

# GATE 2022

## Civil Engineering

Shift-1

► Questions & Answers  
(Memory Based)

**(MEMORY BASED)**

1. What is the formation of C-S-H gel  
[MCQ: 1 Mark]

Ans.  $\text{Ca(OH)}_2 + \text{Silica} + \text{H}_2\text{O} \rightarrow \text{C-S-H Gel}$

Activity	Duration	Depends on
P	10	-
Q	12	-
R	5	P
S	10	Q
T	10	P, Q

Find critical path and total duration

A. PT	22
B. QS	22
C. QT	20
D. PR	20

[MCQ: 2 Marks]

Ans. B

3. • P is sister of Q  
• Q is husband of R  
• T is husband of P  
• R has 1 child as S  
How is T related as S ?

- A. Uncle
- B. Brother
- C. Sister
- D. Grand father

[MCQ: 1 Mark]

Ans. A

4. Match the following

A. Normally consolidated clay	P. Sensitivity > 16
B. Quick clay	Q. Dilation angle = 0
C. Sand in critical state	R. $w_L > 50$
D. Clay of high plasticity	S. OCR = 1

[MCQ: 1 Mark]

Ans. A-S

- B-P
- C-Q
- D-R

5. Volume of soil is 10000 m<sup>3</sup> and its corresponding void ratio  $e = 1$  then soil is compressed to a volume of 7500 m<sup>3</sup> find the final void ratio?

[NAT: 1 Mark]

Ans. 0.5

6. As per Rankine theory of earth pressure the inclination of failure plane is  $(45 + \phi/2)$  with respect to the direction of the minor principle stress. The above statement is correct for which one of the following options-

- A. Both active as well as passive state
- B. only the active state and not the passive state
- C. Only the passive state and not the active state
- D. Neither active or nor passive state

[MCQ: 1 Mark]

Ans. B

7. A square concrete pile of 10 m length is driven into a deep layer of uniform homogeneous clay average unconfined compressive strength of the clay, determined through laboratory test on undisturbed samples extracted from the clay layer is 100 kPa, If the ultimate compressive load capacity of the driven pile is 632 kN, the required width of the pile is \_\_\_\_ mm ( $N_c = 9, a = 0.7$  given)

[NAT: 2 Marks]

Ans. 400

8. A concentration vertical load of 3000 kN is applied on a horizontal ground surface. point P and Q are at depths 1 m and 2 m below the ground respectively, along the line of application of the load. considering the ground to be linearly elastic, isotropic, semi-infinite medium, the ratio of the increase in vertical stress at P to the increase in vertical stress at Q is \_\_\_\_\_.

[MCQ: 1 Mark]

Ans. 4

9. Four different soils are classified as CH, ML, SP and SW, as per the unified soil classification system which one of the following option correctly represents their arrangement in the decreasing order of hydraulic conductivity

- A. ML, SP, CH, SW
- B. CH, ML, SP, SW
- C. SP, SW, ML, CH
- D. SP, SW, CH, ML

[MCQ: 1 Mark]

Ans. C

10. Condition to be satisfied for a soil element under passive earth condition

- A.  $\sigma'_v < \sigma'_n$
- B.  $\sigma'_v = \sigma'_n$
- C.  $\sigma'_v + \sigma'_n$
- D.  $\sigma'_v > \sigma'_n$

[MCQ: 1 Mark]

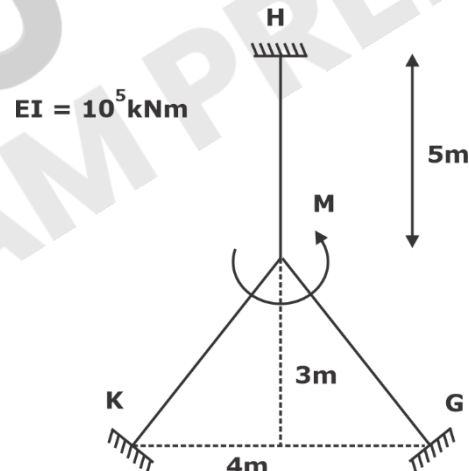
Ans. A

11. A raft foundation of 30 × 25m is proposed to be constructed at a depth of 8m in a sand layer. A 25m thick saturated clay layer exists 2m below the base of the raft foundation. Below the clay layer a dense sand layer exist at the site. A 25 mm thick undisturbed sample was collected from the mid depth of the clay layer and tested in laboratory odometer under double drainage condition it was found that the soil sample had undergone 50% consolidation settlement in 10 min. The time (in days) required for 25% consolidation settlement of the raft foundation will be

