

# NEW STANDARD ACADEMY

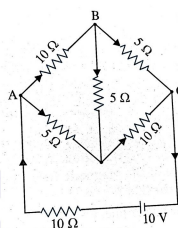
**Date : 19-05-25**

**CLASS : 12<sup>TH</sup>    JEE**

**Marks: 60**  
**Time: 3 hours.**

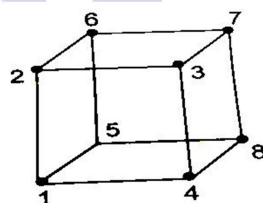
# PHYSICS

1. A parallel plate capacitor with air between the plates has a capacitance of  $8 \text{ pF}$  ( $1 \text{ pF} = 10^{-12} \text{ F}$ ). What will be the capacitance if the distance between the plates is reduced by half, and the space between them is filled with a substance of dielectric constant 6?
2. Three capacitors each of capacitance  $9 \text{ pF}$  are connected in series.
  - (a) What is the total capacitance of the combination?
  - (b) What is the potential difference across each capacitor if the combination is connected to a  $120 \text{ V}$  supply?
3. In a parallel plate capacitor with air between the plates each plate has an area of  $6 \times 10^{-3} \text{ m}^2$  and the distance of the capacitor. If this capacitor is connected to a  $100 \text{ V}$  supply, what is the charge on each plate of the capacitor?
4. A  $12 \text{ pF}$  capacitor is connected to a  $50 \text{ V}$  battery. How much electrostatic energy is stored in the capacitor?
5. The storage battery of a car has an *e.m.f.* of  $12 \text{ V}$ . If the internal resistance of the battery is  $0.4 \Omega$ , what is the maximum current that can be drawn from the battery?
6. A battery of *e.m.f.*  $10 \text{ V}$  and internal resistance  $3 \Omega$  is connected to a resistor. If the current in the circuit is  $0.5 \text{ A}$ , what is the resistance of the resistor? What is the terminal voltage of the battery when the circuit is closed?
7. At room temperature ( $27.0^\circ \text{C}$ ) the resistance of heating element is  $100 \Omega$ . What is the temperature of the element if the resistance is found to be  $117 \Omega$ , given that the temperature coefficient of the material of the resistor is  $1.70 \times 10^{-4} \text{ }^\circ \text{C}^{-1}$ .
8. A silver wire has a resistance of  $2.1 \Omega$  at  $27.5^\circ \text{C}$ , and a temperature coefficient of resistivity of silver.
9. Determine the current in each branch of the network shown in the figure below



10. Find the resistance of a wire shaped as a cube as in figure when measured between points.
- a. 1-2;                      b. 1-3

The resistance of each edge of the frame is  $12\ \Omega$



# CHEMISTRY

- For the reaction  $R \rightarrow P$ , the concentration of a reactant changes from 0.03 M to 0.02 M in 25 minutes. Calculate the average rate of reaction using units of time both in minutes and seconds.
- From the rate expression for the following reactions determine their order of reaction and the dimensions of their rate constants:
  - $3\text{NO(g)} \rightarrow \text{N}_2\text{O(g)} + \text{NO}_2$ ;  $\text{Rate} = k[\text{NO}]^2$
  - $\text{H}_2\text{O}_2(\text{aq.}) + 3\text{I}^-(\text{aq.}) + 2\text{H}^+ \rightarrow 2\text{H}_2\text{O(l)} + \text{I}_3^-$ ;  
 $\text{Rate} = k[\text{H}_2\text{O}_2][\text{I}^-]$
  - $\text{CH}_3\text{CHO(g)} \rightarrow \text{CH}_4(\text{g}) + \text{CO(g)}$ ;  
 $\text{Rate} = k[\text{CH}_3\text{CHO}]^{3/2}$
  - $\text{C}_2\text{H}_5\text{Cl(g)} \rightarrow \text{C}_2\text{H}_4(\text{g}) + \text{HCl(g)}$ ;  
 $\text{Rate} = k[\text{C}_2\text{H}_5\text{Cl}]$
- For the reaction  $2\text{A} + \text{B} \rightarrow \text{A}_2\text{B}$ ,  $\text{rate} = k[\text{A}][\text{B}]^2$  with  $K = 2.0 \times 10^{-6} \text{ mol}^{-2} \text{ L}^2 \text{ S}^{-1}$ . Calculate the initial rate of the reaction when  $[\text{A}] = 0.1 \text{ mol L}^{-1}$  and  $[\text{B}] = 0.2 \text{ mol L}^{-1}$ . Calculate the rate of reaction after  $[\text{A}]$  is reduced to  $0.006 \text{ mol L}^{-1}$ .
- A reaction is second order with respect to a reactant. How is the rate of reaction affected if the Concentration of the reactant is : (a) doubled, (b) reduced to half?

