GATE 2016 CIVIL ENGINEERING[1]

EE25BTECH11013 - Bhargav

1) Out of the following four sentences, select the most suitable sentence with respect to grammar and usage. (*GATE CE* 2016)
   a) I will not leave the place until the minister does not meet me.
   b) I will not leave the place until the minister doesn't meet me.
   c) I will not leave the place until the minister meet me.
   d) I will not leave the place until the minister meets me.

2) A rewording of something written or spoken is a (*GATE CE* 2016)

   a) paraphrase
   b) paradox
   c) paradigm
   d) paraffin

3) Archimedes said, "Give me a lever long enough and a fulcrum on which to place it, and I will move the world." The sentence above is an example of a _ _ _ _ _ _ statement. (*GATE CE* 2016)

   a) figurative
   b) collateral
   c) literal
   d) figurine

4) If "relftaga" means carefree, "otaga" means careful and "fertaga" means careless, which of the following could mean "aftercare"? (*GATE CE* 2016)

   a) zentaga
   b) tagafer
   c) tagazen
   d) relffer

5) A cube is built using 64 cubic blocks of side one unit. After it is built, one cubic block is removed from every corner of the cube. The resulting surface area of the body (in square units) after the removal is . (*GATE GA* 2016)

   a) 56
   b) 64
   c) 72
   d) 96

6) A shaving set company sells 4 different types of razors: Elegance (Rs. 48), Smooth (Rs. 63), Soft (Rs. 78) and Executive (Rs. 173). The table below shows number of each razor sold in each quarter of a year. Which product contributes the greatest fraction to the annual revenue? (*GATE CE* 2016)

a) Elegance
b) Executive
c) Smooth
d) Soft

7) Indian currency notes show denomination in at least 17 languages. This is evidence of _____.   (*GATE CE* 2016)

a) India is a country of exactly 17 lan-
guages.
b) Linguistic pluralism is the only indica-
tor of diversity.
c) Indian currency notes have space for all
languages.
d) Linguistic pluralism is strong evidence
of India's diversity.

8) Four players P, Q, R, S have the following relations: P always beats Q; R always beats S; S loses to P only sometimes; R always loses to Q. Which of the following is correct?   (*GATE CE* 2016)

a) (i) only
b) (ii) only
c) (i) and (ii)
d) neither (i) nor (ii)

9) If $f(x) = 2x^7 + 3x^{-5}$, which of the following is a factor of $f(x)$? (*GATE CE* 2016)

a) $(x^3 + 8)$
b) $(x - 1)$
c) $(2x - 5)$
d) $(x + 1)$

10) In a process, the number of cycles to failure decreases exponentially with load. At 80 units load, failure in 100 cycles; at half load, failure in 10000 cycles. Find the load for failure in 5000 cycles.   (*GATE CE* 2016)

a) 40.00
b) 46.02
c) 60.01
d) 92.02

Civil Engineering - Set 1

11) Newton-Raphson method is used for root of $3x - e^x + \sin x = 0$ with initial trial $x_0 = 0.333$. Find the next approximation (3 decimal places).   (*GATE CE* 2016)

Answer: _____

12) The type of PDE

$$\frac{\partial^2 P}{\partial x^2} + \frac{\partial^2 P}{\partial y^2} + 3\frac{\partial^2 P}{\partial x \partial t} + 2\frac{\partial P}{\partial x} - \frac{\partial P}{\partial t} = 0 \tag{1}$$

is   (*GATE CE* 2016)

a) elliptic
b) parabolic
c) hyperbolic
d) none of these

13) If the entries in each column of a square matrix M add up to 1, then an eigenvalue is   (*GATE CE* 2016)

a) 4

b) 3

c) 2

d) 1

14) Type II error in hypothesis testing is   (*GATE CE 2016*)

a) Accept H_0 when it is false

b) Reject H_0 when it is true

c) Reject H_0 when it is false

d) Accept H_0 when it is true

15) The solution of

$$\frac{\partial^2 u}{\partial t^2} = \alpha^2 \frac{\partial^2 u}{\partial x^2} \tag{2}$$

is of the form: (*GATE CE 2016*)