[NAT: 2 Marks]

Ans. 1736 days

12. The moment at H = 10 kNm, the value of M (kNm) \_\_\_\_\_.



[NAT: 2 Marks]

Ans. 60 kNm

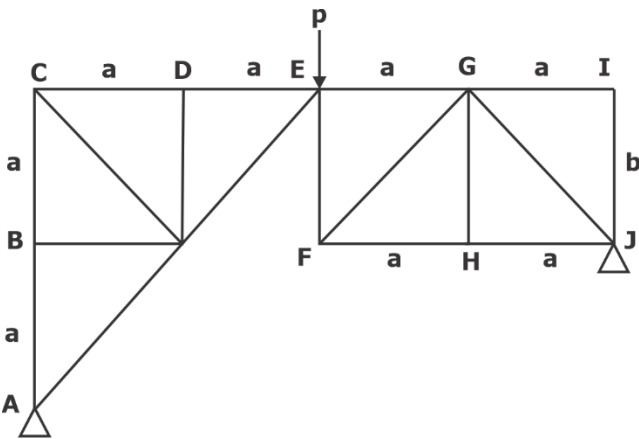
13. Consider a ss beam PQ as shown in the figure. Truck having 100 kN on the front axel and 200 kN on the rear axle moves from left to right to the spacing between the axis is 3m. The max. bending moment at point R is \_\_\_\_\_ kN/m



[NAT: 2 Marks]

Ans. 180 kNm

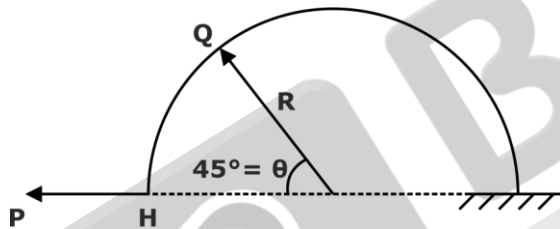
14. The plane truss shown in the figure is subjected to down external force (P). It is given that  $P = 70 \text{ kN}$   $a = 2\text{m}$  and  $b = 3\text{m}$ . What is the force in member EF.



[NAT: 2 Marks]

Ans. 30 kNm (compressive)

15. At  $\theta = 45^\circ$ , value of axial thrust shear force, and bending moment at Q is



[MCQ: 2 Marks]

Ans. Bending moment =  $\frac{PR}{\sqrt{2}}$

$$\text{Axial Force} = \frac{P}{\sqrt{2}}$$

$$\text{Radial shear} = \frac{P}{\sqrt{2}}$$

16. For a Linear regression problem  $y = ax + b$ , if  $a = 6.1$  find b

Independent vocable	5	2	4	3
Pendent vocable	16	10	13	12

[NAT: 1 Mark]

Ans. 8.6

17.  $\frac{d^3y}{dy^3} + x \left( \frac{dy}{dx} \right)^{3/2} + x2y = 0$

Find order and Degree

- A. Order = 3                      Degree = 3/2  
 B. Order = 3                      Degree = 3  
 C. Order = 3                      Degree = 2  
 D. Order = 2                      Degree = 3

[MCQ: 1 Mark]

Ans. C

18. Matrix  $M = \begin{bmatrix} 1 & 3 \\ 4 & 3 \end{bmatrix}$  have eigen value 5, -2.

$$Q = M^3 - 4M^2 - 2M$$

Find eigen volume of Q

- A. -20                      B. -30  
 C. 15                      D. 25

[MSQ: 2 Marks]

Ans. A, C

19. Let  $\max \{a, b\}$  be max of real numbers a & b. Which of the following is/are TRUE for  $\max \{3 - x, x - 1\}$

- A. Continuous in its domain  
 B. Local maxima. at  $x = 2$   
 C. Local minima at  $x = 2$   
 D. Differentiable in its domain

[MSQ: 2 Marks]

Ans. A, C

20.  $Z = \sin (y + it) + \cos (y - it)$ . The Partial differential eqn. derived from above expression.

