor of safety for quick condition?

Ans. (1.267)

$$\text{FOS} = \frac{i_c}{i_{exit}}$$

where, $$i_{exit} = \frac{\Delta h}{L} = \frac{H/N_D}{L} = \frac{9/10}{1} = 0.9$$

$$i_c = \frac{\gamma'}{\gamma_w} = \frac{21 - 9.81}{9.81} = 1.14$$

$$\Rightarrow \quad \text{FOS} = \frac{1.14}{0.9} = 1.267$$

End of Solution

Q.28 Group pile of 4*4, group efficiency is 100%, pile length is 20 m and average unconfined compressive strength (UCS) is 100 kN/m^2. Take adhesive factor, α = 0.8, diameter of pile is 500 mm and neglect bearing of pile. Calculate spacing *S*.

ESE 2025 Prelims
Offline Test Series

MADE EASY

Commencing from

9 Mar 2025

Total 22 Tests

Paper-I : 11 Tests
GS & Engineering Aptitude

- 8 Multiple Subject Tests of 50 Questions (**400 Ques**) *Time : 60 minutes*
- 1 Full Syllabus Test of 100 Questions (**300 Ques**) *Time : 120 minutes*
- **2 Anubhav Tests** Full Syllabus

Paper-II : 11 Tests
Engineering Discipline

- 8 Multiple Subject Tests of 75 Questions (**600 Ques**) *Time : 90 minutes*
- 1 Full Syllabus Test of 150 Questions (**450 Ques**) *Time : 180 minutes*
- **2 Anubhav Tests** Full Syllabus

Each question carries 2 marks • **Negative marking = 2/3 marks**

Latest Pattern — Tests are designed as per latest syllabus, trend and pattern of ESE. Paper-I (GS and Engineering aptitude) and Paper-II (Technical) both are covered.

Care for Accuracy — All care has been taken to ensure the highest level of accuracy.

Cyclic Revision — Dynamic test series for cyclic revision of subjects. Tests are time tabled with "New Topics" and "Repeat Topics" to maintain the continuity and a perfect balance between tech and non tech subjects.

Quality Questions — Quality Questions framed by experienced research and development team of MADE EASY.

Illustrated Solutions — Well explained, step-by-step illustrated solutions for easy understanding of aspirants..

All India Rank — Opportunity to evaluate yourself on All India Basis. Compare your performance with quality students of MADE EASY.

Fee Structure	₹ 3,000 + GST	₹ 2,000 + GST	₹ 1,000 + GST	Nil
	Non-MADE EASY students	Ex. MADE EASY Students Enrolled in Postal or any long term/ short term classroom course	If student opts this test in live-online mode	For Current Session Students Enrolled in ESE + GATE 2025 Batches.

Scan to Enroll

Note: Anubhav Tests are part of the ESE Offline Prelims 2025 test series.
For outside students Anubhav Tests are free of cost. It will be conducted at all our MADE EASY and NEXT IAS centres across India.

Delhi Centre : 44-A/1, Kalu Sarai, Near Hauz Khas Metro Station, New Delhi-110016 • Ph: 9021300500
MADE EASY Centres : Delhi | Bhopal | Hyderabad | Jaipur | Kolkata | Pune

Enroll www.madeeasy.in

Ans. (1.51)

$$\text{Group efficiency, } \eta_g = \frac{Q_{avg}}{nQ_u}$$

Here, $\eta_g = 1$ and $\bar{c} = \frac{UCS}{2} = \frac{100}{2} = 50\ \text{kN/m}^2$

$$Q_{ug} = n \cdot Q_{up}$$

$$\bar{c}(4 \times BL) = n\left[\alpha \bar{c}(\pi DL)\right]$$

$$50 \times 4 \times B \times 20 = 16 \times [0.8 \times 50 \times \pi \times 0.5 \times 20]$$

On solving, $B = 5.026$ m

$$B = 3s + D$$

$$= 3s + 0.5 = 5.026$$

$\Rightarrow$ $s = 1.51$ m

End of Solution

Q.29 A 6 m thick clay stratum has drainage at both its top and bottom surface due to the presence of sandy stratum. The time required for 50% consolidation is 2 years. The coefficient of volume compression (m_v) is 1.51×10^{-3} m^2/kN and unit weight of water is 9.81 kN/m^3. The coefficient of permeability (in m/yr) is _____.

