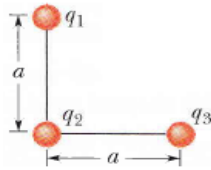


Q1.

In **Figure 1**, three positively charged particles form a right angle triangle with two equal sides $a = 50$ cm. The charges are $q_1 = q_3 = 2Q$ and $q_2 = Q$. Find the value of the charge q_2 if the magnitude of the net electrostatic force on it is 0.23 N.

Fig#



- A) $1.5 \mu\text{C}$
 B) $1.8 \mu\text{C}$
 C) $1.3 \mu\text{C}$
 D) $2.4 \mu\text{C}$
 E) $2.1 \mu\text{C}$

Q2.

Figure 2 shows three pairs of identical small conducting spheres that are to be touched together and then separated. The initial charges on them are indicated in the figure (e is the elementary charge and has the value 1.6×10^{-19} C). Rank the pairs according to the magnitude of the charges transferred during touching.

Fig#



- A) 3, 1, 2
 B) 1, 2, 3
 C) 3, 2, 1
 D) 1, 3, 2
 E) all tie

Q3.

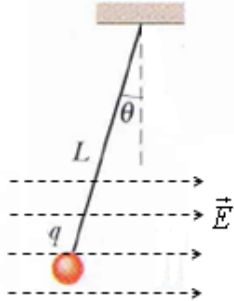
Consider an object having a charge Q . Charge q is removed from it and is placed on a second initially uncharged object. The two objects are placed 1.0 m apart. What should be the value of q such that the force between the two objects is maximum?:

- A) $Q/2$
 B) $2Q$
 C) Q
 D) $Q/4$
 E) 0

Q4.

A small charged sphere of mass 0.40 g is suspended by a light string ($L = 24$ cm) in a uniform electric field directed along the positive x direction as shown in **Figure 3**. The sphere has a charge of $q = -90$ nC. The charge is in equilibrium at an angle $\theta = 33^\circ$. Find the magnitude of the electric field to achieve equilibrium.

Fig#



- A) 28 kN/C
- B) 67 kN/C
- C) 51 kN/C
- D) 31 kN/C
- E) 25 kN/C

Q5.

A proton is moving to the right with a constant velocity of 4.5×10^5 m/s. Find its velocity $3.0 \mu\text{s}$ after entering a uniform electric field of 1100 N/C directed to the left. Ignore gravity.

- A) 1.3×10^5 m/s to the right
- B) 9.6×10^5 m/s to the right
- C) 7.7×10^5 m/s to the right
- D) 9.6×10^5 m/s to the left
- E) 7.7×10^5 m/s to the left

Q6.

A $40 \mu\text{C}$ charge is positioned on the x -axis at $x = +4.0$ cm. Where on this axis should a $-60 \mu\text{C}$ charge be placed in order to produce a zero net electric field at the origin?

- A) +4.9 cm
- B) +3.1 cm
- C) -4.9 cm
- D) -3.1 cm
- E) +6.0 cm

Q7.

The dipole moment of a dipole in a 200 N/C electric field is initially perpendicular to the field, but it rotates so it is in the same direction as the field. Find the work done by the field if the dipole moment has a magnitude of 2×10^{-8} C·m.

- A) $4 \mu\text{J}$
- B) $-8 \mu\text{J}$
- C) $-4 \mu\text{J}$
- D) $8 \mu\text{J}$
- E) 0

Q8.

Consider a spherical shell of radius R and charge Q distributed uniformly on its surface. Find the radial distance where the electric field due to the shell is half its maximum value.

- A) $\sqrt{2} R$
- B) $2 R$
- C) $\frac{R}{2}$
- D) $\frac{R}{\sqrt{2}}$
- E) $3 R$

Q9.

The flux (in $\text{N}\cdot\text{m}^2/\text{C}$) of the electric field $\vec{E} = (24 \text{ N/C})\hat{i} + (30 \text{ N/C})\hat{j} + (16 \text{ N/C})\hat{k}$ through a 1.5 m^2 portion of the yz plane is:

- A) 36
- B) 45
- C) 24
- D) 62
- E) 57

Q10.

The electric field just outside the surface of a hollow conducting sphere of radius 20 cm is 500 N/C and directed radially outward. An unknown charge Q is placed at the center of the sphere and it is noted that the electric field at the same location is still directed radially outward, but has decreased to 100 N/C. What is the magnitude of the charge Q ?

- A) 1.8 nC
- B) 5.1 nC
- C) 2.7 nC
- D) 1.1 nC
- E) 3.3 nC

Q11.

