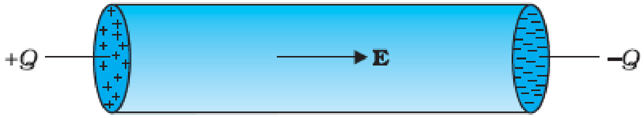
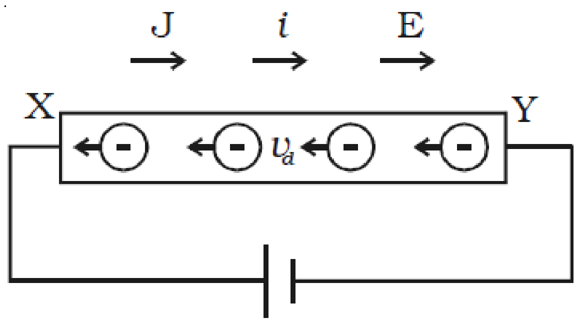
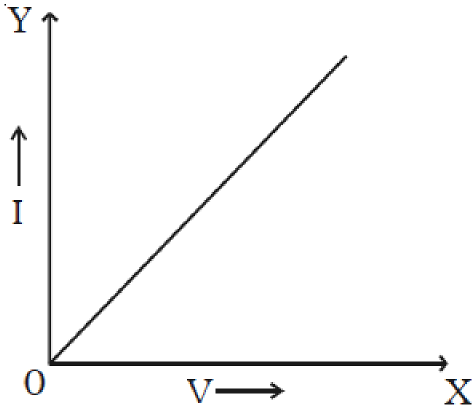
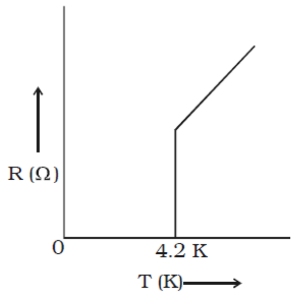
CURRENT ELECTRICITY | STD 12 | 8th September 2018

#	Concept	Graphics / Equations
1.	Electric current Unit: A = Cs^{-1} Unidirectional flow of electric charge.	$I = \frac{q}{t}$ $I(t) \equiv \lim_{\Delta t \to 0} \frac{\Delta Q}{\Delta t}$
2.	Electric current in a conductor Electrons will drift because of electric field, E.	
3.	Drift velocity and mobility XY – conductor carrying current XY connected to battery E = steady electric field is established *In absence of E, the free electrons move randomly in all possible directions. – No current. * In presence of E, the free electrons at the end Y, experience a force, **F = eE**. e=charge of electron	
4.	Drift velocity and electron mobility τ is the average time between two successive collisions a = acceleration of electrons Drift velocity - the velocity with which free electrons get drifted towards the positive terminal Unit of ionic mobility per unit electric field is given by $m^2V^{-1}s^{-1}$	$v_d = a\tau$ $F = ma$ Hence $a = \frac{eE}{m}$ $\therefore v_d = \frac{eE}{m}\tau = \mu E$ $\mu = \frac{e\tau}{m}$ is the mobility

5.	Current density, J A = area of cross section of the conductor q=ne t=time of passage of current	$\mathbf{J} = \frac{(q/t)}{A} = \frac{I}{A}$
6.	Relation between current and drift velocity v_d=drift velocity n=number of free electrons velocity = distance / time L = length of the conductor	$I = nAev_d$ The number of conduction electrons in the conductor = nAL The charge of an electron = e The total charge passing through the conductor q = (nAL) e Time in which the charges pass through the conductor, $t=L/v_d$, $I = \frac{q}{t} = \frac{(nAL)e}{(L/v_d)}$ $I = nAev_d$
7.	Current density (J) in terms of drift velocity	$\mathbf{J} = \frac{I}{A}$, $current\ density$ $\frac{I}{A} = nev_d$ $\mathbf{J} = nev_d$
8.	Ohms law	$\mathrm{V} = \mathrm{IR}$ or $\mathrm{R} = \frac{V}{I}$

	$I = nAev_d$ But $v_d = \frac{eE}{m} \cdot \tau$ $\therefore \quad I = nAe \frac{eE}{m}\tau$ $I = \frac{nAe^2}{mL}\tau V \quad \left[\because E = \frac{V}{L}\right]$ $\frac{mL}{nAe^2\tau}$ is a constant called electrical resistance (R). $I \propto V$ $I \propto V$ or $I = \frac{1}{R}V$ $V = IR$ or $R = \frac{V}{I}$	
9.	Resistance of a conductor, R (Ohm) Conductance = 1/R Unit of conductance = mho or ohm^{-1} l=length of the conductor A=area of cross section of the conductor ρ is called specific resistance or electrical resistivity of the material of the conductor.	$R \propto \frac{l}{A}$ or $R = \frac{\rho l}{A}$
10.	Conductivity Unit mho m^{-1} (Ω^{-1} m^{-1})	$\sigma = \frac{1}{\rho}$
11.	Classification of materials in terms of resistivity	• Conductors (silver, copper, aluminium, iron) – resistivity in the order of 10^{-8} • Insulators (glass, wood, quartz) (10^{10} to 10^{16}) • Semiconductors (germanium, silicon) (9.46 – 2300)

		• Superconductors
12.	Super conductivity *It is the ability of certain metals, their compounds and alloys to conduct electricity with zero resistance at very low temperature. BCS Theory *Bardeen, Cooper and Schrieffer explained this theory of super conductor. * Critical temperature – temperature at which electrical resistivity of the material drops suddenly to zero. Also called transition temperature. Changes to super conductor from normal conductor.	 (i) The electrical resistivity drops to zero. (ii) The conductivity becomes infinity (iii) The magnetic flux lines are excluded from the material.
13.	Applications of super conductors	• Super conducting generator with the smallest size and weight • Super conducting magnets to levitate trains • Super conducting magnetic propulstion to launch satellites into orbits. • High effieciency of ore separation by super magnetic separation method • Efficient transmission lines • Memory or storage elements in computers can be enhanced.