a) $\left(C_1 e^{kx} + C_2 e^{-kx}\right)\cos(\alpha kt)$

b) $\left(C_1 e^{kx} + C_2 e^{-kx}\right)Ce^{\alpha kt}$

c) $(C_1 \cos kx + C_2 \sin kx)\, e^{\alpha kt}$

d) $(C_1 \cos kx + C_2 \sin kx)\sin(\alpha kt)$

16) Consider the plane truss with load P as shown in the figure. Let the horizontal and vertical reactions at the joint B be H_B and V_B, respectively and V_C be the vertical reaction at the joint C.
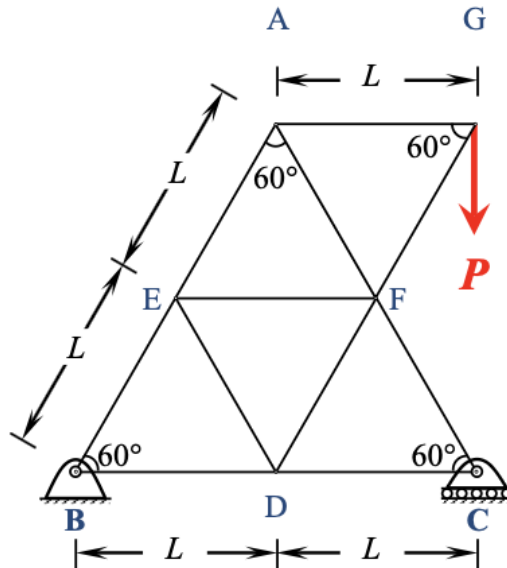

Fig. 16

Which one of the following sets gives the correct values of V_B, H_B and V_C? (*GATE CE 2016*)

a) $V_B = 0$, $H_B = 0$, $V_C = P$ c) $V_B = P/2$, $H_B = P\sin 60°$, $V_C = P/2$

b) $V_B = P\sqrt{2}$, $H_B = 0$, $V_C = -P/2$ d) $V_B = P/2$, $H_B = P\cos 60°$, $V_C = 0$

17) In shear design of an RC beam, other than the allowable shear strength of concrete (τ_c), there is also an additional check suggested in IS 456-2000 with respect to the maximum permissible shear stress ($\tau_{c\ max}$). The check for $\tau_{c\ max}$ is required to take care of   (*GATE CE* 2016)

a) Additional shear resistance from reinforcing steel

b) Additional shear resistance from strain hardening

c) Possibility of failure of concrete by diagonal tension

d) Possibility of crushing of concrete by diagonal compression

18) The semi-compact section of a laterally unsupported steel beam has an elastic section modulus, plastic section modulus and design bending compressive stress of 550 mm^3, 650 mm^3 and 200 MPa, respectively. The shape factor (plastic/elastic) expressed in terms of the section is   (*GATE CE* 2016)

a) 0.85

b) 1.18

c) 1.33

d) 1.41

19) Bull's trench kiln is used in the manufacturing of   (*GATE CE* 2016)

a) lime

b) cement

c) bricks

d) none of these

20) The compound which is largely responsible for initial setting and early strength gain of Ordinary Portland Cement is   (*GATE CE* 2016)

a) C_3A

b) C_3S

c) C_2S

d) C_4AF

21) In the consolidated undrained triaxial test on a saturated soil sample, the pore water pressure is zero   (*GATE CE* 2016)

a) during shearing stage only

b) at the end of consolidation stage only

c) both at the end of consolidation and during shearing stages

d) under none of the above conditions

22) A fine grained soil is found to be plastic in the water content range of 26 – 48%. As per Indian Standard Classification System, the soil is classified as (*GATE CE* 2016)

a) CL

b) CH

c) CL-ML

d) CI

23) A vertical cut is to be made in a soil mass having cohesion c, angle of internal friction φ, and unit weight γ. Considering K_a and K_p as the coefficients of active and

passive earth pressures, respectively, the maximum depth of unsupported excavation is   (*GATE CE* 2016)

a) $\dfrac{4c}{\gamma \sqrt{K_p}}$

b) $\dfrac{2c \sqrt{K_p}}{\gamma}$

c) $\dfrac{4c \sqrt{K_a}}{\gamma}$

d) $\dfrac{4c}{\gamma \sqrt{K_a}}$

24) The direct runoff hydrograph in response to 5 cm rainfall excess in a catchment is shown in the figure. The area of the catchment (expressed in hectares) is _____   (*GATE CE* 2016)
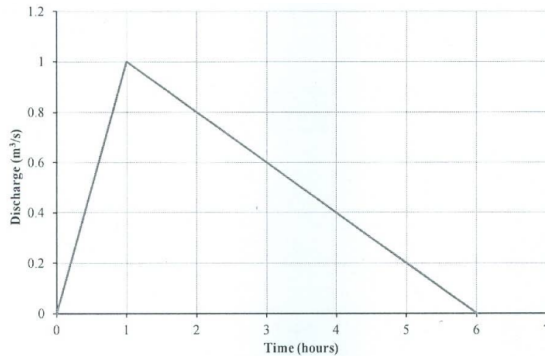