- Consider the reaction  $A + 2B \rightarrow \text{Product}$   
(a) If the concentration of A is doubled and that of B is halved, the rate of reaction is doubled.  
(b) If concentration of A is halved and that of B is doubled, the rate is halved.  
What is rate law?
- Define rate of reaction.
- What is the unit of rate of reaction?
- For the reaction,  $mA + nB \rightarrow xC + yD$  write the equivalence between different rate expressions.
- $2SO_2 + O_2 \rightarrow 2SO_3$ , the concentration of  $SO_2$  decreases by  $16 \times 10^{-3}$  moles after 8 minutes of the start of the reaction. What is the rate of disappearance  $O_2$
- What is the effect of temperature and catalyst on rate constant  $k$  of a chemical reaction?

### MATH

- Determine the value of the constant 'k' so that the function  $f(x) = \begin{cases} \frac{kx}{|x|} & \text{if } x < 0 \\ 3 & \text{if } x \geq 0 \end{cases}$  continuous at  $x = 0$ .
- For what value of  $k$  is the following function continuous at  $x = -\frac{\pi}{6}$ ?

$$f(x) = \begin{cases} \frac{\sqrt{3}\sin x + \cos x}{x + \frac{\pi}{6}}, & x \neq -\frac{\pi}{6} \\ k, & x = -\frac{\pi}{6} \end{cases}$$

- If the function  $f$  defined by  $f(x) = \begin{cases} \frac{\sin(a+1)x + \sin x}{x}, & \text{if } x < 0 \\ c, & \text{if } x = 0 \\ \frac{\sqrt{x+bx^2} - \sqrt{x}}{bx^{3/2}}, & \text{if } x > 0 \end{cases}$
- If the function  $f$  defined by  $f(x) = \begin{cases} \frac{\log(1+ax) - \log(1-bx)}{x}, & x \neq 0 \\ k, & x = 0 \end{cases}$  is continuous at  $x=0$  find the value of  $k$ .
- Let  $f: \mathbb{R} \rightarrow \mathbb{R}$  be a function given by  $f(x) = \begin{cases} \frac{1-\cos 2x}{x^2} & x < 0 \\ \alpha & x = 0 \\ \frac{\beta\sqrt{1-\cos x}}{x} & x > 0 \end{cases}$  Where  $\alpha, \beta \in \mathbb{R}$ . If  $f$  is continuous at  $x=0$  then  $\alpha^2 + \beta^2$  is
- If the function  $f(x) = \begin{cases} \frac{72^x - 9^x - 8^x + 1}{\sqrt{2} - \sqrt{1+\cos x}}, & x \neq 0 \\ a \log_e 2 \log_e 3, & x = 0 \end{cases}$  is continuous at  $x=0$  then the value of  $a^2$  is

- Examine the function  $f$  defined by  $f(x) = \begin{cases} \frac{x^2}{2}, & 0 \leq x \leq 1 \\ 2x^2 - 3x + \frac{3}{2}, & x > 1 \end{cases}$  for continuity at  $x=1$ .
- A function  $f$  is defined as  $f(x) = \begin{cases} \frac{x^2-x-6}{x-3} & x \neq 3 \\ 5 & x = 3 \end{cases}$  Show that  $f$  is continuous at  $x=3$ .
- If  $f(x) = \begin{cases} 3x-8, & x \leq 5 \\ 2k, & x > 5 \end{cases}$  find  $k$  so that  $f$  may be continuous at  $x=5$
- Discuss the continuity of the following function at  $x=0$ :  
 $f(x) = \begin{cases} \frac{x^4+2x^3+x^2}{\tan^{-1}x}, & x \neq 0 \\ 0, & x = 0 \end{cases}$