Q.P. Code :27500

[Time: 2 Hours]   [Marks:60]

Please check whether you have got the right question paper.

N.B:
1. Question number 1 is compulsory.
2. Attempt any three questions from Q.2 to Q.6.
3. Draw neat labelled diagrams wherever necessary.
4. Figures to right indicate full marks.

Q.1   Attempt **any five** from the following:-   **15**
a) What is ecological pyramid?
b) What are reasons and effects of global warming?
c) Explain the concept of 'sustainable development'.
d) Explain only working principle of photovoltaic cells.
e) Why disaster management is important?
f) Write important functions of 'State Pollution Control Board' (SPCB).
g) Write causes and effects of acid-rain.

Q.2 a) Write social and economic aspects of sustainable development.   **5**
b) What are the sources of noise pollution? Why is it bad? What measure can be taken in its prevention?   **5**
c) Draw a neat labelled diagram and explain briefly the process of generating hydropower.   **5**

Q.3 a) Briefly explain how industrial waste water treatment is carried out?   **5**
b) When environmental clearance is required to be taken? Why is it important?   **5**
c) Explain how technology can contribute for better environment and human health.   **5**

Q.4 a) What are the global environmental problems pertaining to population?   **5**
b) Write important features of 'Environmental Protection Act'.   **5**
c) Draw a suitable diagram and explain how electricity is generated from wind energy.   **5**

Q.5 a) Explain any one control measure to achieve sustainable development.   **5**
b) Draw a neat diagram of bag house filter explain its working and role in prevention of pollution.   **5**
c) Differentiate between: - Conventional and Non-conventional sources of energy.   **5**

Q.6 a) What are the reasons for depletion of minerals resources? What will be its future impact?   **5**
b) Explain how solid waste management is done by means of landfilling.   **5**
c) Explain briefly the concept of carbon credits.   **5**

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Q. P. Code: 40005

(3 Hours)

Total Marks : 80

N.B.1. Question No. 1 is Compulsory.
2. Answer any Three more questions out of the remaining Five questions.
3. Assume any suitable data wherever required but justify the same.
4. Figures to the right indicate full mark
5. Take g= 9.81m/s^2

Q1. Attempt any four.

a) Replace four like parallel forces A,B,C,D of magnitudes 5N,10N,15N,20N respectively with 2m distance between each other by i) a force –couple system at the point of application of first force A. ii) a single resultant with respect to the first force A.   [5]

b)State and prove Lami's Theorem .   [5]

c) A block weighing 200KN is placed on rough horizontal plane. A pull force of 40KN is applied at an angle 30^0 on it. If the block is just on the point of moving, find Coefficient of friction and Angle of friction.   [5]
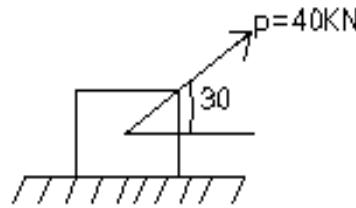

 d) A car moves in a circular path of 2m radius. At an instant its speed is increasing at the rate of 6m/s^2 and its total acceleration is 10m/s^2 . Determine the speed of car at this instant.   [5]

e) A car travelling at a speed of 60kmph is braked and comes to rest in 6 seconds after the brakes are applied. Find the minimum coefficient of friction between the wheels and the road.   [5]
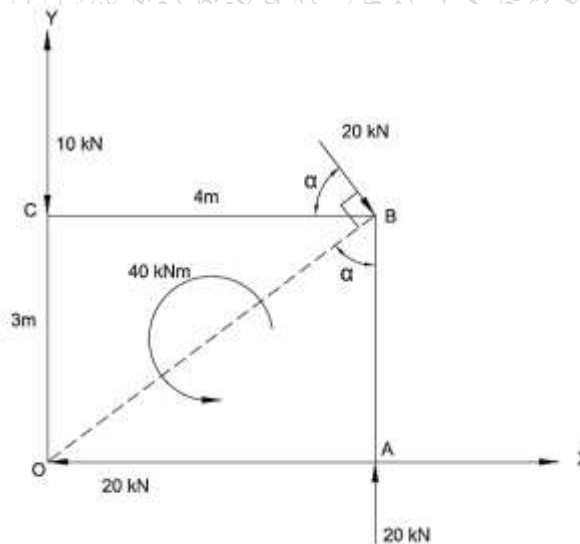
Q2a). A lever AB is hinged at C and attached to a cable at A. If the lever is subjected at B to a
400N horizontal force, determine [8]
(i) Tension in the cable AD (ii)The reaction at C.
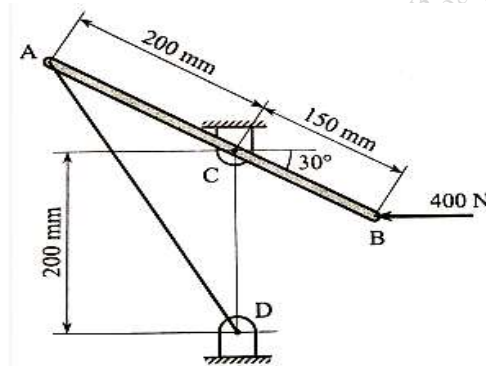
b) Find the resultant of the force system acting on a body OABC, shown in figure. Also find the
points where the resultant will cut the x and y axes. What is the distance of resultant from
point 'O' ? [6]

