Gate Academy

steps to success...

Gate CE 2003

ANSWERS

1.	C	2.	D	3.	A	4.	C	5.	A	6.	B	7.	D	8.	C
9.	B	10.	A	11.	A	12.	B	13.	B	14.	B	15.	A	16.	B
17.	D	18.	C	19.	B	20.	B	21.	C	22.	B	23.	D	24.	C
25.	D	26.	C	27.	D	28.	C	29.	A	30.	C	31.	B	32.	B
33.	A	34.	B	35.	B	36.	A	37.	D	38.	A	39.	A	40.	C
41.	C	42.	A	43.	A	44.	D	45.	B	46.	C	47.	C	48.	B
49.	A	50.	A	51.	D	52.	B	53.	D	54.	B	55.	D	56.	A
57.	A	58.	D	59.	B	60.	A	61.	C	62.	C	63.	D	64.	D
65.	B	66.	B	67.	C	68.	A	69.	B	70.	C	71.	A	72.	C
73.	C	74.	D	75.	A	76.	C	77.	B	78.	D	79.	C	80.	A
81.	D	82.	B	83.	C	84.	C	85.	B	86.	C	87.	A	88.	D
89.	C	90.	D												

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Head Office : A/114-115, Smriti Nagar, Bhilai - 490 020 (C.G) ❖ Contact : 0788-4034176, 98933-68176, email : umeshdhande@gateacademy.co.in

Civil Engineering 2003

Q.1 to Q.25 carry one mark each

Q.1 Given Matrix $[A]=\begin{bmatrix}4 & 2 & 1 & 3\\ 6 & 3 & 4 & 7\\ 2 & 1 & 0 & 1\end{bmatrix}$, the rank of the matrix is

(A) 2 (B) 3 (C) 2 (D) 1

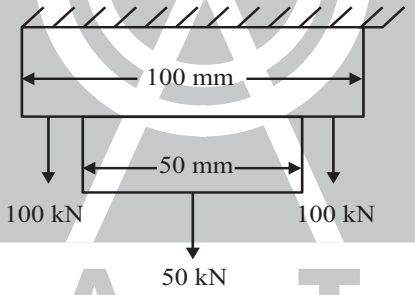
Q.2 A box contains 10 screws, 3 of which are defective. Two screws are drawn at random with replacement. The probability that none of the two screws is defective will be

(A) 100 % (B) 50 % (C) 49 % (D) None of these

Q.3 If P,Q and R are three points having coordinates (3, -2,-1) (1, 3, 4) (2. 1, –2) in XYZ space, then the distance form point P to plane OQR (O being the origin of the coordinate system) is given by

(A) 3 (B) 5 (C) 7 (D) 9

Q.4 A bar or varying square cross section is loaded symmetrically as shown in the figure. Loads shown are placed on one of the axes of symmetry of cross section. Ignoring self weight , the maximum tensile stress in N/mm^2 anywhere is



(A) 16.0 (B) 20.0 (C) 25.0 (D) 30.0

Q.5 Muller Breslau principle in structural analysis is used for

(A) drawing influence line diagram for any force function

(B) writing virtual work equation

(C) super-position of load effects

(D) none of these

Q.6 The effective length of a column in a reinforced concrete building frame, as per IS : 456-2000, is independent of the

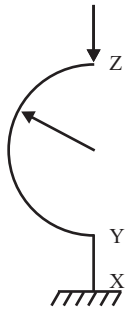
(A) frame type i.e. braced (no sway) or un-braced (with sway)

(B) span of the beam

(C) height of the column

(D) loads acting on the frame

Q.7 A curved member with a straight vertical leg is carrying a vertical load at Z, as shown in the figure. The stress resultants in the XY segment are



(A) bending moment, shear force and axial force

(B) bending moment and axial force only

(C) bending moment and shear force only

(D) axial force only

Q.8 The working stress method of design specifies the value of modular ratio, $m = 280/(3\sigma_{cbc})$, where σ_{cbc} is the allowable stress in bending compression in concrete. To what extent does the above value of m makes any allowance for the creep of concrete ?

(A) No compensation

(B) Full compensation

(C) Partial compensation

(D) The two are unrelated

Q.9 In the design of lacing system for built-up steel column, the maximum allowable slenderness ratio of a lacing bar is

(A) 120 (B) 145 (C) 180 (D) 250

Q.10 Which of the following elements of a pitched roof industrial steel building primarily resists lateral load parallel to the ridge?

(A) bracings (B) purloins (C) truss (D) columns

Q.11 Maximum strains in an extreme fiber in concrete and in the tension reinforcement (Fe-415 grade and Es = 200 kN/ mm^2) in a balanced section at limit state of flexure are respectively

(A) 0.0035 and 0.0038

(B) 0.002 and 0.0018

(C) 0.0035 and 0.0041

(D) 0.002 and 0.0031

Q.12 The stuffiness K of beam deflecting in a symmetric mode, as shown in the figure, is

(A) $\frac{EI}{L}$ (B) $\frac{2EI}{L}$ (C) $\frac{4EI}{L}$ (D $\frac{6EI}{L}$

Q.13 A masonry dam is founded on previous sand having porosity equal to 45 % and specific gravity of sand particles is 2.65. For a desired factor of safety of 3 against sand bolling. The maximum permissible upward gradient will be