Fig. 24

25) The types of flood routing (Group-I) and the appropriate used for its purpose (Group-II) are given below: (*GATE CE* 2016)

(P) Storage Indication Method   1. Reservoir situation
(Q) Muskingum Method   2. Open channel routing
(R) Unit Hydrograph   3. Surface runoff estimation
(S) Hydrological routing   4. Groundwater movement

The correct combination is

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

26) The pre-jump Froude Number for a particular flow in a horizontal rectangular channel is 10. The ratio of sequent depths (*i.e. post − jump depth to pre − jump depth*) is (*GATE CE* 2016)

27) Pre-cursors to photochemical oxidants are   (*GATE CE* 2016)

a) NOx, VOCs and sunlight
b) SO_2, CO and sunlight
c) CO, NOx and sunlight
d) SO_2, NH_3 and sunlight

28) Crown corrosion in a reinforced concrete sewer is caused by: (*GATE CE* 2016)

a) H_2S c) CH_4

b) CO_2 d) NH_3

29) It was decided to construct a fabric filter, using bags of 0.45 m diameter and 7.5 m long, for removing industrial stack gas containing particulates. The expected rate of airflow into the filter is 10 m^3/s. If the filtering velocity is 2.0 m/min, the minimum number of bags (*rounded to nearest higher integer*) required for continuous cleaning operation is   (*GATE CE 2016*)

a) 27   c) 31

b) 29   d) 32

30) Match the items in Group – I with those in Group – II and choose the right combination.   (*GATE CE 2016*)

(P) Aerated lagoon	1. Group – III
(Q) Activated sludge process	2. Microstraining
(R) Coagulation	3. Autotrophic bacteria
(S) Nitrification	4. Heterotrophic bacteria

a) P-3, Q-4, R-2, S-1   c) P-4, Q-3, R-2, S-1

b) P-2, Q-1, R-3, S-4   d) P-1, Q-4, R-3, S-2

31) During a forensic investigation of pavement failure, an engineer reconstructed the graphs P, Q, R and S, using partial and damaged old reports.   (*GATE CE 2016*)
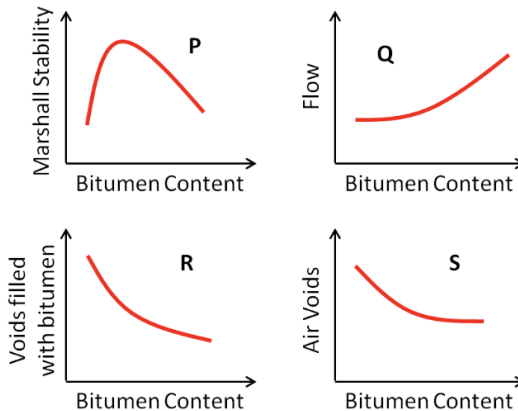

Fig. 31

a) P, Q, R   c) Q, R, S

b) P, Q, S   d) P, S, R

32) In a one-lane one-way homogeneous traffic stream, the observed average headway is 3.0 s. The flow (expressed in vehicles/hr) in this traffic stream is (*GATE CE* 2016)

a) 1200
b) 900
c) 720
d) 600

33) The minimum number of satellites needed for a GPS to determine its position precisely is (*GATE CE* 2016)

a) 2
b) 3
c) 4
d) 24

34) The system that uses the Sun as a source of electromagnetic energy and records the naturally radiated and reflected energy from the object is called (*GATE CE* 2016)

a) Geographical Information System
b) Global Positioning System
c) Passive Remote Sensing
d) Active Remote Sensing

35) The staff reading taken on a workshop floor using a level is 0.645 m. The inverted staff reading taken to the bottom of a beam is 2.950 m. The reduced level of the floor is 40.500 m. The reduced level (expressed in m) of the bottom of the beam is (*GATE CE* 2016)

a) 44.105
b) 43.460
c) 42.815
d) 41.145

36) Probability density function of a random variable X is given below:

$$f(x) = \begin{cases} 0.25 & \text{if } 1 \leq x \leq 5 \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

