PHYSICS

CAPACITORS AND CURRENT ELECTRICITY

51. (3)

Applying conservation of energy.

Electric potential energy of capacitor = heat absorbed

$$\frac{1}{2}CV^2 = ms\Delta t \Rightarrow V = \sqrt{\frac{2ms\Delta t}{C}}$$

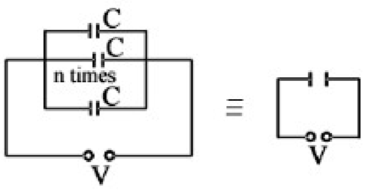
52. (2)

In parallel, equivalent capacitance of n capacitor of capacitance C, C″ = nC

Energy stored in this capacitor

$$E = \frac{1}{2}C'V^2$$

$$\Rightarrow E = \frac{1}{2}(nC)V^2 = \frac{1}{2}nCV^2$$



Alternatively

Each capacitor has a potential difference of V between the plates.

So, energy stored in each capacitor

$$= \frac{1}{2}CV^2$$

Therefore energy stored in n capacitor

$$= \left[\frac{1}{2}CV^2\right] \times n$$

53. (1)

Capacitance of spherical conductor

$= 4\pi E_0 R$

Here, R is radius of conductor

$$\therefore C = 4\pi\varepsilon_0 R = \frac{1}{9\times10^9}\times1 = 1.1\times10^{-10}\ F$$

54. (4)

From colour code for electric resistance

Violet	Green	Red	Gold
7	5	2	5%

$\therefore R = 75 \times 10^2 \pm 5\%$ of 7500

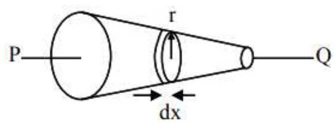
$\Rightarrow R = (7500 \pm 375)\Omega$

55. (1)

Resistance of element of conductor,

$$dR = \frac{\rho dx}{\pi r^2}$$

$$dV = idR = \frac{i\rho dx}{\pi r^2}$$



$$E = \frac{dV}{dx} = \frac{i\rho}{\pi r^2}$$

Drift velocity, $V_d = \frac{eE}{m}$

As, $V_d \propto E$ and $E \propto \frac{1}{r^2}$

56. (2)

Given, $i = \alpha_0 t + \beta t^2$. Put $\alpha_0 = 20$ and $\beta = 8$

We get $i = 20t + 8t^2$

Current, $i = \frac{dq}{dt} \Rightarrow \int dq = \int idt$

$$\Rightarrow q = \int_0^{15}(20t + 8t^2)dt$$

$$\Rightarrow q = \left(\frac{20t^2}{2} + \frac{8t^3}{3}\right)_0^{15}$$

$$\Rightarrow q = 20\times\left(\frac{15^2 - 0^2}{2}\right) + \frac{8}{3}(15^3 - 0^3)$$

$$\Rightarrow q = 10\times(15)^2 + \frac{8(15)^3}{3}$$

$$\Rightarrow q = 2250 + 9000 = 11250\ C$$

57. (1)

Clearly, from graph

Current, $I = \frac{dq}{dt} = 0$ at $t = 4\ s$

[Since q is constant]

58. (3)

Resistance, $R = \frac{\rho l}{A}$

$R = \rho \frac{l}{A} \times \frac{l}{l} = \frac{\rho l^2}{V}$ [>> volume (V) = A >>]

Since resistivity and volume remains constant therefore %charge in resistance

$\frac{\Delta R}{R} = \frac{2\Delta l}{l} = 2 \times (0.5) = 1\%$

59. (3)

Resistance of wire $(R) = \rho \frac{l}{A}$

If wire is bent in the middle then $l' = \frac{l}{2}$, $A' = 2A$

Therefore new resistance,

$R' = \rho \frac{l'}{A'} = \frac{\rho \frac{l}{2}}{2A} = \frac{\rho l}{4A} = \frac{R}{4}$

60. (4)

Resistance of a metal conductor at temperature t °C is given by

$R_t = R_0 (1 + \alpha t)$

R_0 is the resistance of the wire at 0 °C and α is the temperature coefficient of resistance

Resistance at 50 °C,

$R_{50} = R_0 (1 + 50\alpha)$ … (i)

Resistance of 100 °C,

$R_{100} - R_0 (1 + 100\alpha)$ … (ii)

From (i), we get

$R_{50} - R_0 = 50\alpha R_0$ … (iii)

From (ii), we get

$R_{100} - R_0 = 100\alpha R_0$ … (iv)

Dividing (iii) by (iv), we get

$\frac{R_{50} - R_0}{R_{100} - R_0} = \frac{1}{2}$

Here, $R_{50} = 5\ \Omega$ and $R_{100} = 6\ \Omega$

$\therefore \frac{5 - R_0}{6 - R_0} = \frac{1}{2}$

or $6 - R_0 = 10 - 2R_0$ or $R_0 = 4\ \Omega$