[MCQ: 1 Mark]

Ans.  $\frac{\partial^2 z}{\partial y^2} + \frac{\partial^2 z}{\partial t^2} = 0$

21.  $\frac{dy}{dx} = 4(x+2) - y$ , for  $y = 3$  at  $x = 1$ , Find the value of  $y$  at  $x = 1.4$  a step size of 0.2 using Euler's method.

[NAT: 1 Mark]

Ans. 6.4

22.  $f(x) = \sum f_n \cos nx$  for  $f(x) = \cos^4 x$ , Numerical Value of  $(f_4 + f_5)$  is \_\_\_\_\_

[NAT: 2 Marks]

Ans. 0.125

23. The Cartesian co-ordinates of a point in a right-handed Cartesian system are (1, 1, 1). The transformed co-ordinates of  $p$  due to 45° clockwise rotation about positive  $x$ -axis is \_\_\_\_\_

- A.  $[1, 0, \sqrt{2}]$
- B.  $[-1, 0, -\sqrt{2}]$
- C.  $[1, 0, -\sqrt{2}]$
- D.  $[-1, 0, \sqrt{2}]$

[MCQ: 1 Mark]

Ans. A

24. In a water sample, the concentration of  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$  and  $\text{HCO}_3^-$  are 100 mg/l, 36 mg/l, and 122 mg/l respectively. The atomic masses of radius elements are:  $\text{Ca} = 40$ ,  $\text{mg} = 24$ ,  $\text{H} = 1$   $\text{C} = 12$ ,  $\text{O} = 16$ .

The total hardness and temporary hardness in the water sample (m mg/L as  $\text{CaCO}_3$ ) will be.

- A. 500 & 100 respectively
- B. 800 & 200 respectively
- C. 400 & 300 respectively
- D. 400 & 100 respectively

[MCQ: 2 Marks]

Ans. D

25. A wastewater sample contains two nitrogen atoms species namely ammonia and nitrate. Consider the atomic weight of N, H and O as 14 g/mol, 1 g/mol, 16 g/mol, respectively in this wastewater the concentration of ammonia is 34 mg  $\text{NH}_3$ /l and that of nitrate is 6.2 mg  $\text{NO}_3^-$ /l the total nitrogen concentration is in this wastewater is \_\_\_\_ (milligram nitrogen per lit)(Round off to 2 decimal place)

[NAT: 2 Marks]

Ans. 29.4

26. A reinforced concrete beam with rectangular cross section (width = 300 mm, effective depth = 580 mm) is made of M30 grade concrete. It has 1% longitudinal tension reinforcement of Fe 415 grade steel. The design shear strength for this beam is 0.66 N/mm<sup>2</sup>. The beam has to resist a factor shear force of 440 kN. The spacing of two-legged, 10 mm diameter vertical stirrups of Fe 415 grade steel is \_\_\_\_ (mm) (round off to the nearest integer)

[NAT: 2 Marks]

Ans. 101

27. In the context of elastic theory of reinforced concrete, the modular ratio of defined as the ratio of

- A. Shear modulus of reinforcement material to the shear modulus of the concrete
- B. Young's modulus of elasticity of reinforcement material to Young's modulus of elasticity of concrete
- C. Young's modulus of elasticity of reinforcement material to the shear modulus of concrete.
- D. Young's modulus of elasticity of concrete to Young's modulus of elasticity of reinforcement material

[MCQ: 1 Mark]

Ans. B

- 28.** The process used for conversion of salt water into freshwater is  
 A. Reverse osmosis    B. Electro dialysis  
 C. Microfiltration    D. Ultrafiltration

[MSQ: 1 Mark]

**Ans.** A and B

- 29.** Match the following column.

