THE GATE ACADEMY
A Forum of IIT / IISc Graduates

GATE-2018
All India Mock GATE Test Series
Civil Engineering
Test Series 4

Name: …………………………………………

Test ID**: CE-TS-04-18**

Duration: 3 hours

Maximum marks : 100

Please read the following instructions carefully

General Instructions

1. Total duration of examination is 180 minutes (3 hours).
2. The clock will be set at the server. The countdown timer in the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You will not be required to end or submit your examination.
3. The Question Palette displayed on the right side of screen will show the status of each question using one of the following:
   a. You have not visited the question yet.
   b. You have not answered the question.
   c. You have answered the question.
   d. You have NOT answered the question, but have marked the question for review.
   e. You have answered the question, but marked it for review.

   The **Marked for Review** status for a question simply indicates that you would like to look at that question again. If a question is answered and **Marked for Review**, your answer for that question will be considered in the evaluation.

Navigating to a Question

4. To answer a question, do the following:
   a. Click on the question number in the Question Palette to go to that question directly.
   b. Select an answer for a multiple choice type question by clicking on the bubble placed before the 4 choices namely A, B, C, D. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
   c. Click on **Save and Next** to save your answer for the current question and then go to the next question.
   d. Click on **Mark for Review and Next** to save your answer for the current question, and also mark it for review, and then go to the next question.
   e. **Caution**: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on its question number without saving the answer to the previous questions.
   f. You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

Answering a Question

5. Procedure for answering a multiple choice (MCQ) type question:
   a. To select your answer, click on the bubble button of one of the options
   b. To deselect your chosen answer, click on the bubble button of the chosen option again or click on the clear response button
   c. To change your chosen answer, click on the bubble button of another option
   d. To save your answer, you MUST click on the **Save and Next button.**
   e. To mark the question for review, click on the **Mark for Review and Next** button. If an answer is selected for a question that is Marked for Review, that answer will be considered in the evaluation.

6. **Procedure for answering a numerical answer type question:**
   a. To enter a number as your answer, use the virtual numerical keypad
   b. A fraction (eg. −0.3 or −.3) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or − 932.6711 or 12.82 can be entered.
   c. To clear your answer, click on the Clear Response button
   d. To save your answer, you MUST click on the **Save and Next** button
   e. To mark a question for review, click on the **Mark for Review and Next button.** If an answer is selected (for MCQ) or entered (for numerical answer type) for a question that is Marked for Review, that answer will be considered in the evaluation.
7. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.
8. Note that ONLY Questions for which answers are saved or marked for review after answering will be considered for evaluation.

Paper Specific Instructions:
9. There are a total of 65 questions carrying 100 marks. Questions are of multiple choice type or numerical answer type. A multiple choice type question will have four choices for the answer with only one correct choice. For numerical answer type questions, the answer is a number and no choices will be given. A number as the answer should be entered using the virtual keyboard on the monitor.
10. Questions Q.1 – Q.10 belong to General Aptitude (GA) section and carry a total of 15 marks.
    Questions Q.1 – Q.5 carry 1mark each, and questions Q.6 – Q.10 carry 2marks each.
11. Questions Q.1 – Q.25 carry 1mark each. Questions Q.26 – Q.55 carry 2marks each.
12. Questions not attempted will result in zero mark. Wrong answers for multiple choice type questions will result in NEGATIVE marks. For all 1 mark questions, ⅓ mark will be deducted for each wrong answer. For all 2 marks questions, ⅔ mark will be deducted for each wrong answer. There is no negative marking for questions of numerical answer type.
13. Physical calculator is NOT allowed. All candidates will be provided with an online scientific calculator which has to be used to answer the questions.

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Test Series 4
Civil Engineering

General Aptitude:

Q.1 - Q.5 Carry One Mark each.