(A) 0.225 (B) 0.302 (C) 1.0 (D) None of these

Q.14 A double draining clay layer, 6m thick, settles by 30 mm in three years under the influence of a certain loads. Its final consolidation settlement has been estimate to be 120 mm. If a thin layer of sand having negligible thickness is introduced at a depth of 1.5m below the top surface, the final consolidation settlement of clay layer, will be

(A) 60 mm (B) 120 mm (C) 240 mm (D) None of these

Q.15 A granular soil possesses saturated density of $20\ \text{kN/m}^3$. Its effective angle of internal friction is 35 degree. If the desired factor of safety is 1.5, the safe angle of slope for this soil, when seepage occurs at and parallel to the slope surface, will be

(A) 25^0 (B) 23^0 (C) 13^0 (D) 20^0

Q.16 In a plate load test conducted on cohesion less soil, a 600 mm square test plate settle by 15mm under a load intensity of 0.2 N/mm^2. All conditions remaining the same, settlement of a 1 m square footing will be

(A) less than 15 mm (B) greater than 25 mm

(C) 15.60 mm (D) 20.50 mm

Q.17 A 25 kN point load acts on the surface of an infinite elastic medium. The vertical pressure intensity in at a point 6.0 m below and 4.0m away from the load will be

(A) 132 (B) 13.2 (C) 1.32 (D)0.132

Q.18 For a two-dimensional irrotational flow, the velocity potential is define as $\phi = \text{In}\left(x^2 + y^2\right)$. Which of the following is a possible steam function , Ψ, for this flow ?

(A) $\frac{1}{2}\tan^{-1}(y/x)$ (B) $\frac{1}{2}\tan^{-1}(y/x)$

(C) $2\tan^{-1}(y/x)$ (D) $2\tan^{-1}(x/y)$

Q.19 A flat plate is kept in an infinite fluid medium. The fluid has a uniform free-stream velocity parallel to the plate. For the laminar boundary layer formed on the plate, pick the correct option matching column I and II.

Column I

P. Boundary layer thickness

Q. Shear stress at the plate

R. Pressure gradient along the plate

Column II

1. Decreases in the flow direction
2. Increases in the flow direction
3. remains unchanged

Codes:

	P	Q	R
(A)	1	2	3
(B)	2	2	2
(C)	1	1	1
(D)	2	1	3

Q.20 A laboratory model of a river is built to a geometric scale of 1 : 100. The fluid used in the model is oil of mass density $900\,kg/m^3$. The highest flood in the river is 10,000 m^3/s. The corresponding discharge in the model shall be

(A) 0.095 m^3/s (B) 0.100 m^3/s (C) 0.105 m^3/s (D) 10.5 m^3/s

Q.21 Water is pumped form a well tapping an unconfined aquifer at a certain discharge rate and the steady state drawdown (X) in an observation well is monitored. Subsequently, the pumping discharge is doubled and the steady state drawdown in the same observation well is found to be more than double (i.e. more than 2x). This disproportionate drawdown is caused by

(A) well losses

(B) decrease in the saturated thickness of the aquifer

(C) nonlinear flow

(D) delayed gravity yield

Q.22 The vertical hydraulic conductively of the top soil at certain is 0.2 cm/hr. A storm of intensity 0.5 cm/hr occurs over the soil for an indefinite period. Assuming the surface drainage to be adequate, the infiltration rate after the storm has lasted for a very long time, shall be

(A) smaller than 0.2 cm/hr (B) 0.2 cm /hr

(C) between 0.2 and 0.5 cm/hr (D) 0.5 cm/hr

Q.23 The total irrigation depth of water, required by a certain crop in its entire growing period (150 days), is 25.92 cm. The calturable command area for a distributray channel is 100, 000 hectares . The distributary channel shall be designed for a discharge

(A) less than 2 cumecs (B) 2 cumecs (C) 20 cumecs (D) more than 20 cumes

Q.24 The moisture content of soil in lth root zone of an agricultural crop at certain stage is found to be 0.05. The field capacity of the soil is 0.15. the root zone depth is 1.1 m. the consumptive use of corp at this stage is 2.5 mm day and there is no precipitation during this period. Irrigation efficiency is 65%. It is intended to rise the moisture content to the field capacity in 8 days through irrigation. The necessary depth of irrigation is

(A) 115 mm (B) 169 mm (C) 200 mm (D) 285 mm

Q.25 The result of analysis of a raw water sample are given below.

Turbidity	:	5 mg/I
pH	:	7.4
Fluorides	:	2.5 mg/I
Total Hardness	:	300 mg/I
Iron	:	3.0 mg/I
MPN	:	50 per 100 ml

From the data given above, it can be inferred that water needs removal of

(A) Turbidity followed by disinfection (B) Fluorides and Hardness

(C) Iron, followed by disinfection (D) Both (b) and (c)

Q.26 Which of the following sewage treatment methods has inherent problem of odour, ponding, and fly nuisance ?