P(X > 4) is (*GATE CE* 2016)

a) $\frac{3}{4}$
b) $\frac{2}{4}$
c) $\frac{1}{4}$
d) $\frac{1}{2}$

37) The value of

$$\int_0^{\pi/3} \frac{1}{1 + 3\tan^2 x} dx + \int_0^{\pi/3} \frac{\sin x}{x} dx \tag{4}$$

is (*GATE CE* 2016)

a) $\frac{\pi}{6}$
b) $\frac{\pi}{3}$
c) $\frac{\pi}{2}$
d) 1

38) The area of the region bounded by the parabola $y = x^2 + 1$ and the straight line $x + y = 3$ is (*GATE CE* 2016)

a) $\frac{59}{6}$

b) $\frac{9}{2}$

c) $\frac{10}{3}$

d) $\frac{7}{6}$

39) The magnitudes of vectors P, Q and R are 100 kN, 250 kN and 150 kN, respectively. The respective values of the magnitude (in kN) and the direction (with respect to the x-axis) of the resultant vector are *(GATE CE 2016)*
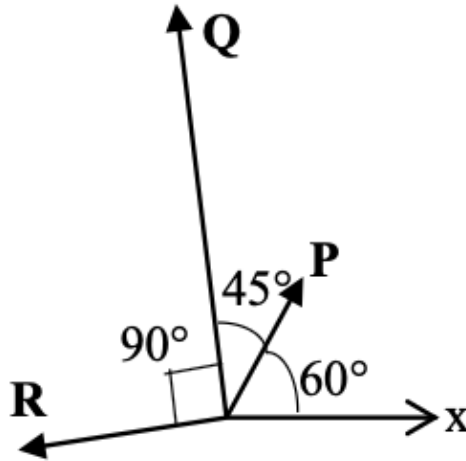

Fig. 39

a) 299.90 and 96.0°

b) 368.1 and 94.7°

c) 330.4 and 118.9°

d) 400.1 and 113.5°

40) The respective expressions for complimentary function and particular integral part of the solution of the differential equation $\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 12x = 108t^2$ are *(GATE CE 2016)*

a) $[c_1 + c_2t + \sin\sqrt{3}t + c_3\cos\sqrt{3}t]$ and $[3t^2 - 12t^2 + c]$

b) $[x + c_1\sin\sqrt{3}t + c_2\cos\sqrt{3}t]$ and $[5t^2 - 12t^2 + c]$

c) $[c_1t + c_2\sin\sqrt{3}t + c_3\cos\sqrt{3}t]$ and $[5t^2 - 12t^2 + c]$

d) $[c_1 + c_2t + \sin\sqrt{3}t + c_3\cos\sqrt{3}t]$ and $[5t^2 - 12t^2 + c]$

41) A 3 m long simply supported beam of uniform cross section is subjected to a uniformly distributed load of $w = 20$ kN/m in the central 1 m as shown. If the flexural rigidity (EI) of the beam is 30×10^6 Nm^2, the maximum slope (expressed in radians) of the deformed beam is *(GATE CE 2016)*

$w = 20$ kN/m

$EI = 30 \times 10^6$ N·m²

P ⟶ 1 m ⟶ 1 m ⟶ 1 m ⟶ Q
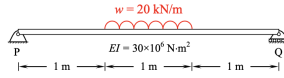
Fig. 41

a) 0.681×10^{-3}

b) 0.943×10^{-3}

c) 4.310×10^{-3}

d) 5.910×10^{-3}

42) Two beams PQ (fixed at P and with a roller support at Q, as shown in Figure I, which allows vertical movement) and XZ (with a hinge at Y) are shown in the Figures I and II respectively. The spans of PQ and XZ are L and $2L$ respectively. Both the beams are under the action of uniformly distributed load (w) and have the same flexural stiffness, EI (where, E and I respectively denote modulus of elasticity and moment of inertia about axis of bending). Let the maximum deflection and maximum rotation be δ_{max1} and θ_{max1} respectively, in the case of beam PQ and the corresponding quantities for the beam XZ be δ_{max2} and θ_{max2} respectively.   (*GATE CE 2016*)
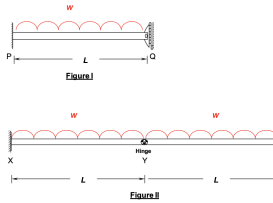
Fig. 42

Which one of the following relationships is true?

a) $\delta_{max1} \neq \delta_{max2}$ and $\theta_{max1} \neq \theta_{max2}$

b) $\delta_{max1} = \delta_{max2}$ and $\theta_{max1} \neq \theta_{max2}$

c) $\delta_{max1} \neq \delta_{max2}$ and $\theta_{max1} = \theta_{max2}$

d) $\delta_{max1} = \delta_{max2}$ and $\theta_{max1} = \theta_{max2}$

43) A plane truss with applied loads is shown in the figure.   (*GATE CE 2016*)
The members which do not carry any force are:
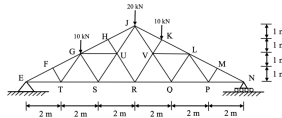
Fig. 43

a) FT, TG, HU, MP, PL

b) ET, GS, UR, VR, QL

c) FT, GS, HU, MP, QL

d) MP, PL, HU, FT, UR

44) A rigid member ACB is shown in the figure. The member is supported at A and B by pinned and guided roller supports, respectively. A force P acts at C as shown. Let