c) A boy throws a ball vertically downwards from a height of 1.5m. He wants to rebound it from
floor and just touch the ceiling of room which is at a height of 4m from ground. If coefficient of
restitution is 0.8. find the initial velocity with which the ball should be thrown. [6]

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Q3.a) Determine the Centroid of the shaded area. Refer Fig(a)   [8]
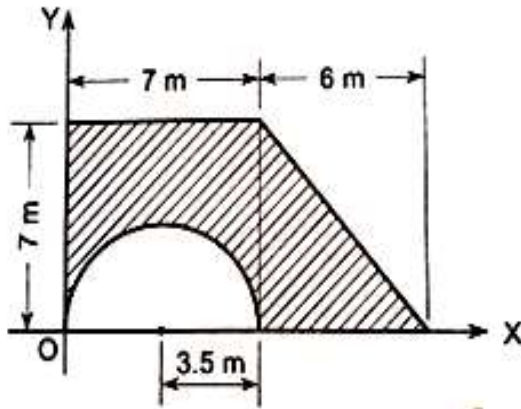
Fig(a)
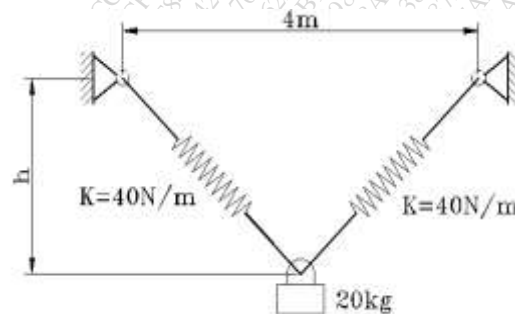
Fig(b)

b) A cylinder has mass 20 kg and is released from rest, when h= 0. Determine the speed when h= 4 m. The spring has an un-stretched length of 2 m. Refer Fig(b).   [6]

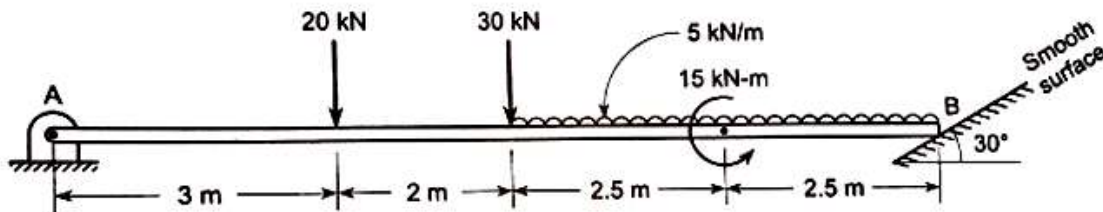c) Replace the given force system by a force couple system at point P (0,2,1).

F_1= (12i+ 16j+3k) N acts at point A (0,0,3) m.