(A) UASB system (B) Activated sludge process

(C) Trickling filters (D) Stabilization ponds

Q.27 From amongst the following sewage treatment options, largest land requirements for a given discharger will be needed for

(A) trickling filter (B) anaerobic pond

(C) oxidation ditch (D) oxidation pond

Q.28 Zero hardness of water is achieved by

(A) lime soda process (B) excess lime treatment

(C) ion exchange treatment (D) excess alum and lime treatment

Q.29 Temperature stresses in concrete pavements may cause the slab to crack. If a slab cools uniformly then the crack will develop at the following locations of the slab

(A) at centre (B) near edges

(C) at corners (D) both (b) and (c)

Q.30 The speed and delay studies on a defined section of highway are conducted by

(A) radar gun (B) traffic counter

(C) moving car method (D) enoscope

Q.31 to Q.90 carry two mark each

Q.31 If L defines the Laplace Transformer of a functions, $L[\sin(at)]$ will be equal to

(A) $a/(s^2-a^2)$ (B) $a/(s^2+a^2)$

(C) $s/(s^2+a^2)$ (D) $s/(s^2-a^2)$

Q.32 The Fourier series expansion of a symmetric and even function, $f(x)$ where

$f(x)=1+(2\times/\pi), -\pi<x<0$ and $=1+(2\times/\pi), 0<x<\pi$ will be

(A) $\sum_{n=1}^{\infty}(4/\pi^2n^2)(1+\cos n\pi)$ (B) $\sum_{n=1}^{\infty}(4/\pi^2n^2)(1-\cos n\pi)$

(C) $\sum_{n=1}^{\infty}(4/\pi^2n^2)(1-\sin n\pi)$ (D) $\sum_{n=1}^{\infty}(4/\pi^2n^2)(1+\sin n\pi)$

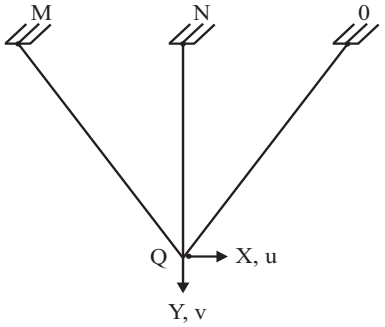
Q.33 A long structural coloum (length = L) with both ends hinged is acted upon by an axial compressive load, P. The differential equation governing the bending of column is given by

$$El\frac{d^2y}{dx^2}=-py$$

Where y is the structural lateral deflection and EI is the flexural rigidity. The first critical load on column responsible for its buckling is given by

(A) π^2EI/L^2 (B) $\sqrt{2}\pi^2EI/L^2$ (C) $2\pi^2EI/L^2$ (D) $4\pi^2EI/L^2$

Q.34 In a redundant joint model, three bar members are pin connected at Q as shown in the figure. Under some loads placed at Q, the elongation of the member MQ and OQ are found to be 48 mm and 35 mm respectively. Then the horizontal displacement u and the vertical displacement v of the node Q, in mm, will be respectively.



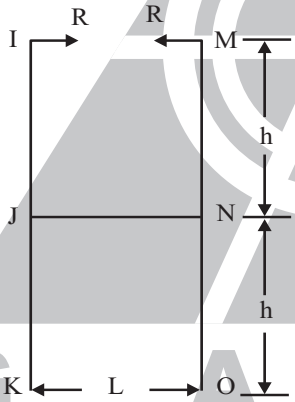
(A) – 6.64 and 56.14 (B) 6.64 and 56.14

(C) 0.0 and 59.41 (D) 59.41 and 0.0

Q.35 Top ring beam of an Intze tank carries a hoop tension of 120 kN. The beam cross-section is 250 mm width and 400 mm deep and it is reinforced with 4 bars of 20 mm diameter of Fe 415 grade. Modular ratio of the concrete is 10. The tensile stress in N/ mm^2 in the concrete is

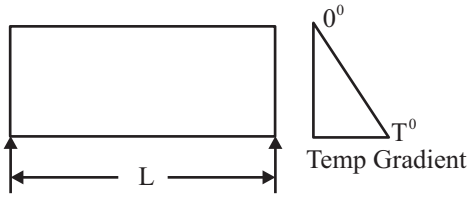
(A) 1.02 (B) 1.07 (C) 1.20 (D) 1.32

Q.36 A "H" shaped frame of uniform flexural rigidity EI is loaded as shown in the figure. The relative outward displacement between points k and O is



(A) $\frac{RLh^2}{EI}$ (B) $\frac{RL^2h}{EI}$ (C) $\frac{RLh^2}{3EI}$ (D) $\frac{RL^2h}{3EI}$

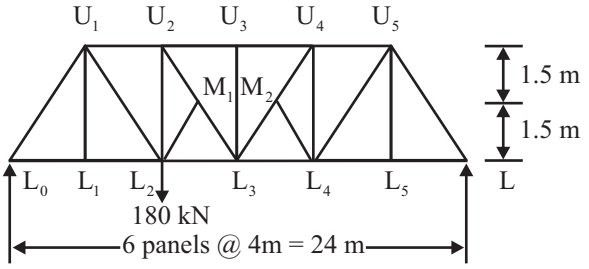
Q.37 A simply supported beam of uniform rectangular cross-section of width b and depth h is subjected to linear temperature gradient, 0^0 at the top and T^0 at the bottom, as shown in the figure. the coefficient of linear expansion of the beam material is α. The resulting vertical deflection at the mid-span of the beam is



(A) $\frac{\alpha Th^2}{8L}$ upward (B) $\frac{\alpha TL^2}{8h}$ upward

(C) $\frac{\alpha Th^2}{8h}$ downward (D) $\frac{\alpha TL^2}{8h}$ downward

Q.38 A truss, as shown in the figure, is carrying 180 kN load at node L_2.The force in the diagonal member M_2U_4 will be