1. In the following question choose the word which is the exact OPPOSITE of the given words.
   "QUIESCENT"
   (A) Active
   (B) Dormant
   (C) Weak
   (D) Unconcerned

2. Which term of the series 5, 10, 20, 40, ... is 1280?

3. A train normally covers a certain distance at a speed of 60 km/hr. However, if it were to halt for a fixed time interval in each hour, its average reduced to 50 km/hr. what is the time interval for which the train halts in each hour?
   (A) 10 minutes
   (B) 20 minutes
   (C) 6 minutes
   (D) 12 minutes

4. Radha moves towards South-East a distance of 7 km, then she moves towards West and travels a distance of 14 km. From here she moves towards North-West a distance of 7 km and finally she moves a distance of 4 km towards east. How far is she now from the starting point?

5. In the following question two statements are given and these statements are followed by two conclusions numbered (1) and (2). You have to take the given two statements to be true even if they seem to be at variance from commonly known facts. Read the conclusions and then decide which of the given conclusions logically follows from the two given statements, disregarding commonly known facts.
   Statements: Some actors are singers. All the singers are dancers.
   Conclusions:
   1. Some actors are dancers.
   2. No singer is actor.
   (A) Only (1) conclusion follows
   (B) Only (2) conclusion follows
   (C) Either (1) or (2) follows
   (D) Neither (1) nor (2) follows

Q.6 - Q.10 Carry Two Mark each.

6. If Rupert has 4 more coins than Laxmi, Laxmi has 1 more coin than bill and bill has 1 more coin than Hawkins. Finally Hawkins has 4 more coins than Ajim. Then minimum number of coins that must be transferred, if all of them wish to have an equal number of coins:

7. The last digit of the expression
$4 \times 9^2 \times 4^3 \times 9^4 \times 4^5 \times 9^6 \times \ldots \times 4^{99} \times 9^{100}$ is:
(A) 4   (B) 6
(C) 9   (D) 1

8. The average age of boys in class is 16.66, while the average age of girls is 18.75. Thus average age of all the 40 students of the class is 17.5. If the difference between the number of boys and girls is 8, then the number of girls in the class is:
(A) 12   (B) 16
(C) 18   (D) Data insufficient

9. In an election only two candidates contested 20% of the voters did not vote and 120 votes were declared as invalid. The winner got 200 votes more than his opponents thus he secured 41% votes of the total voters on the voter list. Percentage votes of the defeated candidate out of the total votes casted is :
(A) 47.5%   (B) 51.25%
(C) 36%   (D) 45%

10. The amount of work in a leather factory is increased by 50%. By what percent is it necessary to increase the number of workers to complete the new amount of work in previously planned time, if the productivity if the new labour is 25% more.

Technical:

Q.1 - Q.25 Carry One Mark each.

1. Find determinant of below matrix $A = \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 5 & 1 & 1 \\ 1 & 1 & 2 & 1 \\ 1 & 1 & 1 & 6 \end{pmatrix}$

2. Is the function given below continuous/differentiable at $x = 2$?

   $f(x) = \begin{cases} x^2 + 1, & x \le 2 \\ x - x^2, & x > 2 \end{cases}$

   (A) Continuous but not differentiable
   (B) Differentiable but not continuous
   (C) Both continuous and differentiable
   (D) Neither continuous nor differentiable

3. The solution of $u_{xx} = u$ is of the form, $\left(\text{Where } u = u(x,y) \text{ and } u_{xx} = \frac{\partial^2 u}{\partial x^2}\right)$

   (A) $C_1(x)e^x + C_2(y)e^{-y}$ (B) $C_1(y)e^x + C_2(y)e^{-x}$
   (C) $C_1(x)e^x + C_2(x)e^{-x}$ (D) $C_1(y)e^y + C_2(y)e^{-x}$

4. The iterative formula to find the value of $1/N$ is given by

   (A) $x_{n+1} = \dfrac{1}{2}(x_n + N/x_n)$ (B) $x_{n+1} = x_n(2 - Nx_n)$

   (C) $x_{n+1} = \dfrac{1}{2}(x_n + 1/Nx_n)$ (D) $x_{n+1} = (x_n + N/x_n)$

5. $f(0) = -1, f'(0) = 6, f''(0) = 2/3,$ and $f'''(0) = -6$. What are the first four nonzero terms of the Maclaurin series

