1. Determine the angle between **A** = 3.00**i** + 1.00**j** +0**k** and the **B** = -3.00**i** +3.00**j** + 0**k**.

A) 26.6°
B) 30.0°
C) 88.1°
D) 117°
E) 45.2°

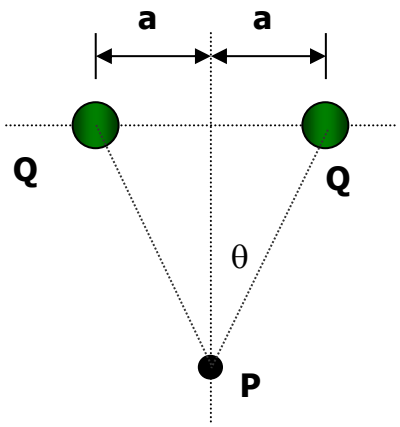
2. A dust particle has a mass of 0.07 grams and a negative charge of 90 nC. What electric field magnitude and direction are needed to exactly balance the weight of the particle so that its acceleration is zero? ($g = 9.8\ m/s^2$)

A) 7600 N/C up
B) 7600 N/C down
C) 7.8 X 10^4 N/C down
D) 3900 N/C up
E) 3900 N/C down

3. A pair of equal negative charges is located on the horizontal axis, as shown in the figure. The angle θ = 30 degrees. Find the direction of the net electric field at point **P** on the negative y axis:

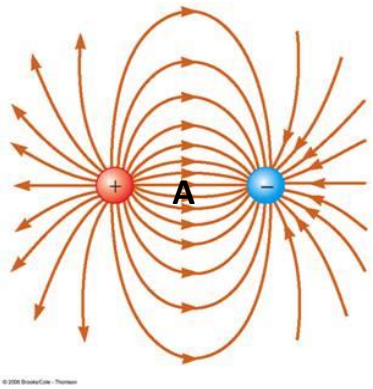
A) ↓
B) ↑
C) →
D) ←

E) The electric field is zero at point P.



4. The sketch at right shows the field of an electric dipole, consisting of opposite charges whose magnitude is 15 nC located a distance 6 cm apart. What is the field magnitude and direction at point A, equidistant from each of the charges.

A) zero
B) 1.35×10^6 N/C to the left
C) 1.35×10^6 N/C to the right
D) 3.00×10^5 N/C to the right
E) 6.75×10^5 N/C to the left

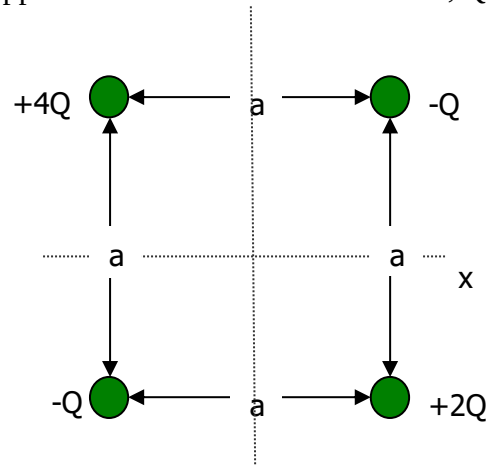


5. The electrostatic force between two negatively charged cubes, 10 cm. on each side, with Q1= -7 μC and Q2= -4 μC is:

A) Attractive. The force on cube 1 is twice as large as the force on cube 2.
B) Attractive. The force on cube 1 is equal to the force on cube 2.
C) Zero.
D) Repulsive. The force on cube 1 is twice as large as the force on cube 2.
E) Repulsive. The force on cube 1 is equal to the force on cube 2.

6. For the square configuration, find the magnitude of the electric field in the center of the square. Use the following numbers for approximate calculations: a= 2 cm., Q=5 μC, $k_e = 9 \times 10^9\ Nm^2/C^2$.

A) 0 N/C
B) 9.0×10^7 N/C
C) 4.5×10^8 N/C
D) 7.0×10^7 N/C
E) 2.9×10^7 N/C



7. Two very long uniform lines of charge are parallel and are separated by 0.390 m. Each line of charge has charge per unit length +5.20 μC/m. What magnitude of force does one line of charge exert on a 0.0500 m section of the other line of charge?

A) 8.54×10^{-2}N
B) 3.67×10^{-3}N
C) 4.12×10^{-3}N
D) 1.56×10^{-4}N
E) 6.23×10^{-2}N

8. A very long uniform line of charge has charge per unit length $\lambda_1 = 4.78$ μC/m and lies along the x-axis. A second-long uniform line of charge has charge per unit length $\lambda_2 = -2.46$ μC/m and is parallel to the x-axis at $y_1 = 0.400$ m. What is the magnitude of the net electric field at point $y_2 = 0.200$ m on the y-axis?