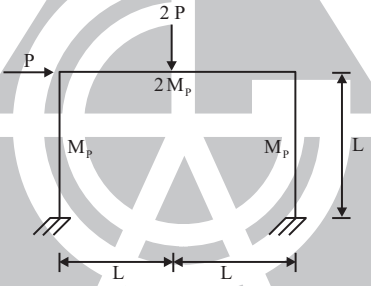
(A) 100 kN tension

(B) 100 kN compression

(C) 80 kN tension

(D) 80 kN compression

Q.39 A steel portal frame has dimensional, plastic moment capacities and applied loads as shown in the figure. The vertical load is always twice of the horizontal load. The collapse load P required for the development of a beam mechanism is



(A) $3M_p/L$ (B) $4M_p/L$ (C) $6M_p/L$ (D) $8M_p/L$

Q.40 The state of two dimensional stresses acting on a concrete lamina consists of a direct tensile stress, $\alpha_x = 1.5N/mm^2$, and shear stress $\tau = 1.20N/mm^2$, which cause cracking of concrete. Then the tensile strength of the concrete in N/mm^2 is

(A) 1.50 (B) 2.08 (C) 2.17 (D) 2.29

Q.41 Group I contains some properties of concrete/cement and Group II contains list of some tests on concrete/cement. Match the property with the corresponding test.

Group I

P. workability of concrete

Q. direct tensile strength of concrete

R. bond between concrete and steel

S. fineness of cement

Group II

1. cylinder splitting test
2. Vee-Bee test
3. surface area test
4. fineness modulus test
5. pull out test

Codes	P	Q	R	S
(A)	2	1	5	3
(B)	4	5	1	3

(C) 2 1 5 4

(D) 1 5 1 4

Q.42 Group I contains some elements in design of a simply supported plate girded and Group II gives some qualitative locations on th girder. Match the items of two lists as per good design practices and relevant codal provisions

Group I	Group II
P. flange splice	1. at supports (minimum)
Q. web splice	2. away from centre of span
R. bearing stiffeners	3. away from support
S. horizontal stiffeners	4. in the middle of span
	5. longitudinally somewhere in the compression flange.

Codes : P Q R S

(A) 2 3 1 5

(B) 4 2 1 3

(C) 3 4 2 1

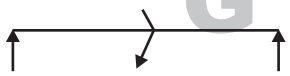
(D) 1 5 2 3

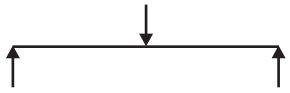
Q.43 A concrete column carries an axial load of 450 kN and bending moment of 60 kN m at its base. An isolate footing of size 2m by 3m , with 3m side along the plane of the bending moment, is provided under the column. Centres of gravity of column and footing coincide. The net maximum and the minimum pressure in kN/m^2 on soil under the footing are respectively .

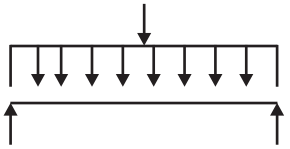
(A) 95 and 55 (B) 95 an d75 (C) 75 and 55 (D) 75 an d 75

Q.44 Group I shows different loads acting on a beam and Group II shows different bending moment distributions. Match the load with the corresponding bending moment diagram

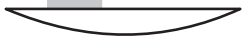
Group I

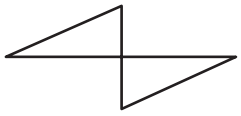
P 

Q 

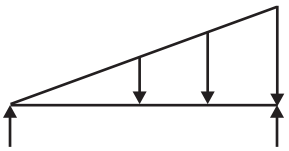
R 

Group II

1 

2 

3 

S 

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5 

Codes : P Q R S

(A) 4 2 1 3

(B) 5 4 1 3

(C) 2 5 3 1

(D) 2 4 1 3

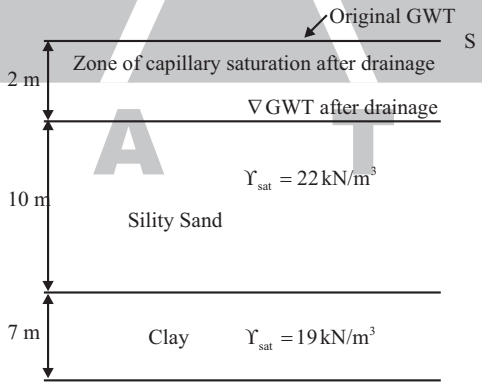
Q.45 Compaction of an embankment is carried out in 500 mm thick layer. The rammer used for compaction has a foot area of 0.05 sq. m and the energy imparted in every drop of rammer is 400 Nm. Assuming 50% more energy in each pass over the compacted area due to overlap the number of passes required to develop capacitive energy equivalent to Indian Standard light compaction for each layer would be

(A) 10 (B) 16 (C) 20 (D) 26

Q.46 A braced cut, 5m wide and 7.5m deep is proposed in a cohesion less soil deposit having effective cohesion c'= 0 and effective friction angle $\phi = 36^0$. The first row of struts is to be installed at a depth of 0.5 m below ground surface and spacing between the struts should be 1.5m. If the horizontal spacing of sturst is 3m and unit weight of the deposit is $20 kN/m^3$, the maximum strut load will be