Ans. (0.013)

$$\text{Time factor, } (T_V)_{50} = C_v \cdot \frac{t}{d^2} = \frac{k}{m_v \gamma_w} \cdot \frac{t}{d^2}$$

$$\frac{\pi}{4} \times 0.5^2 = \frac{k}{1.51 \times 10^{-3} \times 9.81} \times \frac{2}{\left(\frac{6}{2}\right)^2}$$

$$k = 0.013 \text{ m/year}$$

End of Solution

Q.30 The most suitable test for measuring the permeability of clayey soils in laboratory is ____

(a) Pumping out test
(b) Constant head test
(c) Falling head test
(d) Hydrometer test

Ans. (c)

End of Solution

Q.31 A circular plate on surface of diameter 1 m subjected to plate load test unit weight of sand, $\gamma = 16.66$ kN/m^3, ultimate load bearing capacity, $Q_u = 1500$ kPa, The value of N_γ is ____.

Ans. (300.12)

We know, for circular plate

$$q_u = 1.3CN_C + \gamma D_f N_q + 0.3B\gamma N_\gamma$$

For sand, $c = 0$

$\Rightarrow$ $q_u = 0.3 \times 1 \times 16.66 \times N_\gamma = 1500$ $[\because D_f = 0]$

$\Rightarrow$ $N_\gamma = 300.12$

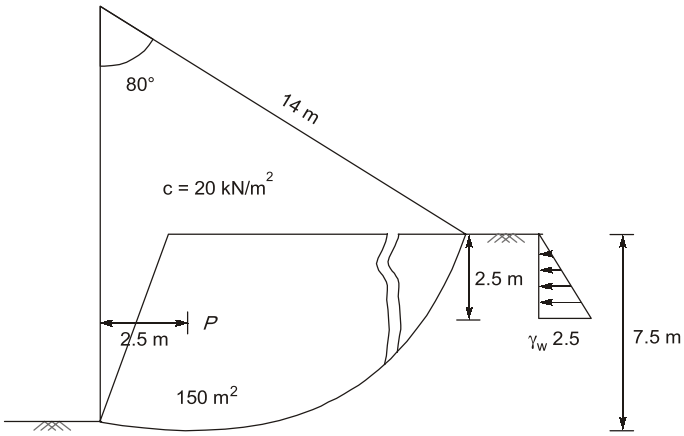
Q.32 $\gamma_{sat} = 22.67$ kN/m^3

Area = 150 m^2

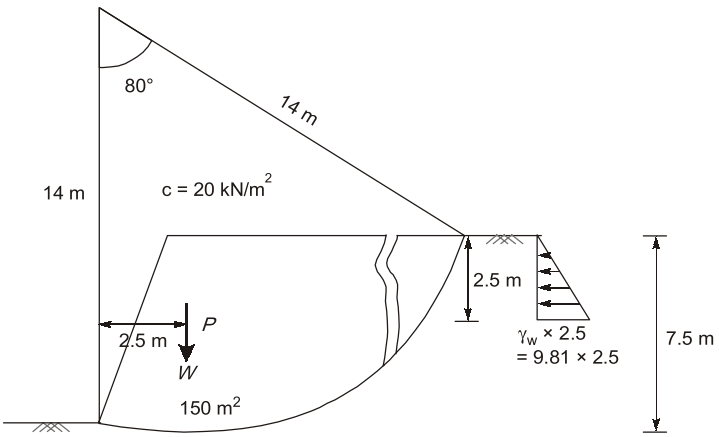
$C = 20$ kPa

Tension cracks are developed and filled with water 2.5 cm below the surface.

FOS = ?



Ans. (0.625)



MADE EASY

UPPSC-AE 2024 Preliminary Examination

Online Test Series

Commencing from 20th FEB'25

Total 10 Tests (Total 1125 Questions)

5 Part Syllabus Tests + 5 Full Syllabus Tests

Paper Pattern:

- Each question carries 2 Marks
- There is a penalty of 0.66 Mark for every wrong answer.