A) 1.32×10^{2} N/C
B) 6.51×10^{5} N/C
C) 5.78×10^{5} N/C
D) 9.57×10^{3} N/C
E) 4.69×10^{6} N/C

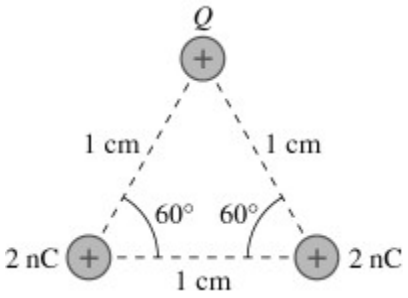
9. The electric field 0.420 m from a very long uniform line of charge is 860 N/C. How much charge is contained in a section of the line of length 1.20 cm?

A) 7.2×10^{-10}C
B) 4.5×10^{-10}C
C) 2.4×10^{-10}C
D) 8.1×10^{-10}C
E) 9.3×10^{-9}C

10. When two point charges are 2.0 cm apart, each one experiences a 1.0-N electric force due to the other charge. If they are moved to a new separation of 8.0 cm, the electric force on each of them is closest to

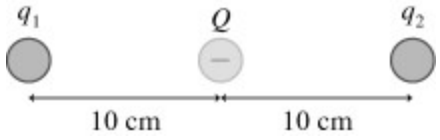
A) 1.0 N.
B) 4.0 N.
C) 16 N.
D) 0.25 N.
E) 0.063 N.

11. In the figure Q = 5.8 nC. What is the magnitude and direction of the force on the charge Q? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2)



A) 1.8×10^{-3} N, up
B) 10.0×10^{-4} N, up
C) 9.0×10^{-4} N, up
D) 9.0×10^{-4} N, down
E) 9.0×10^{-4} N, right

12. In the figure, all the charges are point charges and the charge in the middle is Q = -3.1 nC. For what charge q_1 will charge q_2 be in static equilibrium?



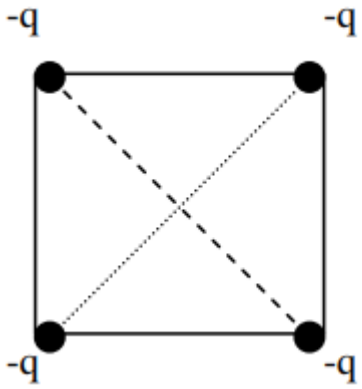
A) 25 nC
B) 6.2 nC
C) 3.1 nC
D) 12 nC
E) 8.9 nC

13. Negative charge -Q is distributed uniformly around a quarter-circle of radius a that lies in the first quadrant, with the center of curvature at the origin. Find the x- and y-components of the net electric field at the origin.

A) $E= (2kQ)/(a^2\pi)$
B) $E= (kQ)/(a\pi)$
C) $E= (kQ)/(a^2\pi)$
D) $E= (kQ)/(2a^2\pi)$
E) $E= (4kQ)/(a^2\pi)$

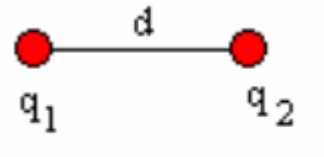
14. Four negative charges q = -6nC form a square, 12 cm on a side, as shown in figure below. What is the magnitude of electric field at the center of the square ?

A) 20 N/C
B) 15 N/C
C) 10 N/C
D) 5 N/C
E) 0



15. Two fixed particles of charges q1 = 1.6x10-9 C and q2 = 3.6x10-9 C are on the x axis, 16 cm apart. How far from q1 along x axis the net electric field is zero?

A) 2.4 cm
B) 4.8 cm
C) 6.4 cm
D) 9.6 cm
E) 12 cm



16. The force acting on an electron 100 cm from a positive .1 μC point charge in a vacuum is:

A) 2.8 x 10+10 N. Repulsive
B) 1.0 x 10-19 N. Attractive
C) 1.4 x 10-12 N. Repulsive
D) 1.4 x 10-16 N. Attractive
E) 1.6 x 10-16 N. Attractiv

ANSWER KEY:

1. **D) 117°**
2. **B) 7600 N/C down**
3. **B)**
4. **D) 3.00×10^5 N/C to the right**
5. **E)**
6. **C) 4.5×10^8 N/C**
7. **E) $6.23 \times 10-2$N**
8. **B) 6.51×10^5 N/C**
9. **C) 2.4×10^{-10}C**
10. **E) 0.063 N.**
11. **A) 1.8 × 10-3 N up**
12. **D) 12 nC**
13. **A) $E= (2kQ)/(a^2\pi)$**
14. **E) 0**
15. **C) 6.4 cm**
16. **D) 1.4 x 10-16 N. Attractive**