   (A) $-1 + 6x + \dfrac{2}{3}x^2 - 6x^3$ (B) $-1 + 6x + \dfrac{1}{3}x^2 - 2x^3$

   (C) $-1 + 6x + \dfrac{1}{3}x^2 - x^3$ (D) $-x + 6x^2 + \dfrac{1}{3}x^3 - x^4$

6. The Kinematic Indeterminacy of the following truss will be_____
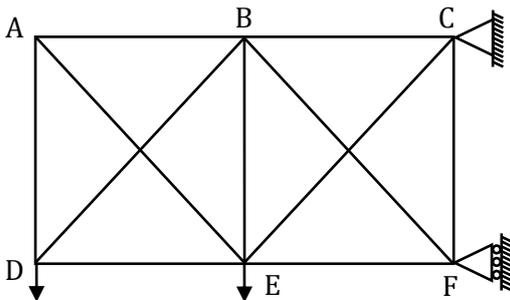
7. At the limit state of collapse, a reinforced concrete beam is subjected to factored shear force of 50 kN and factored torque of 6 kN-m. The beam is 200 mm wide and has gross depth of 400 mm with an effective cover of 35 mm. The grade of concrete and stirrup steel are M20 and Fe250 respectively. The shear strength of concrete for given percentage of steel is 0.76 N/mm^2. The calculated spacing of 2 –legged 8 mm diameter stirrups in mm _____(Up to 2 decimal is)

8. Consider the following statements regarding method of joints:
   X: In this case, taking each joint, the forces acting on it will be external forces are calculated first.
   Y: Then, necessary reactions are worked out.
   Which of the above statements are CORRECT?
   (A) X only
   (B) Y only
   (C) Both X and Y
   (D) Neither X nor Y

9. The bricks when tested in accordance with the procedure laid down in IS 3495 (part 2):1992 after immersion in water for 24 hours, the average water absorption by weight for higher class bricks shall not exceed.
   (A) 15%
   (B) 20%
   (C) 25%
   (D) 5%

10. Consider the following statement for float
    1. Float < 0 Sub-critical, these requires special attention
    2. Float < 0 supercritical , these requires special attention
    3. Float > 0 sub-critical, demanding normal attention but have freedom
    4. Float > 0 super-critical, these requires special attention
    Which of these statements is/are correct?
    (A) 1 and 4
    (B) 1 and 3
    (C) 2 and 3
    (D) 3 and 4

11. A unit volume of mass of saturated soil is subjected to horizontal seepage. Hydraulic gradient is 0.25 and the saturated unit weight is 20kN/m^3. The resultant body force on soil mass is: (Take $\gamma_\omega = 10$kN/m^3) _____kN

12. In a laboratory consolidation test, the void ratio of the sample reduced from 0.80 to 0.72 as the pressure was increased from 1 to 2 kg/cm^2. If co-efficient of permeability of the soil is 3.2×10^{-4} cm/s, then co-efficient of consolidation _____cm^2/s
    (A) 5.2
    (B) 8.1
    (C) 6.7
    (D) 7.3

13. A 20 kN point load acts on the surface of an infinite elastic medium. The vertical pressure intensity (in kN/m^2) at a point 4m below and 2m away from the load will be
    (A) 0.212
    (B) 2.12
    (C) 0.342
    (D) 3.42

14. For 2m depth of flow in a canal with CVR(critical velocity ratio) equal to 0.85, according to Kennedy's theory the velocity of floe will be _____cm/s

15. Water present in artesian aquifer is usually
    (A) At sub-atmospheric pressure
    (B) At atmospheric pressure
    (C) At 0.5 times atmospheric pressure
    (D) Above atmospheric pressure

16. Consider two infinite horizontal parallel plates at a distance of 20 cm from one another. The top plate is moving at a speed of 100cm/s, and the bottom plate is stationary. The gap between the two plates is filled with an oil of viscosity 8 poise. There is no pressure gradient in the oil in the direction parallel to plates. The shear force per unit area acting on the plate is _____Pa