[MCQ: 1 Mark]

A. Viscosity	1. Froude's Number
B. Pressure	2. Reynolds Number
C. Gravity	3. Mach Number
D. Compressibility	4. Euler Number

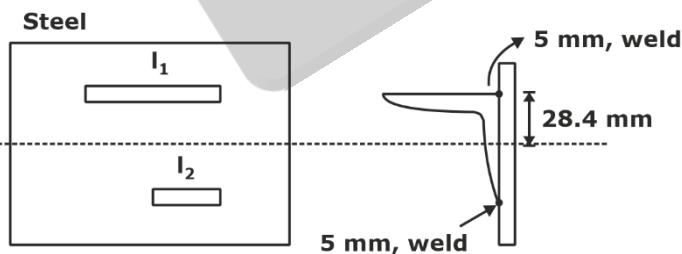
**Ans.** A-2, B-4, C-1, D-2

- 30.** Two reservoirs are connected by 2 branched pipe running parallel to each other. The pipes are equal in length. The diameter of the pipes are 20 cm and 10 cm. The difference in reservoir level is 5 m. For the same friction factor, calculate the ratio of discharge of larger pipe and smaller pipe.

[NAT: 2 Marks]

**Ans.** 5.65

- 31.** An angle section of 100 mm × 100 mm × 10 mm is connected to gusset plate. The allowable stress in angle section is 150 MPa and allowable shear stress in weld is 108 MPa. Area of angle section is 1903 mm<sup>2</sup>. Find values of  $l_1$  and  $l_2$

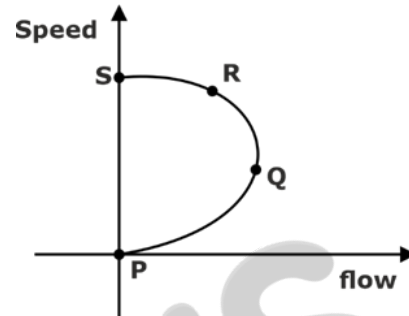


- A. 380 mm and 380 mm  
 B. 541 mm and 219 mm  
 C. \_\_\_ and 380 mm  
 D. 219 mm and 541 mm

[MCQ: 2 Marks]

**Ans.** B

- 32.** Consider the four points P, Q, R and S shown in the Greenshields fundamental speed flow diagram. Denote their corresponding traffic densities by  $K_P$ ,  $K_Q$ ,  $K_R$  &  $K_S$  respectively. The correct order of these densities is



- A.  $K_Q > K_R > K_P > K_S$   
 B.  $K_S > K_R > K_Q > K_P$   
 C.  $K_P > K_Q > K_R > K_S$   
 D.  $K_Q > K_R > K_S > K_P$

**Ans.** C

- 33.** The vehicle rate is computed every 10 minutes interval traffic volume survey done in peak one hours given below  
 The PHF for 10 mins sub-interval of (for not upto one decimal place)

Time interval (in mins)	Vehicle count
0-10	10
10-20	11
20-30	12
30-40	15
40-50	13
50-60	11

[NAT: 2 Marks]

**Ans.** 0.8

- 34.** A two-phase signalised intersection is designed with a cycle of 100s. The amber and red time for each phase are 4s & 50s respectively if clearance loss time = 2sec. then the effective green time of each phase is \_\_\_\_\_(S).

[NAT: 2 Mark]

**Ans.** 48

35. For a slope to be steeper to steep, the GVF profile to be considered

[MSQ: 1 Mark]

- A.  $S_1$
- B.  $S_2$
- C.  $S_3$
- D. May be  $S_1, S_2, S_3$

Ans. C

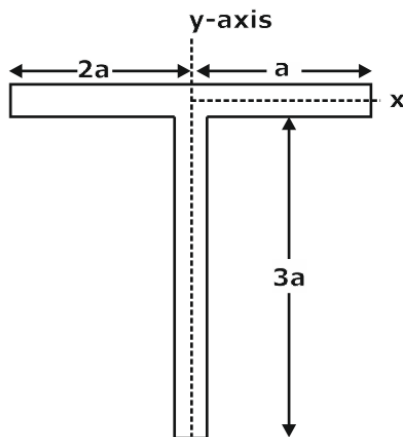
36. The hoop stress of a this cylindrical shell is 30 N/mm<sup>2</sup>. The maximum shear stress at this point is

