Answer 1:

The rate of a chemical reaction is defined as the change in concentration of reactants or products per unit time. It is usually expressed as the decrease in concentration of reactants or increase in concentration of products per unit time.

For a first-order reaction, the rate is proportional to the concentration of the reactant:

$Rate = -d[A]/dt = k[A]$

To derive the integrated rate equation:

$d[A]/[A] = -k\,dt$

Integrating both sides:

$\int d[A]/[A] = -k\int dt$

$\ln[A] = -kt + C$

At $t = 0$, $[A] = [A]_o$, so $C = \ln[A]_o$

Therefore, $\ln[A]_t = \ln[A]_o - kt$

This can be rearranged to: $\ln[A]_o/[A]_t = kt$

For the half-life calculation:

$t_{1/2} = 0.693/k$

$t_{1/2} = 0.693/0.0693 = 10$ minutes

Answer 2:

Faraday's laws of electrolysis:

First law: The mass of a substance deposited at an electrode during electrolysis is directly proportional to the quantity of electricity passed through the electrolyte.

$m \propto Q$ or $m = ZQ$ (where Z is the electrochemical equivalent)

Second law: When the same quantity of electricity is passed through different electrolytes, the masses of substances deposited are proportional to their chemical equivalent weights.

Answer 3:

The Lewis structure of PCl_5 shows the phosphorus atom at the center with five single bonds to chlorine atoms. Phosphorus has 5 valence electrons, and each chlorine contributes 7 valence electrons. Phosphorus uses all its 5 valence electrons to form 5 bonds with chlorine atoms.

According to VSEPR theory, the five electron pairs (all bonding pairs) around the phosphorus atom adopt a trigonal bipyramidal arrangement to minimize electron-pair repulsion. Three chlorine atoms lie in the equatorial plane at 120° angles to each other, while two chlorine atoms occupy the axial positions at 180° to each other. The axial bonds are slightly longer than the equatorial bonds due to greater repulsion. The molecular geometry of PCl_5 is trigonal bipyramidal.