Test Series Features:

- Quality questions as per UPPSC-AE standard and pattern.
- Step by step detailed solutions for tough questions.
- Detailed performance analysis report.

Stream : CE, ME, EE

Test Series Schedule

Test No.	Activate Date	Total Questions	Total Time	Test Type	Syllabus Covered
1	20th Feb 2025	75 Qs	1 Hour	Part Syllabus Test	General Principles of Design and Drawing, Industrial Safety and Safety Standards, Engineering Materials, Quality Control, Types of Machinery and Maintenance, Production and Construction, Handling and Storage of Products
2	27th Feb 2025	75 Qs	1 Hour	Part Syllabus Test	Basics of project Management, Information and communication technologies, Ethics and values in engineering profession, intellectual property rights, Role of science and technology in daily life, recent developments in applied sciences, basics of artificial intelligence and robotics
3	6th Mar 2025	75 Qs	1 Hour	Part Syllabus Test	Green Energy, Energy conversion principles, Climate change, Disaster Management, Basics of thermodynamics, Water resources and conservation processes, Basics of measurement and instrumentation, Human health and sanitation
4	13th Mar 2025	75 Qs	1 Hour	Part Syllabus Test	General Hindi
5	20th Mar 2025	75 Qs	1 Hour	Part Syllabus Test	Indian History, Indian Polity, Geography, GK & Miscellaneous and Current Affairs
6	27th Mar 2025	150 Qs	2 Hours	Full Syllabus Test	Full Syllabus Test (100 Qs. Engineering Aptitude + 25 Hindi + 25 General Studies)
7	3rd Apr 2025	150 Qs	2 Hours	Full Syllabus Test	Full Syllabus Test (100 Qs. Engineering Aptitude + 25 Hindi + 25 General Studies)
8	5th Apr 2025	150 Qs	2 Hours	Full Syllabus Test	Full Syllabus Test (100 Qs. Engineering Aptitude + 25 Hindi + 25 General Studies)
9	8th Apr 2025	150 Qs	2 Hours	Full Syllabus Test	Full Syllabus Test (100 Qs. Engineering Aptitude + 25 Hindi + 25 General Studies)
10	11th Apr 2025	150 Qs	2 Hours	Full Syllabus Test	Full Syllabus Test (100 Qs. Engineering Aptitude + 25 Hindi + 25 General Studies)

Fee:

₹1000/-	₹500/-	₹500/-	Nil
For Non-MADE EASY Students	For MADE EASY GATE & ESE Batch Students (Old/Current)	For MADE EASY AE/JE Batch Students (Old/Current)	For UPPSC-AE Batch Students

www.madeeasy.in | 9021300500 Click to Enroll

$$\text{FOS} = \frac{\text{Resisting moment}}{\text{Overturning moment}}$$

$$= \frac{c(L \times 1) \times R}{w \times \bar{x} + P_w \cdot \bar{y}}$$

$$= \frac{20 \times 14\left[\frac{80}{180} \times \pi\right] \times 14}{(150 \times 1) \times 22.67 \times 2.5 + \frac{1}{2} \times 9.81 \times 2.5^2 \times \left[14 - 7.5 + \frac{2.5 \times 2}{3}\right]}$$

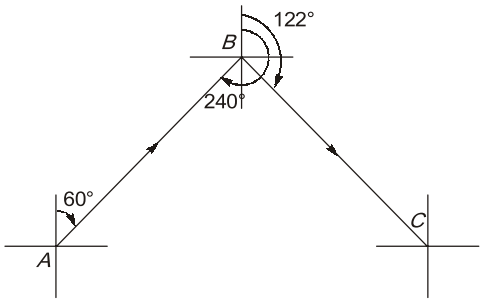
$$= \frac{5473.35}{8501.25 + 250.36} = 0.625$$

End of Solution

Q.33 If the fore bearing of the lines AB and BC are 60° and 122° respectively, then the interior angle ∠ABC (in degree) is _____.