F_2 = (7i+6j) N acts at point B(3,-2,0) and a couple with moment

M= (20k) N m.   [6]

Q4.a) Find support reactions at A and B for the beam loaded as shown in Fig(7).   [8]


b) An aeroplane is flying in a horizontal direction with a velocity of 540kmph at a height of 3000m. When it is vertically above the point A on the ground, a box is dropped from it. The box strikes the ground at a point B. Calculate the distance AB on the ground. Neglect air resistance.
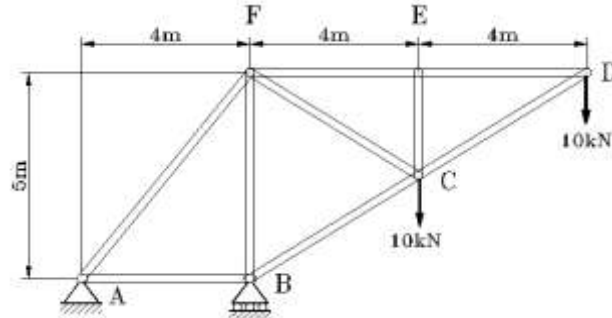
[6]

Page **3** of **5**

c) Velocity of point A on rod is 20 m/s at the instant shown in Fig(c). Locate ICR for the rod and determine velocity of point B on the rod. [6]
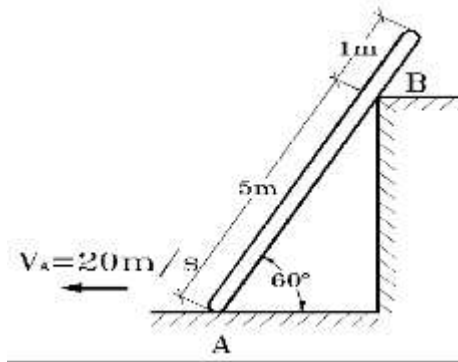

Fig(c)

Fig(d)

Q5a) For the truss shown in Fig(d), determine

    (i)Forces in members EF, CF and BC by method of sections only. [3]

    (ii)Forces in all other members by method of joints [5]

b) A motorcycle starts from rest and accelerates at $2m/s^2$ till velocity reaches 10m/s. Then it accelerates at $1m/s^2$ till velocity reaches 15m/s and continues at uniform velocity of 15m/s till it covers a total distance of 300m. Find the total time taken to cover this distance. Draw the v-t and x-t graph for this motion. [6]

c) A bar AB is hinged to wall at A. Another bar CD is connected to it by a pin at B such that CB=12cm. and BD=20cm. At the instant shown in Fig, AB is perpendicular to CD and the angular velocities of bar AB is 4rad/sec and that of CD is 6rad/sec both clockwise. Determine the linear velocities of points C and D. [Note:- bar CD is in plane motion] . [6]
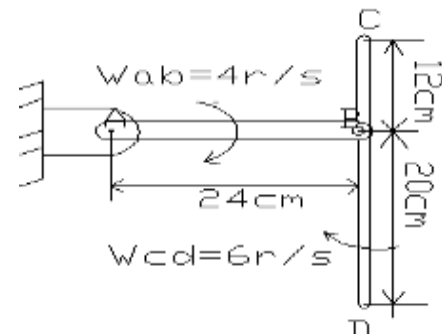
Q6 a) A uniform ladder of length 4m rests against a rough vertical wall with its lower end on a rough horizontal floor, the ladder being inclined at 50^0 to the horizontal. The coefficient of friction between the ladder and the wall is 0.3 and that between the ladder and the floor is 0.5. A man of weight 500N ascends up the ladder. What is the maximum length up along the ladder, the man will

be able to ascend before the ladder commences to slip. The weight of the ladder is 1000N.
[8]

b) Write down the conditions of equilibrium for Forces in Space for

    (i) con-current system   (ii) parallel system and   (iii) general system .   [6]

c) The velocity of a particle moving along a straight line is given by $v=2t^3 +6t^2$ where v is in m/sec and t is in seconds. Determine its acceleration and displacement at t=5sec after it starts from origin.

<div align="center">or</div>

c) Blocks A and B of mass 600kg and 1200kg respectively are connected by a string passing over a smooth pulley. Neglect mass of pulley. If coefficient of kinetic friction between the block A and the inclined surface is 0.2, determine the acceleration of block A and block B. Refer Fig.
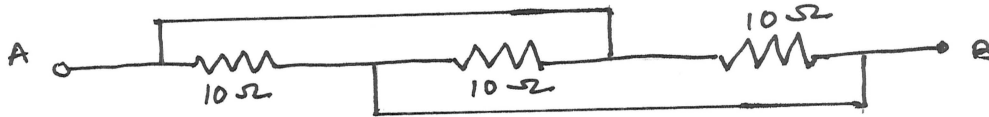
[6]

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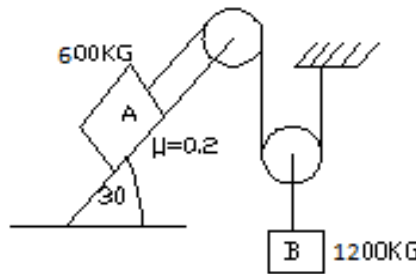
[3 Hours]

[Total Marks: 80]

Note: 1. Question No. 1 is compulsory.
       2. Attempt any three questions from remaining five.