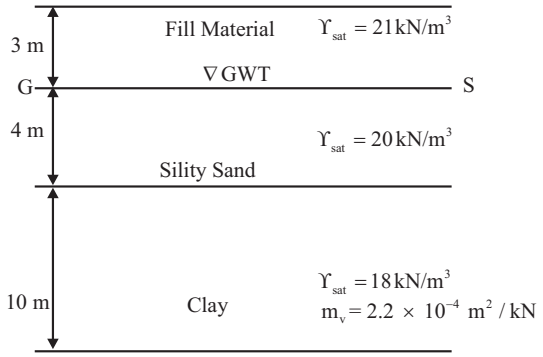
(A) 70.87 kN (B) 98.72 kN (C) 113.90 kN (D) 151.86 kN

Q.47 For the soil strata shown in figure, the water table is lowered by drainage by 2m an dif the top 2m thick silty sand stratum remains statured by capillary action even after lowering of water table, in increase in the effective vertical pressure in kPa at mid-height of clay layer will be



(A) 0.2 (B) 2 (C) 20 (D) 200

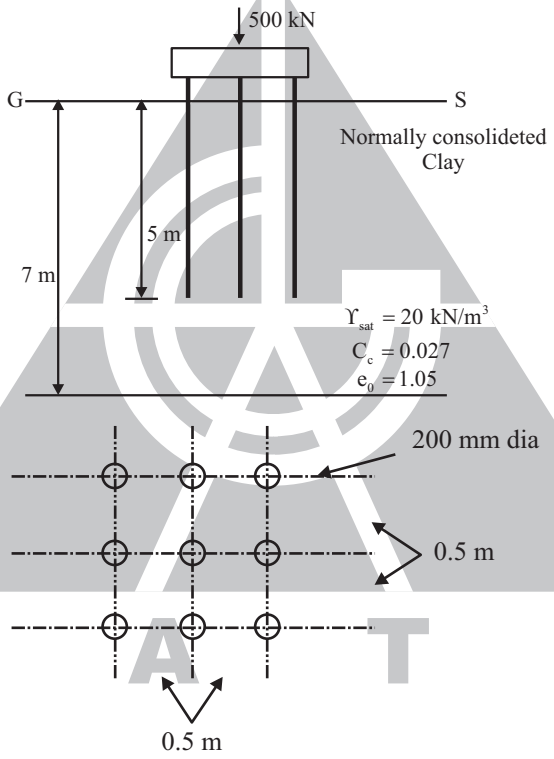
Q.48 At a reclamation site for which the soil strata is shown in the figure, a 3m thick layer of a fill material is to be laid instantaneously in the top surface. If the coefficient of volume compressibility, m_v for clay is $2.2 \times 10^{-4} m^2/kN$, the consolidation settlement of the clay layer due to the placing of fill material will be



(A) 69.5 mm (B) 139 mm

(C) 228 mm (D) 278 mm

Q.49 For the (3x3) pile group shown in the figure, the settlement of pile group, in a normally consolidated clay stratum having properties as shown in the figure, will be



(A) 13.2 mm (B) 12.775 mm (C) 7.345 mm (D) none of these

Q.50 Match the items of the two lists and select the correct answer.

List I (Boring Methods)

P. Auger Boring

Q. Wash Boring

R. Percussion Drilling

S. Rotary Drilling

List II (Field Conditions)

1. Below water table in the all soil types except hard soil and rocks

2. Large diameter boreholes over 150 mm size
3. Explorations for shallow foundational and highways
4. Bouldery and gravelly strata

	P	Q	R	S
(A)	3	1	4	2
(B)	1	2	4	3
(C)	2	3	4	3
(D)	3	1	2	4

Q.51 Match the items of List I with List II and select the correct answer.

List I

P. Modulus of sub grade reaction

Q. Relative density and strength

R. Skin friction and point baring resistance

S. Elastic constants

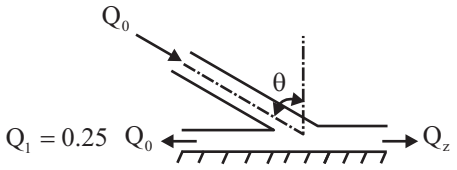
List II

1. cycles pile laod test
2. Pressure meter test
3. Standard penetration test
4. Dynamic cone penetration test

Codes :

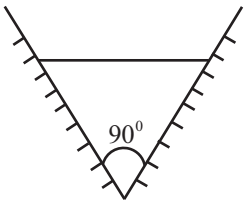
	P	Q	R	S
(A)	1	3	2	5
(B)	1	2	4	3
(C)	2	5	1	3
(D)	3	4	1	2

Q.52 A horizontal jet strikes a frictionless vertical plate (the plan view is shown in the figure). It is then divided in to tow parts as shown in the figure if the impact loss can be neglected, What is the value of θ ?