Ans. **(118)**

Given : For bearing of line AB, $(FB)_{AB} = 60°$
For bearing of line BC, $(FB)_{BC} = 122°$



$(BB)_{AB} = (FB)_{AB} + 180°$ [$\because$ $(FB)_{AB} < 180°$]
$= 60° + 180° = 240°$
Interior angle $ABC = (BB)_{AB} - (FB)_{BC}$
$= 240° - 122° = 118°$

End of Solution

Q.34 For a map drawn to a scale of $\frac{1}{40}$, the length of a line was measured as 468 m. However it was later realized that a scale of $\frac{1}{20}$ was used to make the measurement. The corrected length of the line is _____ m.

Ans. **(936)**

$$\text{RF of wrong scale} = \frac{1}{20}$$

$$\text{RF of corrected scale} = \frac{1}{40}$$

Measured length = 468 m

$$\text{Corrected length} = \frac{(RF)_{\text{wrong scale}}}{(RF)_{\text{corrected scale}}} \times \text{Measured length}$$

$$= \frac{\left(\frac{1}{20}\right)}{\left(\frac{1}{40}\right)} \times 468 = 936 \text{ m}$$

End of Solution

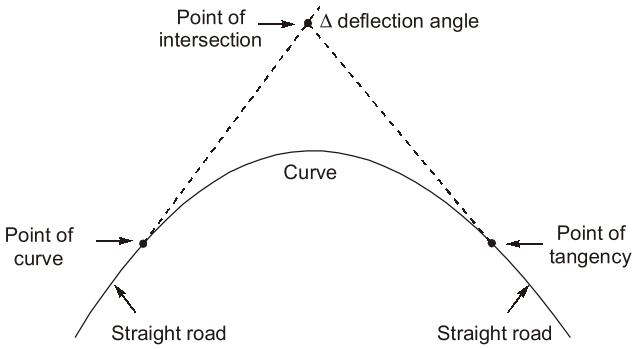
Q.35 The point where road alignment changes from a tangent to a curve is known as

(a) Point of deflection (b) Point of tangency

(c) Point of curve (d) Point of intersection

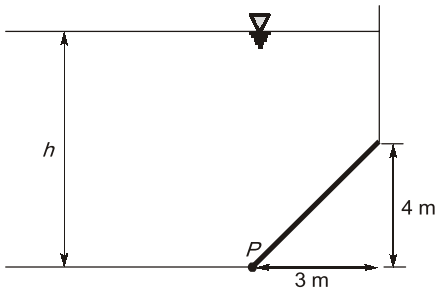
Ans. **(c)**

The point where road alignment changes from a tangent to a curve is called as point of curve.



End of Solution

Q.36 The shaft of a 6 m wide gate in the figure will fail at a moment of 3924 kN-m about the hinge P. Find the maximum value of water depth h (in m) that gate can hold. (Take density of water = 1000 kg/m^3 and g = 9.81 m/s^2)



RRB-JE
CBT-2 | 2024 Exam
Online Test Series

MADE EASY

Launching

10 Full Syllabus Tests (Total 1500 Questions)

Commencing from **11th FEB 2025** | **Stream : CE, ME, EE, EC**

Paper Pattern:

- Each question carries 1 Mark.
- There will be a negative marking of 1/3rd Mark for every wrong answer.

Test Series Features:

- Questions crafted to align with the RRB-JE syllabus and exam format.
- Comprehensive, step-by-step solutions for tough questions.
- Detailed performance analysis report to track your progress.

RRB JE CBT 2 Exam Pattern 2024

Subject	No. of Questions	Marks	Duration
General Awareness	15	15	120 Mins
Physics & Chemistry	15	15	
Basics of Computers and Applications	10	10	
Basics of Environment and Pollution Control	10	10	
Technical Abilities (CE/ME/EE/EC)	**100**	**100**	
Total	**150**	**150**	

