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Conceptual Questions:

12th Ch#11

2. If a point charge q of mass m is released in a non-uniform electric field with field lines pointing in the same direction, will it make a rectilinear motion?

(a) If a point charge q of mass m is placed at any point in a non-uniform field of a positive point charge, it will follow straight or rectilinear path along the field line due to repulsive force.

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3. What is the relationship between potential difference and electric potential energy?

Potential Difference (V): Potential difference between two points is the work done in moving a unit positive charge from one point to another keeping the charge in electrostatic equilibrium.

$$\Delta V = \frac{\Delta W}{q} = \frac{\Delta U}{q}$$

Electric potential energy (U): The energy which a charge possess due to its position in electric field is called electric potential energy.

$$\Delta U = q\Delta V$$

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5. How can electric potential be high when the electric potential energy is relatively low?

Consider moving a negative charge. If the electric potential energy of the negative charge increases (for example by moving it towards another negative charge which requires work) its electric potential would actually decrease. That's because th

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6. Can the potential of a non-uniformly charged sphere be the same as that of a point charge?

The electric potential due to non-uniformly charged sphere is same as that the electric potential due to point charge.

As

$$E = \frac{V}{d} \;\&\; E = \frac{\sigma}{\varepsilon_o}$$

$$\frac{V}{d} = \frac{\sigma}{\varepsilon_o} \quad \rightarrow \quad V = \frac{\sigma}{\varepsilon_o} d$$

$$V \propto \sigma$$

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7. Will the energy stored in three capacitors be greater when they are connected in series or in parallel?

If number of capacitors are connected in parallel, all get same voltage, each one has energy storage as per its value, and net energy storage is sum of all the individual energy storages.

If all these capacitors are in series, each capacitor will have voltage depending upon overall capacitor value distribution and individual voltages decided by these values.
So for the same voltage, parallel connected capacitors store much more energy in comparison.

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9. Water has a large dielectric constant, but it is rarely used in capacitors. Why?

The water molecule is a polar molecule having large value of relative permittivity $\varepsilon_r = 80$.
If the water is used as dielectric between the plates of capacitor, then at certain voltage between the plates of the capacitor, the water molecules due to polar properties will have a large value of conduction. This large value of conduction causes dielectric breakdown which destroys the dielectric.
Hence water cannot be used as dielectric between the plates of the capacitor.

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