R_{Ah} and R_{Bh} be the horizontal reactions at supports A and B, respectively, and R_{Av} be the vertical reaction at support A. Self-weight of the member may be ignored. (*GATE CE* 2016)
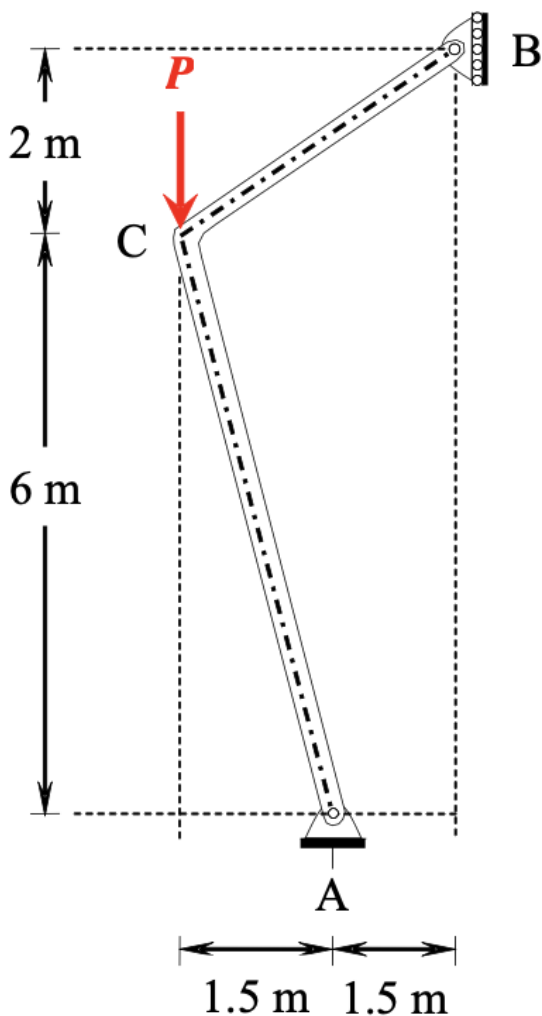

Fig. 44

Which one of the following sets gives the correct magnitudes of R_{Av}, R_{Ah} and R_{Bh}?

a) $R_{Av} = 0$; $R_{Bh} = \frac{1}{3}P$; $R_{Ah} = \frac{2}{3}P$

b) $R_{Av} = 0$; $R_{Bh} = \frac{2}{3}P$; $R_{Ah} = \frac{1}{3}P$

c) $R_{Av} = P$; $R_{Bh} = \frac{3}{8}P$; $R_{Ah} = \frac{1.5}{8}P$

d) $R_{Av} = P$; $R_{Bh} = \frac{1.5}{8}P$; $R_{Ah} = \frac{1.5}{8}P$

45) A reinforced concrete (RC) beam with width of 250 *mm* and effective depth of 400 *mm* is reinforced with Fe415 steel. As per the provisions of IS 456 - 2000, the minimum and maximum amount of tensile reinforcement (expressed in mm^2) for the section are, respectively: (*GATE CE 2016*)

a) 250 and 3500

b) 205 and 4000

c) 270 and 2000

d) 300 and 2500

46) For M25 concrete with creep coefficient of 1.5, the long-term static modulus of elasticity (expressed in MPa) as per the provisions of IS:456 - 2000 is (*GATE CE 2016*)

47) A propped cantilever of span L carries a vertical concentrated load at the mid-span. If the plastic moment capacity of the section is M_p, the magnitude of the collapse load is (*GATE CE 2016*)