Test Series Schedule

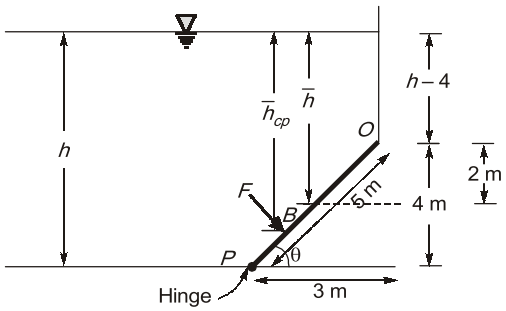
Test No.	Activate Date	Total Marks	Total Questions	Total Time
1	11th Feb 2025	150 Marks	150 Qs	2 Hours
2	14th Feb 2025	150 Marks	150 Qs	2 Hours
3	18th Feb 2025	150 Marks	150 Qs	2 Hours
4	21st Feb 2025	150 Marks	150 Qs	2 Hours
5	25th Feb 2025	150 Marks	150 Qs	2 Hours
6	28th Feb 2025	150 Marks	150 Qs	2 Hours
7	4th Mar 2025	150 Marks	150 Qs	2 Hours
8	7th Mar 2025	150 Marks	150 Qs	2 Hours
9	11th Mar 2025	150 Marks	150 Qs	2 Hours
10	14th Mar 2025	150 Marks	150 Qs	2 Hours

Fee: ₹500/-

www.madeeasy.in | 9021300500 Click to Enroll

Ans. (8)

Let force F acts on a gate at B.



$$F = \rho g \bar{h} A$$

$$= \rho g (h - 4 + 2)(5 \times 6)$$

$$= 1000 \times 9.81 \times (h - 2) \times 30$$

$$= 294.3 \times (h - 2) \text{ kN}$$

From figure, $\sin\theta = \dfrac{h - \bar{h}_{cp}}{PB}$

$$\frac{4}{5} = \frac{h - \left[\bar{h} + \dfrac{I_{CG} \sin^2\theta}{A\bar{h}}\right]}{PB}$$

$$= \frac{h - \left[h - 2 + \dfrac{\dfrac{6 \times 5^3}{12} \times \left(\dfrac{4}{5}\right)^2}{(h-2) \times 5 \times 6}\right]}{PB}$$

$$\Rightarrow \quad PB = \frac{5}{4}\left[2 - \frac{4}{3(h-2)}\right]$$

Now, taking moment about P,

$$F \times PB = 3924$$

$$294.3 \times (h-2) \times \frac{5}{4}\left[2 - \frac{4}{3(h-2)}\right] = 3924$$

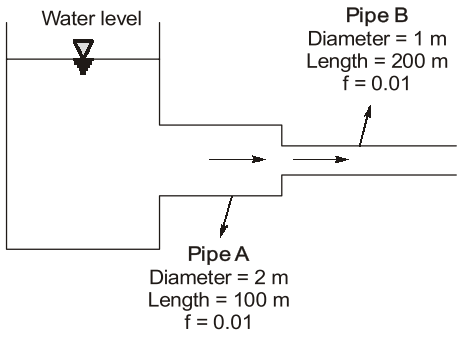
$$(h-2) \times \left(2 - \frac{4}{3(h-2)}\right) = \frac{32}{3}$$

$$2h - 4 - \frac{4}{3} = \frac{32}{3}$$

$$h = 8 \text{ m}$$

End of Solution

Q.37 The ratio of head loss in pipe (B) to the head loss in pipe (A) is _____.



Ans. (64)

Head loss in pipe, $h_f = \frac{8Q^2}{\pi^2 g}\cdot\frac{fL}{D^5}$

Ratio of head loss in pipe B to pipe A,

$$\frac{h_{f_B}}{h_{f_A}} = \frac{\frac{8Q^2}{\pi^2 g}\cdot f\frac{L_B}{D_B^5}}{\frac{8Q^2}{\pi^2 g}\cdot f\frac{L_A}{D_A^5}} = \left(\frac{D_A}{D_B}\right)^5 \times \frac{L_B}{L_A}$$

$$= \left(\frac{2}{1}\right)^5 \times \frac{200}{100} = 64$$

End of Solution

Q.38 Which of the following bacteria is mainly responsible for crown corrosion in sewer?