17. Elevation and temperature data for places are tabulated below

Elevation $'m'$	Temperature $°C$
5	19.42
305	16.72

    Based on this data, lapse rate can be referred as
    (A) Sub adiabatic
    (B) Super adiabatic
    (C) Inversion
    (D) Neutral

18. A sedimentation tank has following data. What is its efficiency?
    Discharge $= 5 \text{ m}^3/\text{s}$
    Size(L × B × D) $= 10 \times 5 \times 3 \text{ m}^3$
    Size of collidal particle $= 1.2$ mm
    $\gamma_s = 20 \text{ kN/m}^3$, $\gamma_w = 9.81 \text{ kN/m}^3$, $\mu = 10.19 \times 10^{-3} \text{ Ns/m}^2$
    Take $n_\tau < 1$
    (A) 76%
    (B) 80%
    (C) 84%
    (D) 90%

19. For a sample of water with the ionic composition shown in the figure below, the non-carbonate hardness concentration (in mg/l as $CaCO_3$) is :

20. An 72 dB noise lasting for 15 min followed by 55 dB for 70 min followed by 90 dB for 5 min. The $\widehat{L_{eq}}$ value for fluctuating noise level for 90 min is _____dB.
   (A) 71.7 dB
    (B) 74.6 dB
    (C) 77.7 dB
    (D) 79.4 dB

21. The width of expansion joint gap is 3 cm in a cement concrete pavement. If the laying temperature is $10°C$ and maximum slab temperature is $60°C$.Calculate the spacing between expansion joints. Assume coefficient of thermal expansion of concrete as 10×10^{-6} Per °C

22. The CBR value of subgrade soil is 5%. Assuming type pressure = 6 kg/cm^2 and 4100 kg wheel load, the thickness of pavement will be?
    (A) 32.3 cm
    (B) 33.9 cm
    (C) 35.5 cm
    (D) 37.1 cm

23. Regarding data acquisition, which one is usually obtained by interpreting the recorded data?
    (A) Geometric information
    (B) Physical information
    (C) Semantic information
    (D) Temporal information

24. Which of the following rotation depicts the transits rule? (in case of departure)
    (A) $C_D = \Sigma D \frac{D}{D_T}$
    (B) $C_D = \Sigma D \frac{L}{\Sigma l}$
    (C) $C_D = \Sigma D \frac{l}{D_T}$
    (D) $C_D = \Sigma D \frac{D}{\Sigma l}$
    Where notations have their usual meaning

25. Consider the following statements:
    X: The line of collimation not perpendicular to the trunnion axis by a small amount is an example of error in horizontal circle reading
    Y: The trunnion axis not perpendicular to the vertical axis by a small amount is an example of error in vertical circle reading
    Which of the above statement is are CORRECT?
    (A) X only
    (B) Y only
    (C) Both X and Y
    (D) Neither X Nor Y
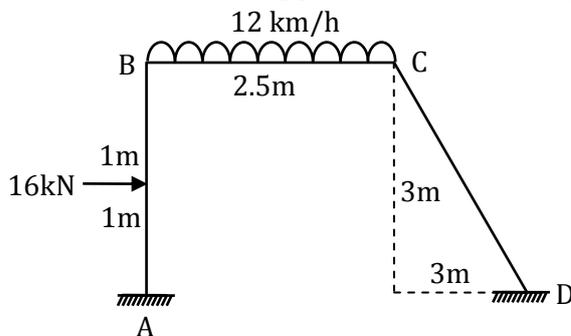
Q.26 - Q.55 Carry Two Mark each.

