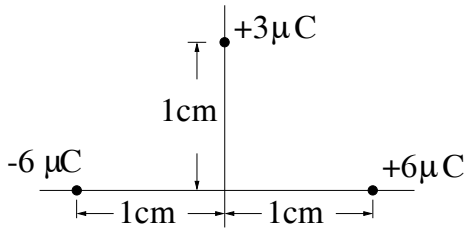
1. A charge of -3.0 nC lies on the x-axis at $x = +6$ cm, and another equal charge of -3.0 nC is at $x = -6$ cm. The magnitude of the electric field at the origin is

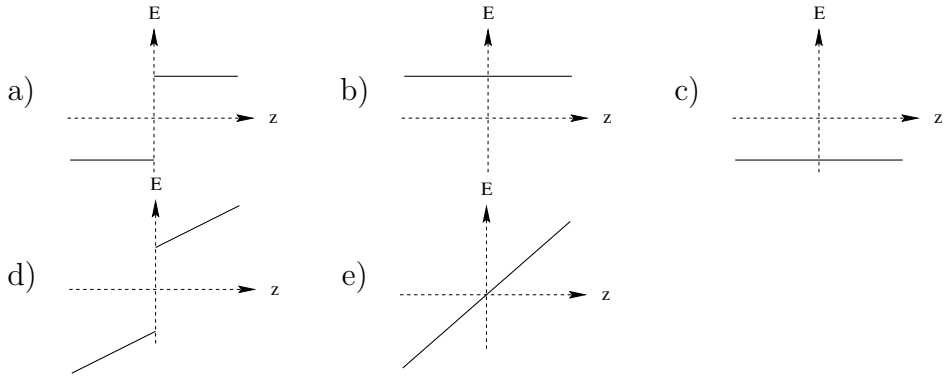
   a) Zero
   b) 7500 N/C
   c) 15000 N/C
   d) 450 N/C
   e) 900 N/C

2. A charge of $+6.00\,\mu$C is placed at $(x, y) = (+1.00\,\text{cm}, 0)$, and a charge of $-6.00\,\mu$C is placed at $(x, y) = (-1.00\,\text{cm}, 0)$. What is the magnitude and direction of the force on a charge of $+3.00\mu$C located at (x,y) = (0,+1.00 cm)?

   a) $-1620\hat{\imath}$ N
   b) $+1146\hat{\imath}$ N
   c) $+1620\hat{\imath}$ N
   d) $-573\hat{\imath}$ N
   e) $-1146\hat{\imath}$ N

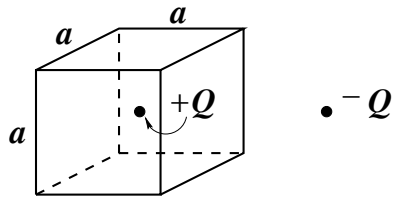


3. In an xyz-coordinate system, a plane of infinite extent with uniform surface charge density $+\sigma$ lies in the xy-plane (z=0). Which graph best represents the z-component of the electric field E *vs.* z along the z-axis?



4. Two point charges $+Q$ and $-Q$ are located as shown in the diagram. The cube surrounding the charge $+Q$ has sides a. The total electric field flux through the surface of the cube is

   a) zero
   b) Q/ϵ_0
   c) $-Q/\epsilon_0$
   d) $2Q/\epsilon_0$
   e) $Q/6a\epsilon_0$



5. Consider two concentric spherical surfaces, one of radius 0.10m with a total charge of $+20\mu$C and the other of radius 0.20m with a total charge of -30μC. The charge on each surface is distributed uniformly. What is the electric field 0.30m from their common center?

   a) $(1 \times 10^6)\ \hat{\mathbf{r}}$ N/C
   b) $(-1 \times 10^6)\ \hat{\mathbf{r}}$ N/C
   c) $(-5.0 \times 10^6)\ \hat{\mathbf{r}}$ N/C
   d) $(2.0 \times 10^6)\ \hat{\mathbf{r}}$ N/C
   e) $(-3.0 \times 10^6)\ \hat{\mathbf{r}}$ N/C