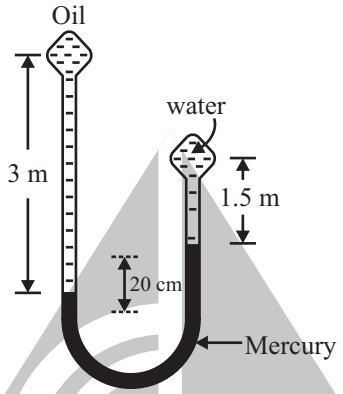
(A) 15^0 (B) 30^0 (C) 45^0 (D) 60^0

Q.53 A hydraulic jump takes place in triangular channel of vertex angle 90^0, as shown in figure. The discharge is $1 m^2/s$ and the pre-jump depth ? take $g = 9.81\ m/s^2$)



(A)0.57 m (B) 0.91 m (C) 1.02 m (D) 1.57 m

Q.54 Two pipeline, one carrying oil (mass density 900 kg/ m^3) and the other water, are connected to a manometer as shown in the figure. By what amount the pressure in the water pipe should be increased sot that th mercury levels in both the limbs of the manometer become equal ? (mass density of mercury = 13,550 kg/ m^3 and g= 9.81 m/ s^2)



(A) 24.7 kPa (B) 26.5 kPa (C) 26.7 kPa (D) 28.9 kpa

Q.55 A solid sphere (diameter 6 mm) is rising through oil (mass density 900 kg/ m^3 , dynamic viscosity 07 kg /ms) at a constant velocity of 1 cm/s .What is the specific weight of the material from which the sphere is made ? (Take g = 9.81 m/s^2)

(A) 4.3 kN/m^3 (B) 5.3 kN/m^3 (C) 8.7 kN/m^3 (D) 12.7 kN/m^3

Q.56 While applying the Rational formula for computing the design discharge, the rainafall duration is stipulated as the time of concentration because

(A) this leads to the largest possible rainfall intensity

(B) this leads to smallest possible rainfall intensity

(C) the time of concentration is the smallest rainfall duration for which the Rational formula is applicable

(D) the time of concentration is the largest rainfall duration for which the Rational formula is applicable

Q.57 While designing a hydraulic structure, the piezometric head at bottom of the floor is computed as 10 m. The datum is 3m below floor bottom. The assured standing water depth above the floor is 2m. The specific gravity of the floor material is 2.5. The floor thickness should be

(A) 2.00 m (B) 1.0 (C) 4.40 m (D) 6.00 m

Q.58 The plane area of a reservoir is 1 km^2 . The water level in the reservoir is observed to decline by 20 cm in a certain period. During the period the reservoir receives a surface inflow of 10 hectare-meters, and 20 hectare-meter are abstracted from the reservoir for irrigation and power. The pan evaporation and rainfall recorded during the same period at a near by metrological station are 12 cm and 3 cm respectively. The calibrated pan factor is 0.7 . The seepage loss from the reservoir during this period in hectare-meters is

(A) 0.0 (B) 1.0 (C) 2.4 (D) 4.6

Q.59 Match the following:

Group I

P. Rainfall intensity

Q. Rainfall excess

R. Rainfall Averaging

S. Mass curve

Group II

1. Isohyets
2. Cumulative rainfall
3. Hyetograph
4. Direct runoff hydrograph

Codes :

	P	Q	R	S
(A)	1	3	2	4
(B)	3	4	1	2
(C)	1	2	4	3
(D)	3	4	2	1

Q.60 Settling test on a sample drawn from Aeration Tank liquor of ASP (MLSS = 2800 mg/I) was carried out with 1 litre sample. The test yielded a settled volume of 20 ml. The value of sludge Volume Index shall be

(A) 14.0 (B) 34.2 (C) 71.4 (D) 271

Q.61 Results of a water sample analysis are as follows :

Cation	Concentration (mg/I)	Equivalent Weight
Na^{+}	40	23
Mg^{+2}	10	12.2
Ca^{+2}	55	20
K^{+}	2	39

(milli equivalent weight of $CaCO_3 = 50$ mg/meq) Hardness of the water sample in mg / I as $CaCO_3 = 50$ is

(A) 44.8 (B) 89.5 (C) 179 (D) 358

Q.62 A ideal horizontal flow setting basin is 3m deep having surface area $900\,m^2$. Water flows at the rate of $800\,m^3/d$, at water temperature $20^0 C$ $\left(m = 10^{-3} kg/\,m.s\right)$ and $\rho = 1000\,kg/\,m^3$) Assuming stockes law to be valid, the proportion (percentage) of spherical sand particles, (0.01 m in diameter with specific gravity 2.65), that will be removed, is

(A) 32.5 (B) 67 (C) 87.5 (D) 95.5

Q.63 Match the following :

Group I (Characteristic of sewage discharged Into inland waters)	Group II (Allowable limit, mg/I)
P BOD_5	1 250
Q COD	2 30
R Oil and Grease	3 20
S Total Suspended Solids	4 10
	5 5
	6 3

Codes :

	P	Q	R	S
(A)	2	5	4	2
(B)	4	1	6	4
(C)	3	1	4	2
(D)	2	1	6	3

Q.64 Match of following:

Group I (Type of water inpurity)

P hardness

Q Brackish water from sea

R Residual MPN from filters

S Turbidity

Group II (Method of treatment)

1 Reverse Osmosis

2 Chlorination

3 Zeolite Treatment

4 Coagulation and Flocculation

5 Coagulation, Flocculation and Filtration

Codes :

	P	Q	R	S
(A)	1	2	4	5
(B)	3	2	2	4
(C)	2	1	3	5
(D)	3	1	2	5

Q.65 The design speed for a National Highway is 100 kmph. If the maximum permissible superelevation is 0.10 and the coefficient of lateral friction is 0.15 the ruling minimum radius of horizontal curve on the highway should be