Q. 1 a) Find R_{AB} for the following   [3]

   b) State Superposition theorem   [3]

   c) An alternating voltage is given by v = 10sin(942t) V. Determine the time taken from   [3]
       time t = 0 for the voltage to reach +6V for the first time.

   d) Given an RLC series circuit with values of R=10Ω, L=0.01H and C=100μF. Find   [3]
       the bandwidth of the circuit.

   e) Draw phasor diagram of a transformer on no-load.   [2]

   f) A 3000/200 V, 50 Hz single phase transformer has cross sectional area of the core   [4]
       is 150 cm². If the number of turns on the low voltage winding is 80, determine the
       number of turns on the high voltage winding and maximum value of flux density in
       the core

   g) Draw the input and output waveforms for a halfwave Rectifier   [2]

Q. 2 a) Find $I_{2\Omega}$ using mesh analysis   [6]
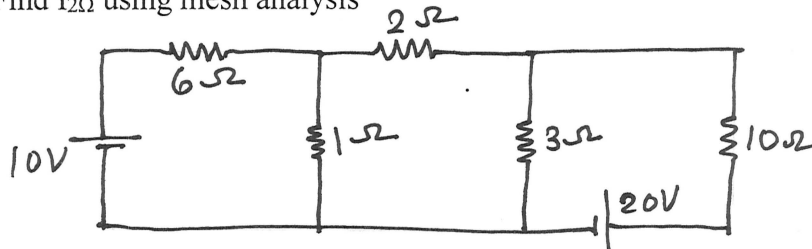
   b) The two impedances, Z_1=(6+j8) Ω and Z_2=(8-j6) Ω are connected in parallel. If the   [8]
       applied voltage to the combination is 100 V, calculate (i) current and pf of each
       branch, (ii) overall current and pf of the combination, (iii) power consumed by each
       branch

   c) A single phase transformer has a primary voltage of 230 V. No load primary current   [6]
       is 5A. No load pf is 0.25. Number of primary turns are 200 and the frequency is
       50Hz. Calculate (i) active component of the current, (ii) core loss, and
       (iii)magnetising current

Q. 3 a) Three equal impedances, each of (8+j10) Ω are connected in star across a three phase   [8]
       440V, 50 Hz supply. Calculate phase voltage, phase angle, phase current, line
       current, active power and reactive power

   b) A 50 KVA 4400/220 V transformer has R_1=3.45 Ω, R_2=0.009 Ω. The reactances   [6]
       are X_1=5.2 Ω, X_2=0.015 Ω. Calculate
       i) Full load primary and secondary currents
       ii) Equivalent resistances, reactances and the impedances referred to primary and
       secondary

   c) Explain the output characteristics of a transistor in the CE configuration.   [6]

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Q. 4 a) Determine the current supplied by the source (use star delta transformation). [7]
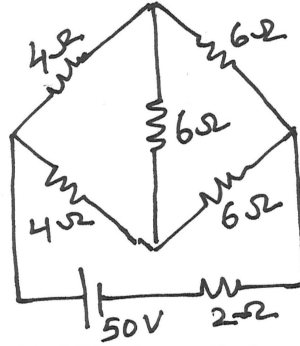
b) A voltage of 150 V, 50Hz is applied to a pure inductor of 0.2 H. Write the [5] equations for voltage and current

c) Prove that the power in delta connection is three times the power in star [4]

d) Explain the working of Full wave bridge rectifier [4]

Q. 5 a) Calculate the current through 3 Ω resistor, using Thevenin's theorem [8]
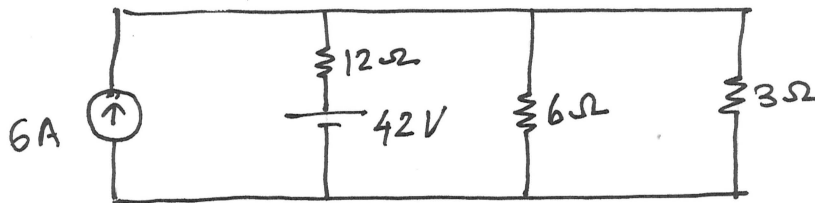
b) An alternating voltage of 80+j60 V is applied to a circuit. The resultant current is [4] 4-j2A. Calculate Z, φ, pf and average power dissipated in the circuit.

