

Chapter 15

Electrostatic Potential and Capacitance

1. Answer (3)

$$Q = 100e = -100 \times 1.6 \times 10^{-19} = -1.6 \times 10^{-17} \text{ C}$$

$$\Delta V = -14 \text{ V}$$

$$\therefore W = Q\Delta V = 14 \times 1.6 \times 10^{-17} = 2.24 \times 10^{-16} \text{ J}$$

2. Answer (1)

$W_s = -q(V_f - V_i)$ It depends on initial and final point only, because electrostatic field is a conservative field.

3. Answer (4)

$$U = \frac{q^2}{2C} = \frac{(q_0)^2}{2C} e^{-2t/RC} = U_0 e^{-2t/RC}$$

$$q = q_0 e^{-t/RC}$$

When charge becomes $\frac{1}{4}$ times, energy becomes

$$\frac{1}{16} \text{ times.}$$

So, $t_1 = \text{one half life}$, while $t_2 = 4 \text{ half lives}$

4. Answer (2)

5. Answer (2)

For this, charge must be same $Q = C_1 V_1 = C_2 V_2$

$$\Rightarrow 120C_1 = 200C_2$$

$$\Rightarrow 3C_1 = 5C_2$$

6. Answer (4)

$$V = \int \frac{k dq}{L-x}$$

$$V = \frac{kQ}{L} \int_0^L \frac{dL}{L-x} = \frac{kQ}{L} \ln 2$$

$$V = \frac{Q}{4\pi\epsilon_0 L} \ln 2$$

7. Answer (3)

$$dV = -E \cdot dx$$

$$\int_{V_0}^{V_f} dV = - \int_0^2 30x^2 dx$$

$$V_A - V_O = -[10x^3]_0^2 = -80 \text{ J}$$

8. Answer (1)

$$E = \frac{\sigma}{K\epsilon_0}$$

$$\sigma = K\epsilon_0 E$$

$$= 2.2 \times 8.85 \times 10^{-12} \times 3 \times 10^4 = 6 \times 10^{-7} \text{ C/m}^2$$

9. Answer (3, 4)

$$V_0 = k \frac{Q}{R} \quad \dots (1)$$

$$V_1 = \frac{kQ}{2R^2} (3R^2 - r^2)$$

$$V = \frac{3}{2} V_0 \Rightarrow R_1 = 0$$

$$\frac{5}{4} \frac{kQ}{R} = kQ \frac{(3R^2 - r^2)}{2R^2}$$

$$\Rightarrow R_2 = \frac{R}{\sqrt{2}}$$

$$\frac{3}{4} \frac{kQ}{R} = \frac{kQ}{R^2}$$

$$\Rightarrow R_3 = \frac{4R}{3}$$

$$\frac{1}{4} \frac{kQ}{R} = \frac{kQ}{R_4}$$

$$\Rightarrow R_4 = 4R \Rightarrow R_4 > 2R$$

Answers For Chapter 15 Electrostatic Conceptual

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