A point charge of 10.0 nC is placed at the center of a hollow spherical conductor of inner radius 5.00 cm and outer radius 6.00 cm. The spherical conductor has a net charge of -5.00 nC . Determine the surface charge density on the inner surface of the conductor.

- A) -318 nC/m^2
 - B) $+318 \text{ nC/m}^2$
 - C) -159 nC/m^2
 - D) $+159 \text{ nC/m}^2$
 - E) $+450 \text{ nC/m}^2$
-

Q12.

Calculate the electrostatic potential energy between a proton and an electron in a hydrogen atom of radius 52.9 pm ($1 \text{ m} = 1 \times 10^{12} \text{ pm}$). Assume the electrostatic potential energy between the proton and electron is zero at infinite separation. Express your answer in electron-volts (eV).

- A) -27.2
 - B) $+9.71$
 - C) -12.9
 - D) $+5.15$
 - E) -13.5
-

Q13.

Consider two points in an electric field. The potentials at point P_1 is $V_1 = -0.24 \text{ kV}$, and at point P_2 is $V_2 = +0.36 \text{ kV}$. How much work is done by an external force in moving a charge $q = -8.0 \text{ } \mu\text{C}$ from P_2 to P_1 ?

- A) 4.8 mJ
 - B) 7.5 mJ
 - C) 1.5 mJ
 - D) 1.0 mJ
 - E) 2.4 mJ
-

Q14.

The electric potential in a certain region is given by $V = 4xz - 5y + 3z^2$, where x , y , and z are in meters, and V is in volts. Find the magnitude of the electric field at the point $(+2 \text{ m}, -1 \text{ m}, +3 \text{ m})$.

- A) 29 V/m
 - B) 47 V/m
 - C) 125 V/m
 - D) 25 V/m
 - E) 12 V/m
-

Q15.

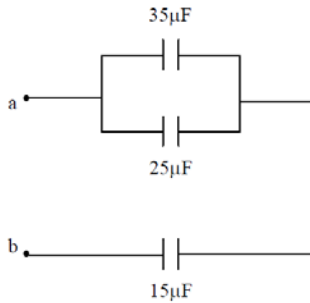
A proton of kinetic energy $4.8 \times 10^6 \text{ eV}$ travels head-on toward a lead nucleus (with 82 protons). Assuming that the proton does not penetrate the nucleus and that the only force between the proton and the nucleus is Coulomb force, calculate the smallest separation between the proton and the nucleus when the proton comes momentarily to rest.

- A) 2.5×10^{-14} m
 B) 3.4×10^{-14} m
 C) 5.3×10^{-14} m
 D) 1.2×10^{-14} m
 E) 6.7×10^{-14} m

Q16.

If V_{ab} is equal to 100 V, find the charge stored and the potential difference across the $35 \mu\text{F}$ capacitor shown in **Figure 4**.

Fig#



- A) $700 \mu\text{C}$ and 20 V .
 B) $250 \mu\text{C}$ and 10 V .
 C) $600 \mu\text{C}$ and 10 V .
 D) $600 \mu\text{C}$ and 20 V .
 E) $250 \mu\text{C}$ and 40 V .

Q17.

Two capacitors, $C_1 = 16 \mu\text{F}$ and $C_2 = 4.0 \mu\text{F}$ are connected in parallel and charged with a 50 V power supply. What potential difference would be required across the same capacitors connected in series so that the combination stores the same energy as when connected in parallel?

- A) 125 V
 B) 600 V
 C) 100 V
 D) 175 V
 E) 160 V .

Q18.

Which of the following statements is TRUE?

- A) The capacitance depends on the geometry of the capacitor.
 B) The capacitance does not depend on the material separating the charged conductors.
 C) The energy stored in a capacitor does not change by changing its potential.
 D) Capacitors do not store energy.
 E) The capacitance of a capacitor doubles when the voltage across it is doubled.

Q19.

An electric device heats water by immersing a resistance wire in the water. It generates 300 J of heat per second when an electric potential difference of 12 V is applied across its ends. What is the resistance of the heater wire?

- A) 0.48 Ω
- B) 0.81 Ω
- C) 0.58 Ω
- D) 0.94 Ω
- E) 2.1 Ω

Q20.

A cylindrical wire of radius $R = 2.0$ mm has a uniform current density $J = 2.0 \times 10^5$ A/m². What is the current through the portion of the wire between radial distances $R/3$ and $R/2$?

- A) 0.35 A.
 - B) 3.7 A.
 - C) 1.9 A.
 - D) 5.3 A.
 - E) 9.1 A.
-