c) A 5 KVA, 1000/200V, 50 Hz single phase transformer gave the following test [8] results:
OC Test (L V side): 200V, 1.2A, 90W
SC Test (H V side): 50V, 5A, 110W·
Calculate the efficiency on (i) full load at unity power factor and
(ii) half load 0.8pf lag.

Q. 6 a) Determine the current through 4 Ω using Superposition theorem. [7]
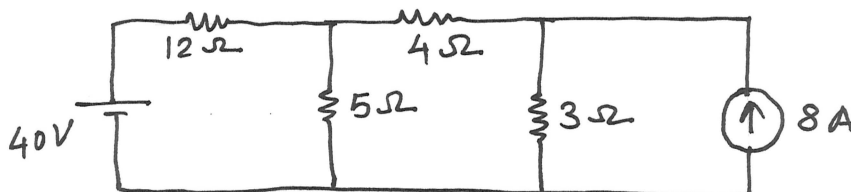
b) Explain with neat diagrams how R, X, Z, I vary with frequency in an RLC series [7] resonant circuit.

c) Two wattmeters connected to measure the power in a three phase balanced circuit [6] indicate 2000W and 500W respectively. Determine the power factor of the circuit when (i) both readings are positive, and (ii) the latter reding is obtained after reversing the connection to the current coil

(3 hours)   **Total marks:80**

N.B.: (1) Question **No. 1** is **compulsory.**
      (2) Attempt **any Three** from remaining.

Q1 a) If $\tanh x = 1/2$ then find value of x and $\sinh 2x$ [3]

    b) If $u = \log(x^2 + y^2)$ Find $\dfrac{\partial^2 u}{\partial x \partial y}$ [3]

    c) If $x = u - uv$, $y = uv - uvw$, $z = uvw$ find $\dfrac{\partial(x,y,z)}{\partial(u,v,w)}$ [3]

    d) Using Maclaurin's series , Prove $\log(1 + \sin x) = x - \dfrac{x^2}{2} + \dfrac{x^3}{6} + \cdots$ [3]

    e) Check if the matrix $A = \dfrac{1}{\sqrt{3}}\begin{bmatrix} 1 & 1+i \\ 1-i & 1 \end{bmatrix}$ is unitary   [4]

    f) Find n^{th} derivative of $\dfrac{2}{(x-1)(x-2)(x-3)}$ [4]

Q2. a) Solve $x^5 = 1 + i$ and find the continued product of the roots.   [6]

    b) Reduce the matrix $A = \begin{bmatrix} 3 & -2 & 2 \\ -1 & 1 & 3 \\ 1 & 2 & 1 \end{bmatrix}$ to the normal form   [6]
        and find its Rank

    c) State and Prove Euler's theorem for two variables hence   [8]
        find value of $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y}$ where $u = \dfrac{xy}{x+y}$

Q3 a) Investigate for what values of λ and μ the equations   [6]
        $x + y + z = 6$, $x + 2y + 3z = 10$ and $x + 2y + \lambda z = \mu$ have
        i) No solution   ii) Unique solution   iii) Infinite solutions

    b) Examine the function for its extreme values   [6]
        $f(x,y) = y^2 + 4xy + 3x^2 + x^3$

    c) If $\tan(\alpha + i\beta) = \sin(x + iy)$ then Prove $\dfrac{\tan x}{\tanh y} = \dfrac{\sin 2\alpha}{\sinh 2\beta}$ [8]

Q4 a) If $x = u\cos v$, $y = u\sin v$ then   [6]
        Prove $\dfrac{\partial(u,v)}{\partial(x,y)} \cdot \dfrac{\partial(x,y)}{\partial(u,v)} = 1$

    b) Prove that $\log\left(\dfrac{\sin(x+iy)}{\sin(x-iy)}\right) = 2i\tan^{-1}(\cot x \tanh y)$ [6]

    c) Solve by Gauss Jordan method   [8]
        $2x + 3y + 4z = 1$, $x + 5y + z = 1$, $x + y + 6z = 5$