26. For the shaded region given below, what is it's area? (**Hint:** Given Curve is a parabola)
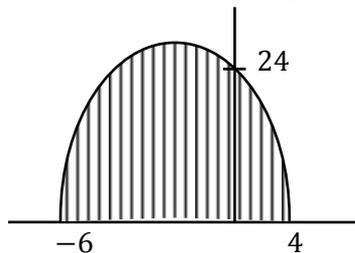
27. Using Cauchy's Integral formula .Find the value of
    $$\oint_c \frac{\sin z}{z^2 - 2iz} dz, \qquad C: |z| = 3 \text{ (Counter clockwise)}$$
    (A) $\frac{\pi}{2} i(e^2 + e^{-2})$
    (B) $\frac{\pi}{2} i(e^{-2} - e^{+2})$
    (C) $\frac{\pi}{2} i(e^2 - e^{-2})$
   (D) $\frac{\pi}{2} i(-e^{+2} - e^{-2})$

28. In the integral $\int \sin^{3/4} x \cos^3 x \, dx$ is equal to

    (A) $\dfrac{7}{4} \sin^{7/4} x - \dfrac{15}{4} \sin^{15/4} x$

    (B) $\dfrac{4}{7} \sin^{7/4} x + \dfrac{4}{15} \sin^{15/4} x$

    (C) $\dfrac{4}{7} \sin^{7/4} x - \dfrac{4}{15} \sin^{15/4} x$

    (D) $\dfrac{4}{7} \sin^{7/4} x - \dfrac{15}{4} \sin^{15/4} x$

29. The solution of the differential equation $(D^3 - 2D^2 - 9D + 18)y = e^{2x}$ is

    (A) $y = C_1 e^{-4x} + C_2 e^{2x} + C_3 e^{4x} - 0.2 \, xe^{2x}$

    (B) $y = C_1 e^{-3x} + C_2 e^{2x} + C_3 e^{3x} - 0.2 \, xe^{2x}$

    (C) $y = C_1 e^{-x} + C_2 e^{2x} + C_3 e^{x} - 0.2 \, xe^{2x}$

    (D) $y = (C_1 + C_2 x)e^{x} + C_3 e^{2x} - 0.2 \, xe^{2x}$

30. If $f(x) = x^2 + 5x + 1$ the average rate of change if f(x) on [0,2] is

    (A) 0

    (B) 2

    (C) 7

    (D) None

31. Determine the percentage change in volume of a steel bar 50 mm square in section and 1m long when subjected to an axial compressive load of 20 kN. Take $\mu = 0.25$, E=200GPa

    (A) 2.54×10^{-5}

    (B) 2.54×10^{-4}

    (C) 2.54×10^{-3}

    (D) 2.54×10^{-2}

32. Which of the following statements are correct

    (1) On principle planes shear stress is zero

    (2) On plane of maximum shear stress normal stress is zero

    (3) Maximum shear stress plane lies exactly between the principle planes

    (4) Maximum principle plane lies between maximum and minimum shear stress plane

    (A) 1 and 2

    (B) 1 and 3

    (C) 1 and 4

    (D) 2 and 4

33. Consider the following portal frame assuming all members have the same flexural rigidity.

    The ratio distribution factors of CB and CD will be _____. (Up-to 1 digit after decimals)

34. Consider the following statements regarding method of joints:
    X: It is one of the simplest methods for determining the force acting on the individual members of a truss.
    Y: Only two unknowns can be solved at a times.
    Z: It is more useful than method of sections if one the just wants to know the forces acting on a particular member close to the center of the truss.
    Which of the statements are CORRECT?
    (A) X and Y only   (B) Y and Z only
    (C) X and Z only   (D) X,Y and Z

35. Beam having a cross section of an equilateral triangle of side 10 cm is experiencing a shear load of 200 KN. Find out the magnitude of shear stress at the neutral axis (MPa)

36. On a square cross section beam of $10mm^2$ area, transverse force of 200 N is acting. This transverse force is causing bending of the beam. What is the induced shear stress on the plane shown below(MPa)

