# PH108 : Electricity & Magnetism

## Weekly Quiz 2 - Continuity equation & Gauss's law

### 31 January, 2018

### *Answer*

$\frac{\partial \rho}{\partial t} + \frac{\sigma}{\epsilon_0}\rho = 0$ $[\frac{1}{2}$ **mark**$]$

$\rho(t) = \rho(0)e^{-\frac{\sigma}{\epsilon_0}t}$ $[\frac{1}{2}$ **mark**$]$

### *Solution*

$\frac{\partial \rho}{\partial t} + \nabla.\mathbf{J} = 0$

$\mathbf{J} = \sigma\mathbf{E} \Longrightarrow \nabla.\mathbf{J} = \sigma\nabla.\mathbf{E} = \frac{\sigma}{\epsilon_0}\rho$

$\Longrightarrow \frac{\partial \rho}{\partial t} + \frac{\sigma}{\epsilon_0}\rho = 0$

$\frac{d\rho}{\rho} = -\frac{\sigma}{\epsilon_0}dt$

$\Longrightarrow \rho(t) = \rho(0)e^{-\frac{\sigma}{\epsilon_0}t}$