a) $\frac{8M_p}{L}$

b) $\frac{6M_p}{L}$

c) $\frac{4M_p}{L}$

d) $\frac{2M_p}{L}$

48) Two plates are connected by fillet welds of size 10 *mm* and subjected to tension. The thickness of each plate is 12 *mm*. The yield stress and the ultimate tensile stress of steel are 250 *MPa* and 410 *MPa*, respectively. The welding is done in the workshop ($\gamma_{mw} = 1.25$). As per the Limit State Method of IS 800: 2007, the minimum length (rounded off to the nearest higher multiple of 5 *mm*) of each weld to transmit a force P equal to 270 *kN* (factored) is (*GATE CE 2016*)
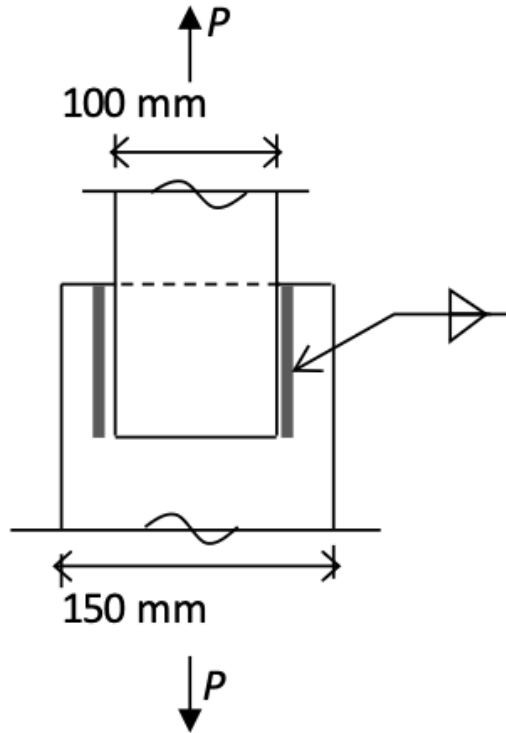
Fig. 48

    a) 90 *mm*
    b) 105 *mm*
    c) 110 *mm*
    d) 115 *mm*

49) The Optimistic Time (O), Most likely Time (M) and Pessimistic Time (P) (in days) of the activities in the critical path are given below in the format O-M-P:

Fig. 49

The expected completion time (in days) of the project is _ _ _ _ _ _
(*GATE CE* 2016)

50) The porosity (*n*) and the degree of saturation (*S*) of a soil sample are 0.7 and 40%, respectively. In a 100 m^3 volume of the soil, the volume (expressed in m^3) of air is _ _ _ _ _ _ (*GATE CE* 2016)

51) A homogeneous gravity retaining wall supporting a cohesionless backfill has a height of 6 *m* and base width 4 *m*. The lateral active earth pressure at the bottom of the wall is 40 *kPa*. The minimum weight of the wall (*expressed in kN per m length*) required to prevent it from overturning about its toe (*Point P*) is: (*GATE CE* 2016)
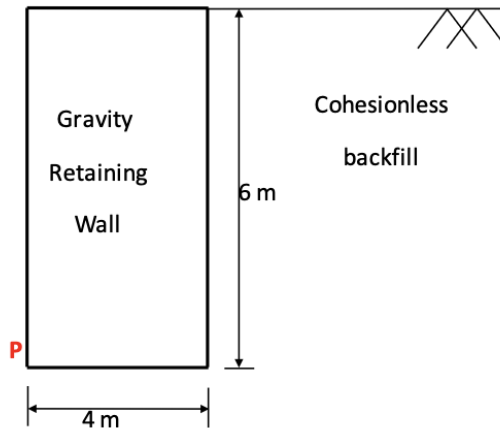
Fig. 51

   a) 120
   b) 180
   c) 240
   d) 360

52) An undisturbed soil sample was taken from the middle of a clay layer (i.e., 1.5 *m* below GL). The water table was at the top of clay layer. Laboratory test results are as follows: (*GATE CE* 2016)

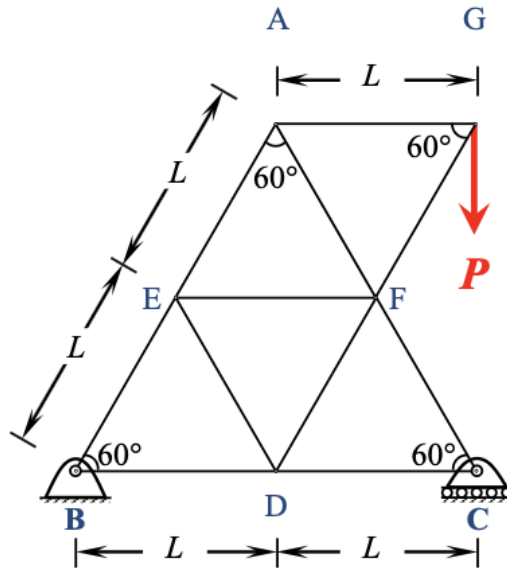|	
Natural water content of clay	: 25%
Preconsolidation pressure of clay	: 60 *kPa*
Compression index of clay	: 0.50
Recompression index of clay	: 0.05
Specific gravity of clay	: 2.70
Bulk unit weight of sand	: 17 kN/m^3

Fig. 52

A compacted fill of 2.5 *m* height with unit weight of 20 kN/m^3 is placed at the ground level.