    200 M

37. For the given plate in tension, possible critical sections are
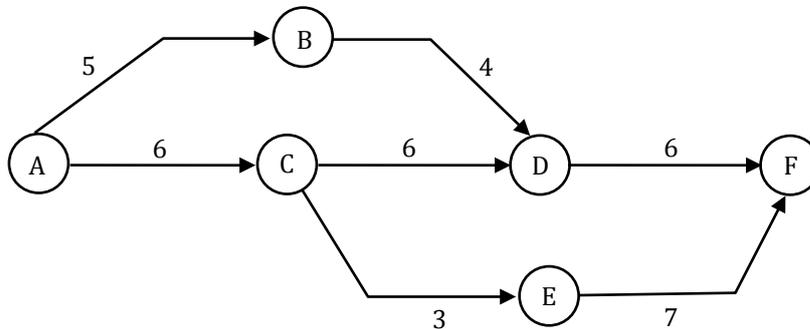   a. 1-2-3-4
    b. 5-6-7
    c. 1-2-6-3-4

38. Given figure shows a portal frame with loads. Members of frame have same plastic moment of resistance M_P.
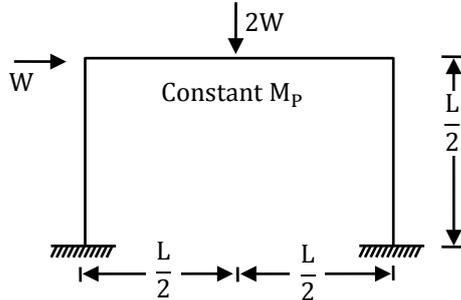
The value of W at collapse load will be

(A) $2\,M_p/L$ (B) $4\,M_P/L$

(C) $6\,M_P/L$ (D) $8\,M_P/L$

39. A network of seven activities is shown in the diagram given below. The respective activity durations are shown beside the arrows. Calculate the free float in EF respectively.
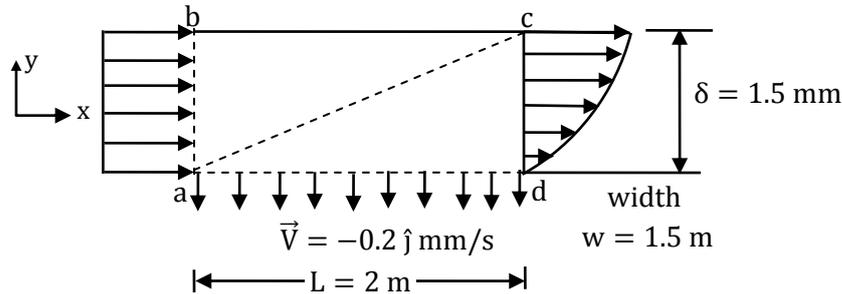

(A) 3   (B) 0

(C) 1   (D) 2

40. A saturated soil sample has a volume of 25cm^3 at liquid limit. The shrinkage limit and liquid limit are 20% and 38% respectively. The specific gravity of solids is 2.6 and $\gamma_\omega = 10$ kN/m^3. The minimum volume which can be attained by soil is _____cm^3

41. Consider the following statements:
    (i) For sand having the same relative density, N values are different at different depths.
    (ii) Corrected SPT test value N (Corrected) = 40 represents Medium sand.
    Correct Statement(s) is/are:
    (A) (i) only   (B) (ii) only
    (C) Both   (D) None of these

42. A 4m thick clay layer is subjected to pressure 60kN/m^2. If the layer has double drainage and undergo 50% .Consolidation in one year, then the settlement after one year is_____ m (Take co-efficient of permeability = 0.020 m/yr)

43. Apex angle and Base area of the cone used in static cone penetration test are respectively:
    (A) $45°, 5\text{cm}^2$ (B) $30°, 10\text{cm}^2$
    (C) $60°, 10\text{cm}^2$ (D) $36°, 5\text{cm}^2$

44. A square footing of $3\text{m} \times 3\text{m}$ size is founded at depth 1.5m below ground level in a cohesion soil having a bulk density of $1.8\,\text{t/m}^3$ and an unconfined compressive strength of $5\,\text{t/m}^2$. Determine the safe bearing capacity (in t/m^2) of the footing for FOS of 3.0 by Skempton's theory:_____

45. Water flows steadily past a porous flat plate. Constant suction is applied along the porous section. The velocity profile at section cd is

    $$\frac{u}{U_\infty} = 3\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^{3/2}$$