(A) 260 m (B) 315 m

(C) 380 m (D) 410 m

Q.66 A traffic steam in a particular direction of a two lane road is moving with a constant speed of 50 kmph, with an average headway of 2.52 seconds. The longitudinal distance between two consecutive vehicles is

(A) 30 m (B) 35 m (C) 38 m (D) 42 m

Q.67 In the Marshall method of mix design, the coarse aggregates, fine aggregates, filter and bitumen, having respective specific gravities of 2.62, 2.72 and 2.70 and 1.02 are mixed in the ratio of 55, 34.6, 4.8 and 5.6 percent, respectively. The theoretical specific gravity of the mix would be

(A) 2.36 (B) 2.40

(C) 2.44 (D) 2.50

Q.68 The place load test conducted with a 75 cm diameter plate on soil subgrade yielded a deflection of 2.5 mm under a stress of 800 $N\,cm^2$. The modulus of elasticity of the subgrade soil, in kN/cm^2 is

(A) 141.6(B) 154.6 (C) 160.0 (D) 185.4

Q.69 Column I below gives a list of physical properties of aggregates which should be determined to judge their suitability in road contraction. Colum II give a list of laboratory test which are conducted to determine these properties.

Column I	Column II
P Hardness	1 Water adsorption
Q Porosity	2 Impact test
R Toughness	3 Soundness test
S Durability	4 Abrasion test

Which of the following matches is correct?

Codes	P	Q	R	S
(A)	1	2	3	4
(B)	4	1	2	3
(C)	3	4	1	2
(D)	2	3	4	1

Data for Q.70 72 are given below solve the problem and choose correct answers.

A beam PQRS is 18 m long and is simply supported at points Q and R 10 m aparts. Overhangs PQ and RS are 3 m and 5 m respectively. A train of two point loads of 150 kN and 100 kN, 5m apart, acrosses this beam from left to right with 100 kN load lading.

Q.70 The maximum sagging moment under the 150 kN load anywhere is

(A) 500 kNm (B) 450 kNm (C) 400 kNm (D)375 kNm

Q.71 During the passage of loads, the maximum and the minimum reactions at support R, in kN are respectively.

(A) 300 and – 30 (B) 300 and –25

(C) 225 and – 30 (D) 225 and – 25

Q. 72 The maximum hogging moment in the beam anywhere is

(A) 300 kNm (B) 450 kNm (C) 500 kNm (D) 750 kNm

Data for Q.73- 74 are given below solve the problem and choose correct answers.

A reinforce concrete beam, size 200 mm wide and 300 mm deep overall simply supported over a spam of 3m . It is the subjected to two point loads P of equal magnitude placed at middle third points. Two loads are gradually increased simultaneously. Beam is reinforced with 2 HYSD bars of 16 mm diameter placed at an effective cover of 40 mm on bottom face and nominal shear reinforcement. The characteristic compressive strength and the bending tensile strength of the concrete are 20.0 N/mm^2 and 2.2 N/mm^2 respectively.

Q.73 Ignoring the presence of tension reinforcement, find the value of the load P in kN when the first flexure crack will develop in the beam.

(A) 4.5 (B) 5.0 (C) 6.6 (D) 7.5

Q.74 The theoretical failure load of the beam for attainment of limit state of collapse in flexure is attainment of limit state of collapse in flexure is

(A) 23.7 kN (B) 25.6 kN

(C) 28.7 kN (D) 31.6 kN

Data for Q.75- 76 are given below solve the problem and choose correct answers.

A truss tie consisting of 2 ISA 75 x 75 x 8 mm carriers a pull of 150 kN. At ends the two angles ar connected, one each on either side of a 10 mm thick gussets plate, by 18 mm diameter rivets arranged in one row. The allowable stresses in rivet are $f_s = 90.0\,N/mm^2$ and $f_{br} = 250\,N/mm^2$.

Q.75 Maximum tensile stress in the tie in N/mm^2 is

(A) 93.6 (B) 87.5 (C) 77.2 (D) 66.0

Q.76 Minimum number of rivets required at each end is

(A) 2 (B) 3 (C) 4 (D) 5

Data for Q.77- 78 are given below solve the problem and choose correct answers.

A canal having side slopes 1:1 is proposed to be constructed in a cohesive soil to a depth of 10 m below the ground surface. The soil properties are : $\phi_u = 15^0$, $C_n = 12\,kpa$, e = 1.0, Gs = 2.65.

Q.77 If Taylor's Stability Number, Sn is 0.08 and if the canal flows full, the factor of safety with respect to cohesion against failure of the canal bank slopes will be

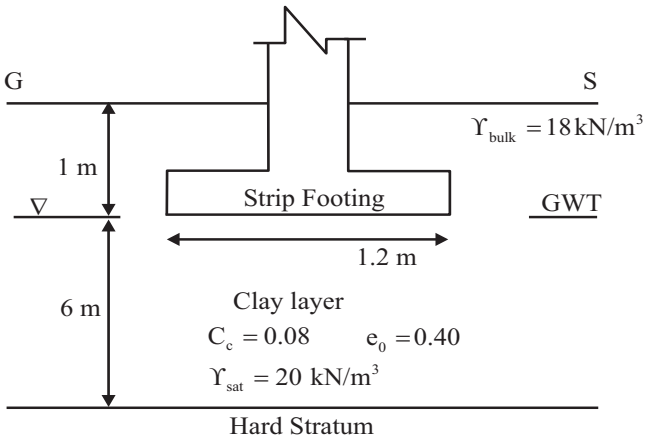
(A) 3.7 (B) 1.85 (C) 1.0 (D) None of these

Q. 78 If there is a sudden drawdown of water in the canal and if Taylor's Stability Number for the reduced value of ϕ_v is 0.126 , the factor of safety with respect to cohesion against the failure of bank slopes will be

(A) 1.85 (B) 1.18 (C) 0.84 (D) 0.53

Data for Q.79- 80 are given below solve the problem and choose correct answers.