Assuming unit weight of water as 10 kN/m^3, the ultimate consolidation settlement (expressed in mm) of the clay layer is _ _ _ _ _ _

53) A seepage flow condition exists in a soil mass. The saturated unit weight of the soil $\gamma_{sat} = 18$ kN/m³. Using unit weight of water $\gamma_w = 9.81$ kN/m³, the effective vertical stress (*expressed in kN/m2*) on plane *X–X* is _ _ _ _ _ _   (*GATE CE* 2016)
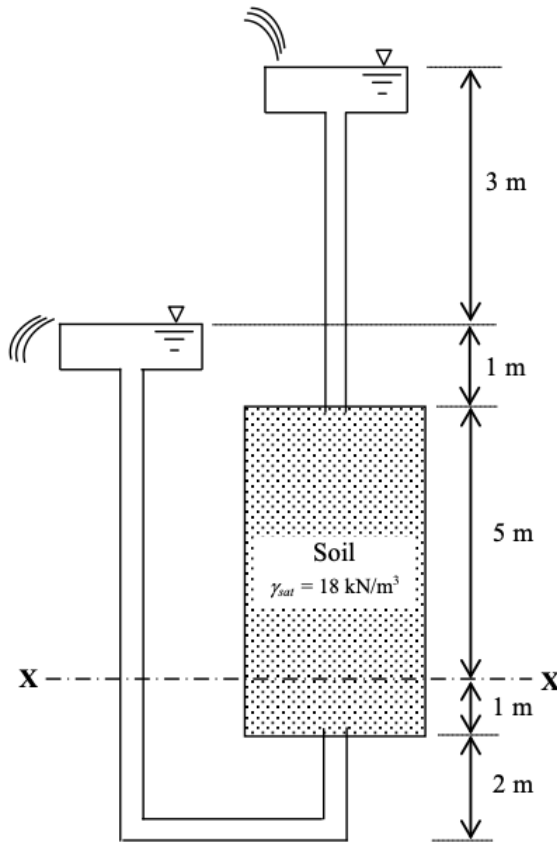
Fig. 53

54) A drained triaxial compression test on a saturated clay yielded the effective shear strength parameters as $c' = 15\ kPa$ and $\phi' = 22°$. Consolidated Undrained triaxial test on an identical sample of this clay at a cell pressure of $200\ kPa$ developed a pore water pressure of $150\ kPa$ at failure. The deviator stress (expressed in kPa) at failure is _ _ _ _ _ _   (*GATE CE* 2016)

55) A concrete gravity dam section is shown. Assuming unit weight of water as $10\ kN/m^3$ and unit weight of concrete as $24\ kN/m^3$, the uplift force per unit length of the dam (expressed in kN/m) at PQ is _ _ _ _ _ _   (*GATE CE* 2016)
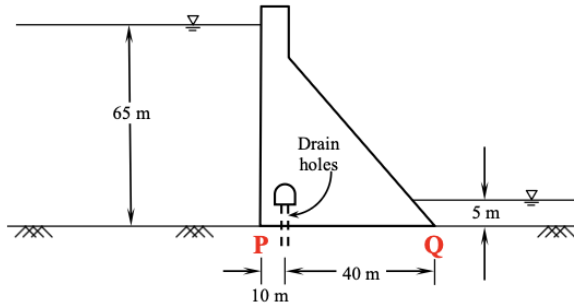
Fig. 55

56) Seepage is occurring through a porous media. The hydraulic conductivity values k_1, k_2, k_3 are in m/day. The seepage discharge (m³/day per m) through the porous media at section PQ is   (*GATE CE* 2016)
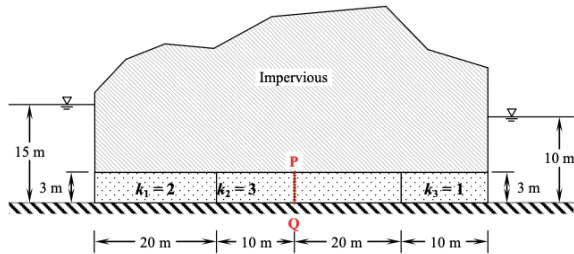

