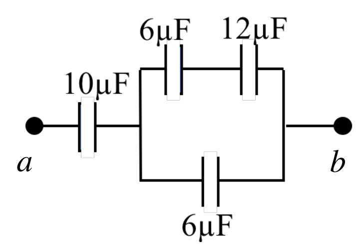
Closed book. No work needs to be shown for multiple-choice questions.

1. Two charges $+Q$ and $-Q$ are separated by a distance d. What is the electric potential at the point exactly in the middle between these two charges?

a. $+4k_eQ/d$
b. $+2k_eQ/d$
c. $+k_eQ/d$
d. $-2k_eQ/d$
e. zero.

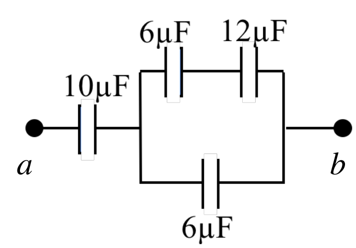
2. Four capacitors are connected as shown below. What is the equivalent capacitance of the combination between points a and b?

a. 12 μF.
b. 5.0 μF.
c. 20 μF.
d. 15 μF.
e. 34 μF.



3. Four capacitors are connected as shown below. If a difference of potential of 18 V is applied between points a and b, what is the potential difference and the charge in the 12 μF capacitor?

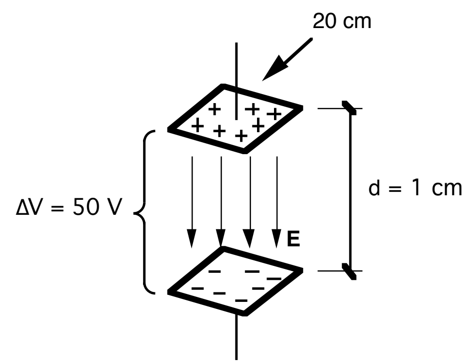
a. 18 V and 54 μC.
b. 3 V and 54 μC.
c. 6 V and 36 μC.
d. 3 V and 36 μC.
e. 6 V and 90 μC.



4. Two capacitors with capacitances of 3.0 μF and 6.0 μF, respectively, are connected in series. The system is connected to a 90 V battery. What electrical potential energy is stored in the 3.0 μF capacitor?

a. 0.18×10^{-3} J
b. 5.4×10^{-3} J
c. 8.1×10^{-3} J
d. 2.7×10^{-3} J
e. 10.8×10^{-3} J

5. A parallel plate capacitor is made from two square plates, 20 cm on a side. The plates are spaced 1.0 cm apart and connected to a 50 V battery. How much energy is stored in the capacitor?



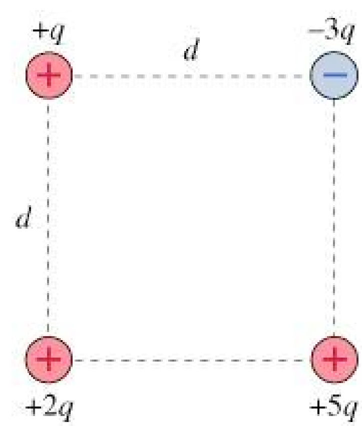
a. 8.9×10^{-8} J.
b. 2.2×10^{-7} J.
c. 3.5×10^{-11} J.
d. 8.9×10^{-10} J.
e. 4.4×10^{-8} J.

6. If an electron is accelerated from rest through a potential difference of 4,800 V, find its approximate velocity at the end of this process.

a. 2.0×10^{7} m/s.
b. 2.8×10^{7} m/s.
c. 4.2×10^{7} m/s.
d. 5.6×10^{7} m/s.
e. 4.6×10^{8} m/s.

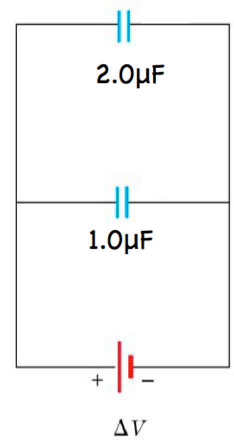
7. If the value of the charge q is 10 nC, what is the potential created by the charges +q, +2q and +5q at the point exactly where the charge -3q is located? Use d= 2m.

a. 167 V.
b. 180 V.
c. 225 V.
d. 333 V.
e. 360 V.



8. A 2.0 μF and a 1.0 μF capacitor are connected in parallel and a potential difference, ΔV, is applied across the combination. The 2.0 μF capacitor has:

a. twice the charge of the 1.0 μF capacitor.
b. half the charge of the 1.0 μF capacitor.
c. twice the potential difference of the 1.0 μF capacitor.
d. half the potential difference of the 1.0 μF capacitor.
e. none of the above.



Recall that

$$F = k_e \frac{|q_1||q_2|}{r^2};\ k_e = 8.99 \times 10^9\ \frac{\mathrm{N \cdot m^2}}{\mathrm{C^2}};\ e = 1.60 \times 10^{-19}\mathrm{C};\ \varepsilon_o = 8.85 \times 10^{-12}\ \frac{\mathrm{C^2}}{\mathrm{N \cdot m^2}}$$

$$m_e = 9.11 \times 10^{-31}\mathrm{kg};$$

$$\vec{\mathbf{F}} = q_o \vec{\mathbf{E}};\ E = k_e \frac{|q|}{r^2};\ \Phi_E = EA\cos\theta;\ \Phi_E = \frac{Q_{inside}}{\varepsilon_0};\ PE_{elec,\mathrm{point}} = k_e \frac{qq_0}{r};\ V_{point\ charge} = k_e \frac{q}{r};$$

$$\Delta PE_{elec} = q_0 \Delta V;\ C = \frac{Q}{\Delta V};\ C_{parllel\ plate} = \varepsilon_0 \frac{A}{d};\ C_{dielectric} = \kappa\varepsilon_0 \frac{A}{d};\ \frac{1}{C_{series\ eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots;$$

$$C_{parallel\ eq} = C_1 + C_2 + C_3 + \ldots;\ Energy_{capacitor} = \frac{1}{2}Q(\Delta V) = \frac{1}{2}C(\Delta V)^2 = \frac{Q^2}{2C};$$