    $U_\infty = 9\text{m/s}$

    $\delta = 1.5$ mm

    width
    w = 1.5 m

    $\vec{V} = -0.2\,\hat{\jmath}$ mm/s

    L = 2 m

    The mass flow rate across section bc is _____ kg/s (Take density of water $= 999\,\text{kg/m}^3$

46. Chlorine gas (7 mgl as Cl_2) was added to a drinking water sample. If the free chlorine residual and PH are measured to be 1.5 mg/l (as Cl_2) and 7.6 respectively. What is the concentration of residual OCl^- ions in the water. Assume that the chlorine gas was added to the water is completely converted to HOCl and OCl. Atomic weight of Cl:35.5

    Given , $OCl^- + H^+ \overset{k}{\rightleftharpoons} HOCl, k = 10^{7.6}$

    (A) 1.416×10^{-5} moles/l   (B) 3.124×10^{-5} moles /l
    (C) 4.263×10^{-5} moles/l   (D) 1.055×10^{-5} moles/l

47. For open channel flow in triangular section with side slopes 1:m(V:H),the expression for specific energy(E_c) at critical depth (y_c) can be given by $E_c = k\,y_c$
    What is the value of k?
    (A) 1.5   (B) 2.0
    (C) 2.0 m   (D) 1.25

48. At a particular hydroelectric station, the available head is 60 m and it is estimated that a discharge of $34\,\text{m}^3/\text{s}$ will be available. It is proposed to install Francis turbines of specific speed 215 rpm and these are to run at 550 rpm with an overall efficiency of 85%. The number of turbines is _____ (Take acceleration due to gravity as $9.81\,\text{m/s}^2$ and density of water as $1000\,\text{kg/m}^3$)

49. If the base period of a 6-hour unit hydrograph of a basin is 84 hours, then a 12-hour unit hydrograph derived for this unit hydrograph will have a base period of
    (A) 72 hours
    (B) 78 hours
    (C) 84 hours
    (D) 90 hours

50. The hardness of a ground water sample was found to be 500 mg/l as $CaCO_3$ .A softener containing ion exchange resins was installed to reduce the total hardness to 60 mg/l as $CaCO_3$ before supplying to 5 households. Each household gets treated water at a rate of 500 l/day. If the efficiency of softener is 100%, the bypass flow rate (expressed in m^3/ day) is _____

51. Treated water requirement of a small colony is $600 \, m^3$/day. A settling column analysis indicates than an over flow rate of 15 m/day will produce satisfactory removal for a depth of 2.6 m. It is decided to have two circular settling tanks in parallel diameter of settling tanks required (in m) is _____

52. A completely mixed process (ASP) is designed with the following data:
    $Q_0 = 1200 \, m^3$/day
    BOD after PST=200 mg/l
    Efficient BOD=25 mg/l
    $y = 0.5, k_{ER} = 0.05 \, d^{-1}$
    Mean Cell retention time= 10 days
    MLSS =3000 mg/l
    The volume of the reaction tank for given data will be:
    (A) $1820 \, m^3$
    (B) $2040 \, m^3$
    (C) $2333 \, m^3$
    (D) $2562 \, m^3$

53. At an intersection, cycle time is 65 seconds, the green time for a phase is 30 seconds and the corresponding yellow time is 5 seconds. If the saturation headway is 2.4 seconds per vehicle, the startup lost time is 3 seconds per phase and the clearance lost time is 1 second per phase, the capacity of the movement per lane will be_____veh/hr per lane. (In full digit)

54. An intersecting runway system has the following conditions:

Operation	Percentage of time	Capacity(operation/hr)
Single runway	25	70
Operation from the intersection	65	130
One operation away, one towards intersection	10	80

The peaking factor is 10%. The weighted hourly capacity of the runway wills be_____ operation/hr (in full digit)

55. The first branch of a reverse curve has a radius of 200m. If the distance between the tangent points is 110m, the radius of the second branch will be_____ m, so that, the curve can connect two parallel straight lines 18 m apart. (Up to 2 digits after decimal)