Fig. 56

a) $\frac{7}{12}$ b) $\frac{1}{2}$ c) $\frac{9}{16}$ d) $\frac{3}{4}$

57) A 4 *m* wide rectangular channel, having bed slope of 0.001 carries a discharge of 16 m³/s. Considering Manning's roughness coefficient = 0.012 and $g = 10$ m/s², the category of the channel slope is   (*GATE CE* 2016)
   a) horizontal
   b) mild
   c) critical
   d) steep
58) A sector gate is provided on a spillway. Assuming $g = 10$ m/s², the resultant force per meter length (expressed in kN/m) on the gate will be _ _ _ _ _ _ (*GATE CE* 2016)
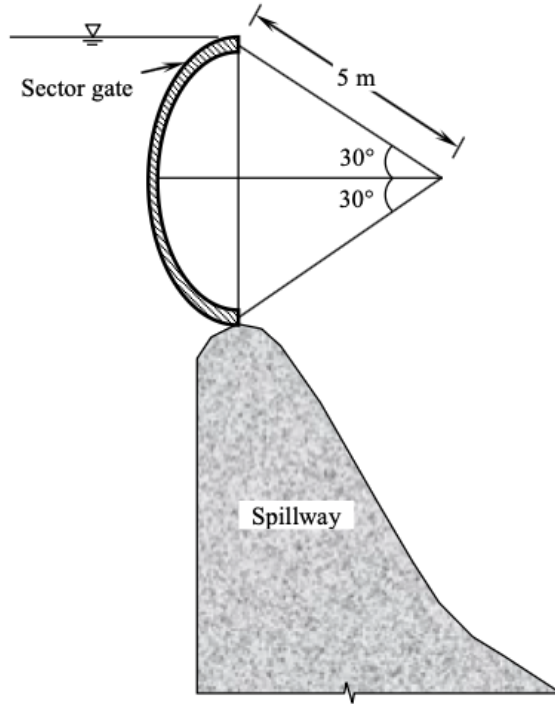
Fig. 58

59) A hydraulically efficient trapezoidal channel section has a uniform flow depth of 2 *m*. The bed width (expressed in m) of the channel is _ _ _ _ _ _ (*GATE CE* 2016)

60) Effluent from an industry 'A' has a pH of 4.2. The effluent from another industry 'B' has double the hydroxyl (OH^-) ion concentration than the effluent from industry 'A'. pH of effluent from the industry 'B' will be _ _ _ _ _ _ (*GATE CE* 2016)

61) An electrostatic precipitator (ESP) with 5600 m^2 of collector plate area is 96% efficient in treating 185 m^3/s of flue gas from a 200 MW thermal power plant. It was found that in order to achieve 97% percent efficiency, the collector plate area should be 6100 m^2. In order to increase the efficiency to 99%, the ESP collector plate area (expressed in m^2) would be _ _ _ _ _ _ (*GATE CE* 2016)

62) The 2-day and 4-day BOD values of a sewage sample are 100 mg/L and 155 mg/L, respectively. The value of BOD rate constant (expressed in per day) is _ _ _ _ _ _ (*GATE CE* 2016)

63) A two lane, one-way road with radius of 50 *m* is predominantly carrying lorries with wheelbase of 5 *m*. The speed of lorries is restricted to be between 60 kmph and 80 kmph. The mechanical widening and psychological widening required at 60 kmph are designated as $w_{me,60}$ and $w_{ps,60}$, respectively. The mechanical widening and psychological widening required at 80 kmph are designated as $w_{me,80}$ and $w_{ps,80}$, respectively. The correct values of $w_{me,60}$, $w_{ps,60}$, $w_{me,80}$, $w_{ps,80}$ respectively are

(*GATE CE* 2016)

a) 0.89 m, 0.50 m, 1.19 m, and 0.50 m
b) 0.50 m, 0.89 m, 0.50 m, and 1.19 m
c) 0.50 m, 1.19 m, 0.50 m, and 0.89 m
d) 1.19 m, 0.50 m, 0.89 m, and 0.50 m

64) While traveling along and against the traffic stream, a moving observer measured the relative flows as 50 vehicles/hr and 200 vehicles/hr, respectively. The average speeds of the moving observer while traveling along and against the stream are 20 km/hr and 30 km/hr, respectively. The density of the traffic stream (*expressed in vehicles/km*) is _ _ _ _ _ _ (*GATE CE* 2016)

65) The vertical angles subtended by the top of a tower T at two instrument stations set up at P and Q are shown. The two stations are in line with the tower and spaced at a distance of 60 m. Readings taken from these two stations on a leveling staff placed at the benchmark (BM = 450.000 m) are also given. The reduced level of the top of the tower T (*expressed in m*) is _ _ _ _ _ _ (*GATE CE* 2016)
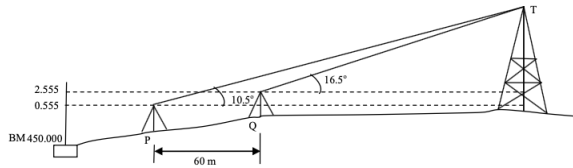

Fig. 65