[MCQ: 1 Mark]

- A. 15 N/mm<sup>2</sup>
- B. 7.5 N/mm<sup>2</sup>
- C. 30 N/mm<sup>2</sup>
- D. 25 N/mm<sup>2</sup>

Ans. A

37. Find shear center,



[MCQ: 2 Marks]

Ans. (0, 3a)

38. A two-hour duration storm event with uniform excess rainfall of 3 cm occurred on a watershed.

0	1	2	3	4	5	6	7
10	16	34	40	41	25	16	10

Consider a baseflow of 10 m<sup>3</sup>.

The peak flow ordinate of 1 hour unit hydrograph is \_\_\_\_\_.

[MCQ: 2 Marks]

Ans. 12

39. A line between P and Q laid on a slope of 1 in 5 was measured to be 350 m using a 50 m tape. The tape is short by 0.1 m. The corrected horizontal length is \_\_\_\_\_.

- A. 349.99 m
- B. 350.72 m
- C. 356.5 m
- D. 342.5 m

[MCQ: 1 Mark]

Ans. D

40. The bearing of a survey line is N 31°17' W. Its azimuth observed from North is \_\_\_\_\_.

[NAT: 1 Mark]

Ans. 328.72°

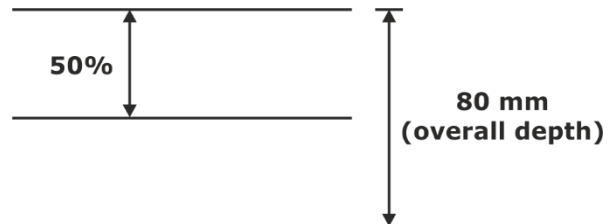
41. An aerial photograph is taken from a height of 3.5 km, from a camera of focal length of 152 mm. The average height above the MSL is 460 m. Find the scale of the photograph.

[NAT: 2 Marks]

Ans. 1/20000

42. If consumptive use of crop is 2.8 mm per day with overall depth 80 mm of soil. Also the consumption of irrigation is 50%. Find the frequency of irrigation.

[NAT: 2 Marks]



Ans. 14 days

**43.** In the contact of cross-drainage structure, the correct statement(s) regarding the relative position of a natural drain (stream/river) and an irrigation canal is/are

**[MSQ: 2 Marks]**

- A. In a canal syphon, natural drain water goes through the irrigation canal.
- B. In an aqueduct, natural drain water goes under the irrigation canal, whereas in a super-passage, natural drain water goes over the irrigation canal.
- C. In an aqueduct, natural drain water goes over the irrigation canal, whereas in a super-passage, natural drain water goes under the irrigation canal.
- D. In a level crossing, natural drain water goes through the irrigation canal.

**Ans.** B, D

**44.** P invested Rs. 5000 for 6 months, Q invested Rs. x for 8 months. At the end of 1 year, the profit of P and Q in the ratio of  $\frac{4}{9}$ . The profit is calculated at investment. Find x

**[MCQ: 2 Marks]**

**Ans.** Rs. 3000

**45.** Two straight lines both passing through origin, pass through (1, 3) & (1, 2) respectively. Find the area enclosed for  $x \in [0, 1]$

- A. 2
- B. 1
- C. 0.5
- D. 1.5

**[MCQ : 2 Marks]**

**Ans.** C

**46.** If

$$p : q = 1 : 2$$

$$q : r = 4 : 3$$

$$r : s = 4 : 5$$

If u = 50% more than S, find p : u ?

- A.  $\frac{16}{15}$
- B.  $\frac{16}{45}$
- C.  $\frac{2}{15}$
- D.

**[MCQ: 2 Marks]**

**Ans.** B

\*\*\*\*\*