(a) methanogenic bacteria
(b) sulphur reducing bacteria
(c) pseudomonas bacteria
(d) denitrifying bacteria

Ans. (b)

Sulphur reducing bacteria is responsible for formation of hydrogen sulphide. This hydrogen sulphide on combining with oxygen makes sulphuric acid which is responsible for crown corrosion of sewer lines.

End of Solution

Q.39 For a water sample, following data is given

Ca^{2+} = 150 mg/L as $CaCO_3$
Mg^{2+} = 40 mg/L as $CaCO_3$
Fe^{2+} = 10 mg/L as $CaCO_3$
CO_3^{2-} = 50 mg/L as $CaCO_3$
HCO_3^{-} = 100 mg/L as $CaCO_3$
Find the non-carbonate hardness of the sample.

Check Your Expected

Rank & GATE Score

by

MADE EASY
Rank Predictor

Once GATE releases the Response Sheet.

The link will be live
on the homepage of **www.madeeasy.in**
on the day of the response sheet release.

Ans. **(50)**

Total hardness as $CaCO_3$ = 150 + 40 + 10 = 200 mg/L as $CaCO_3$
(For Ca^{2+}, Mg^{2+} and Fe^{2+})

Alkalinity as $CaCO_3$ = 100 + 50 = 150 mg/L as $CaCO_3$

CH (Carbonate hardness) = Min.{Alkalinity and Total hardness}

$\therefore$ CH = 150 mg/L

CH + NCH = TH

NCH = TH – CH (NCH = Non-carbonate hardness)

NCH = 200 – 150 = 50 mg/L as $CaCO_3$

End of Solution

Q.40 For a confined aquifer of depth 20 m and k value is 2×10^{-6} m/s. Drawdown at well is 1 m, radius of influence is 300 m and radius of well is 30 cm, what is discharge from the aquifer?

Ans. **(36.38×10^{-6})**

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

$b = 20$ m, $R = 300$ m, $r_w = 0.3$ m, $s_w = 1$ m

$$Q = \frac{2\pi kbs_w}{\log\left(\frac{R}{r_w}\right)}$$

$$= \frac{2\pi \times 2 \times 10^{-6} \times 20 \times 1}{\log\left(\frac{300}{0.3}\right)}$$

$$Q = \frac{80\pi \times 10^{-6}}{\log 10^3} = \frac{80\pi \times 10^{-6}}{3 \times 2.303}$$

$\Rightarrow$ $Q = 36.38 \times 10^{-6}$ m^3/s

End of Solution

Q.41 Which method is not used for treating highly organic waste?

(a) Anaerobic decomposition (b) Biohydrogenation

(c) Composting (d) Open dumping

Ans. **(b, d)**

Biohydrogenation and open dumping is not used for treating highly organic waste.

End of Solution

Q.42 If the free chlorine residual and pH was measured to be 2 mg/L (as Cl_2) and 8.5, respectively, what is the concentration of residual HOCl ions (in μmoles/L) in the water? Assume that the chlorine gas added to the water is completely converted to HOCl and OCl^-. Atomic weight of Cl is 35.5 g/mol.

Given: $OCl^- + H^+ \underset{}{\overset{K}{\rightleftharpoons}} HOCl$, $K = 10^{7.5}$

Ans. (2.56)

$$k = \frac{[HOCl]}{[OCl^-][H^+]} \qquad \text{(All conc. in moles/}l\text{)}$$

$$10^{7.5} = \frac{[HOCl]}{[OCl^-]10^{-8.5}} \qquad \text{(PH = 8.5)}$$

$$10^{-1} = \frac{[HOCl]}{[OCl^-]}$$

$$\therefore \quad [OCl^-] = 10[HOCl]$$

$$[HOCl] + [OCl^-] = \frac{2mg \times 10^{-3} gm}{71} \qquad [Cl_2 = 71 \text{ gm}]$$

$$11[HOCl] = \frac{2 \times 10^{-3}}{71} \frac{\text{moles}}{\text{lt.}} \times 10^6 \mu \text{ moles}$$

$$[HOCl] = 2.56 \ \mu \text{ moles/litre}$$

End of Solution

■■■■