6. A metal sphere centered at the origin has a radius R and a net charge Q. The electric field at the point $x = 5R$ is E_0. The sphere is replaced by a different metal sphere centered at the origin with radius $2R$ and a net charge Q'. The field at $x = 5R$ is still E_0. Therefore, we can deduce:

   a) $Q' = \frac{1}{2}Q$ b) $Q' = 2Q$ c) $Q' = 4Q$
   d) $Q' = \frac{1}{4}Q$ e) $Q' = Q$

7. Consider a conductor in electrostatic equilibrium. Which of the following statements is **false**?

   a) Any net charge on the conductor must reside on the surface.
   b) The electric field at the surface cannot have a component parallel to the surface
   c) No work is done by the electric field in moving a charge on the surface.
   d) The conductor cannot be given a net charge.
   e) The electric potential must be constant inside the conductor.

8. Two large parallel conducting plates are 10 cm apart and carry equal but opposite charges on their facing surfaces. An electron placed midway between the two plates experiences a force of 1.6×10^{-15} N. The potential difference between the plates is

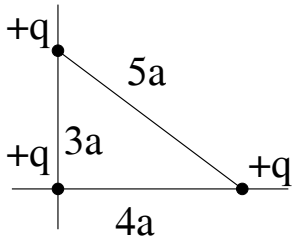
   a) 10,000 V
   b) 100 V
   c) 1000 V
   d) 100,000 V
   e) 1100 V

9. An ion of charge +3e is accelerated from rest through a potential difference of 90V. It then acquires a kinetic energy (in electron volts) of

   a) 4.32×10^{-17} eV
   b) 90 eV
   c) 270 eV
   d) 3 eV
   e) 30 eV

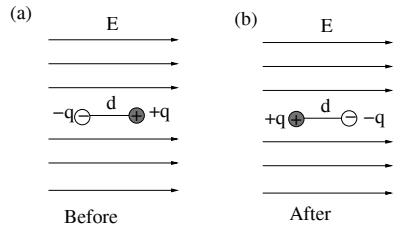
10. Three identical charges are initially at rest infinitely far apart. How much work is required to put the three charges together at rest as shown in the figure?

    a) $0.78kq^2/a$
    b) $0.20kq^2/a$
    c) $0.45kq^2/a$
    d) $1.6kq^2/a$
    e) $2.4kq^2/a$



11. A dipole consists of a charge q and a charge $-q$ separated by a distance d. Suppose the dipole moment is in a field E, with the dipole moment pointing in the direction of the field ((a) in the figure). If the dipole is flipped around to point in the direction opposite to the field ((b) in the figure), by how much does its potential energy change?

    a) +2qdE
    b) +4qdE
    c) -2qdE
    d) -4qdE
    e) 0.



12. Two $+10\mu$C charges are placed at (x,y)=(0.00 m, 0.05 m) and (x,y)=(0.00 m, –0.05 m). What is the electric potential at (x,y)=(0.1 m,0.0 m)?

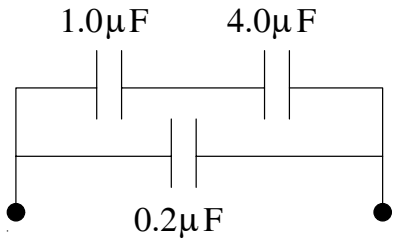
    a) 0 V
    b) -1.6×10^6 V
    c) 1.6×10^6 V
    d) 1.6×10^4 V
    e) -1.6×10^4 V

13. A parallel plate capacitor is charged by transferring a charge of +2.0 C from one plate to the other. If the resulting voltage between the plates is 4.0 V, the capacitance is

a) 0.5 F
b) 2.0 F
c) 8.0 F
d) 1.0 F
e) not enough information is given

14. The equivalent capacitance of the three capacitors is

a) 0.16μF
b) 0.19μF
c) 1.00μF
d) 5.20μF
e) 6.25μF



15. A parallel plate capacitor has two plates of area $4.0m^2$, separated by a distance $d = 2.0cm$. If voltage of $10kV$ is applied across the plates, how much energy is stored in the capacitor?

a) 88.5J b) 11.1J c) 88.5×10^{-6} J d) 177J
e) 0.0885J