Q5. a) Prove $\cos^6\theta - \sin^6\theta = \dfrac{1}{32}[\cos 6\theta + 15\cos 2\theta]$ [6]

    b) Evaluate $\lim\limits_{x \to 0}\left[\dfrac{x - \sin x}{x^3}\right]$ [6]

    c) If $y = \cos(m\sin^{-1}x)$ then   [8]
        prove that $(1 - x^2)y_{n+2} - (2n + 1)x\, y_{n+1} + (m^2 - n^2)y_n = 0$

67760   Page **1** of **2**

Q6 a) Check if the following vectors [6]
$X_1 = [3,1,2,1], X_2 = [4,6,2,-4], X_3 = [-6,0,-3,-4]$
$X_4 = [1,0,2,1]$ are linear dependent hence find the relation between them if any.

b) If $f\left(\frac{z}{x^3}, \frac{y}{x}\right) = 0$ then [6]

prove that $x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y} = 3z$

c) Fit a second degree parabola $y = ax^2 + bx + c$ to the following data [8]

x	1	2	3	4	5	6	7	8	9
y	2	6	7	8	10	11	11	10	9

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[Time: 2 Hours]   **[Marks: 60]**

Please check whether you have got the right question paper.

N.B: 1. Questions No 1 is compulsory.

2. Attempt any three questions from remaining five questions.

3. Figure to the right indicates full marks.

4. Atomic weights : Ca=40, C=12, O=16, H=1, Mg=24

S =32, C1=35,5, Na=23.

Q.1   Attempt **any five** from the following.   **15**

a) Differentiate between temporary and permanent hardness.

b) Define lubricant and give its functions.

c) What are plasticizer? Give its functions.

d) Define Gibbs Phase rule. State the number of phases and component in the following equation. $NH_4Cl_{(s)} \rightleftharpoons NH_{3(g)} + HCl_{(g)}$

e) What are nanomaterials? Write the applications of fullerenes.

f) What are thermoplastic polymer? Name any two thermoplastic polymer.

g) 20 ml of sewage water is refluxed with 0.1 N $K_2Cr_2O_7$ in presence of H_2SO_4 & Ag_2SO_4.The unreacted dichromate required 5ml of 0.1 N FAS solution. Blank titration consumed 15ml of 0.1 N FAS solution. Calculate COD of effluent

Q.2   a) Calculate the amount of time (90% pure) and soda (100% pure) required for softening one million liters of water containing following impurities in ppm: $CaSO_4$=136, H_2SO_4=49, $MgCl_2$=95, $MgSO_4$= 60, SiO_2= 50.   **06**

b) With the help of phase diagram explain one component system.   **05**

c) What is SWCNT and MWCNT? Explain laser method for the production of CNT.   **04**

Q.3   a) Define lubrication. Discuss the mechanism of thick film lubrication with neat diagram.   **06**

b) What is meant by fabrication of Plastic? Describe a molding method suitable for thermoplastic resins.   **05**

c) State the limitations of phase rule.   **04**

69330

Q.4   a) Give the preparation, properties and uses of **(any two)**   **06**

        (i) PMMA   (ii) Kevlar (iii) Buna-s

     b) Write a note on :   **05**

        (i) Reverse osmosis (ii) Disinfection of water by Ozone

     c) Find the acid value of a vegetable oil. whose 10ml required 4ml of 0.01 N KOH during **04**

        titration (density of oil = 0.92 gm/m1)

Q.5   a) What is cement? Name the raw materials necessary for the manufacturing of port land **06**

        cement. Draw the diagram of the rotary kiln and write the chemical reactions with

        temperature, during the burning process.

     b) Write note on :   **05**

         i) Role of polymers in medicine & surgery

         ii) Glass Transition temp

     c) An exhausted zeolite sufferer was regenerated by 150 liters of Nacl solution having a **04**

        strength of 150gm/L of Nacl. If the hardness of water is 500 ppm, calculate total

        volume of water that is softened by the softener

Q.6   a) Explain activated sludge process with the help of flow sheer diagram. And write the **06**

        main objectives of sewage treatment.

     b) What is valucnigation? Explain giving proper reaction. Write advantages of vulcanized **05**

        rubber.

     c) Define & give the significance of following properties of lubricant. **04**

        i.   Flash point & fire Point

        ii.   Cloud point & pour Point

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69330