Figure shown the geometry of a strip footing supporting the load baring walls of a three storied building and the properties of clay layer.



Q.79 If the pressure acting on the footing is 40 kPa. The consolidation settlement of the footing will be

(A) 0.89 mm (B) 8.9 mm (C) 89.0 mm (D) None of these

Q.80 If the elastic modulus and the Poisson's ratio of the clay layer are respectively 50×10^3 kPa and 0.4 and if the influence factor for the strip footing is 1.75 , the elastic settlement of the footing will be

(A) 0.41 mm (B) 1.14 mm (C) 14.1 mm (D) None of these

Data for Q.81- 82 are given below solve the problem and choose correct answers.

A very wide rectangular channel carriers a discharge of $8m^3/s$ per m width. The channel has a bed slope of 0.004 and Manning's roughness coefficient, n = 0.015 . At a certain section of the channel, the flow depth is 1m.

Q.81 What Gradually Varied Flow profile exists at this sceton ?

(A) M_2 (B) M_3 (C) S_2 (D) S_3

Q.82 What distance from this section the flow depth will be 0.9 m ? (Use the direct step method employing a single step)

(A) 65 m downstream (B) 50 m downstream (C) 50 m downstream (D) 65 m downstream

Data for Questions 83 and 84 are given below. Solve the problems and choose the correct answer.

A pipeline (diameter 0.3m length 3 km) carries water form point p to point R (see figure). The piezomtric heads at P and R are to be maintained at 100 m and 80m, respectively. To increase the discharge, a second pipe is added in parallel to the existing pipe from Q to R. The length of the additional pipe is also 2 km . Assume the friction factor, f = 0.04 for all pipes and ignore minor losses.

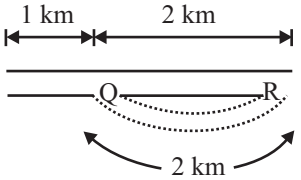


FIGURE NOT TO SCALE

Q.83 What is the incrase in discharge if the additional pipe has some diameter (0.3m) ?

(A) 0% (B) 33% (C) 41% (D) 67%

Q.84 If there is no restriction on the diameter of the additional pipe, what would ebe the maximum increase in discharge theoretically possible from this arrangement ?

(A) 0% (B) 50 % (C) 67% (D) 73 %

Data for Questions 85 and 86 are given below. Solve the problems and choose the correct answer.

A average rainfall of 16 cm occurs over a catchment during a period of 12 hours with a uniform intensity. The unit hydrograph (unit depth = 1cm, duration = 6 hours,) of the catchment rises linearly from 0 to 30 cumecs in six hours and then falls linearly form 30 to 0 cumecs in the next 12 hours. ϕ index of the catchment is known to be 0.5 cm /hr. Base flow in the river is known to be 5 cumecs.

Q.85 Peak discharge of the resulting direct runoff hydrograph shall be

(A) 150 cumecs (B) 225 cumecs (C) 230 cumecs (D) 360 cumecs

Q. 86 Area of the catchment in hectares is

(A) 97.20 (B) 270 (C) 9720 (D) 27000

Data for Questions 87 and 88 are given below. Solve the problems and choose the correct answer.

A conventional Activated Sludge Plant treating 1000 m^3/d of municipal waste water disposes of its anaerobically digested sludge on relatively impervious farmland. Use the following data

1	Raw Sewage	SS=225 mg/I (70% volatile) BOD = 190 mg/I (Excess activated sludge returned to primary)
2	Primary Setting	SS-55% removal BOD-30% removal
3	Excess Activated Sludge	0.4 g VSS produced per g BOD applied (80% volatile of total)
4	Anaerobic Digester	VSS reduced 50% Digested Sludge concentration-60% Sludge specific Gravity-1
5	Application on farmland	2 m^3 / ha.d

Q.87 Total volatile suspended solids to be anaerobically digested (kg/d VSS) shall be

(A) 133 (B) 168 (C) 233 (D) 245

Q.88 Area requirement (ha) for disposal of the sludge on farmland shall be

(A) 2.95 (B) 1.95 (C) 0.95 (D) 0.55

Data for Questions 89 and 90 are given below. Solve the problems and choose the correct answer.

A water treatment plant treating 10 mld of water requires 20mg/I of filter Alum, $Al_2(SO_4)_3, 18H_2O$ The water ha 6 mg/I alkalinity as $CaCO_3$ $(Al = 26.97, S = 32, O = 16, H = 1, Ca = 40, \text{and } C = 12)$.

Q.89 Total alkalinity requirement (10^6 mg per day as $CaCO_3$) matching filter Alum, shall be

(A) 180 (B) 120 (C) 90 (D) 60

Q.90 Quantity of Quick Lime required (10^6 mg per year as CaO) shall be

(A) 2132 (B) 3000 (C) 4132 (D) 6132

END OF THE QUESTION PAPER