Electric Fields - Worksheet

17 Free-Response Questions

Organic Chemistry Tutor

1. A force of 100N is directed north on a -20 μC point charge. What is the magnitude and direction of the electric field at this point?

2. A positive charge of 50 μC is placed in an electric field of 50,000 N/C directed upward. What mass should the charge have to remain suspended in the air?

3. An electron is released from rest in a uniform electric field and accelerates to the east at a rate of 4.0×10^6 m/s^2. What is the magnitude and direction of the electric field?

4. A +40 μC point charge is placed at the origin. Calculate the magnitude and direction of the electric field created by the point charge at the following locations: (a) Point P (5m, 0). (b) Point S (3m, 4m).

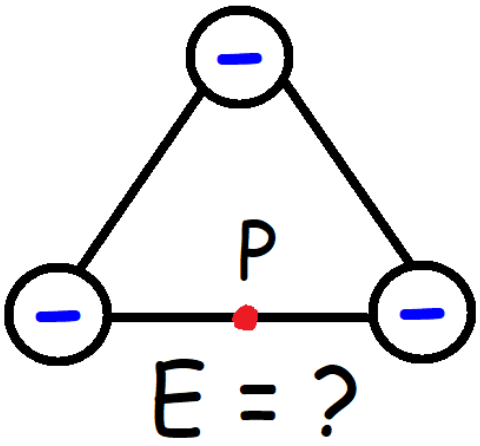
5. An electron, initially at rest, is placed in an electric field of 2×10^4 N/C directed to the west. The electric field is created by two parallel plates with a hole at the center of the positively charged plate. The distance between the plates is 1cm. (a) What is the acceleration of the electron due to the electric field? (b) What will be the speed of the electron after it leaves the hole traveling a distance of 1 cm?

6. A +200 μC is placed at the origin and a -300 μC is placed 1m to the right of it. What is the magnitude and direction of the electric field midway between the two charges and 30 cm to the right of the negative charge?

7. The electric field at point X which is 2 meters to the right of a certain positive charge is 100 N/C. What will be the magnitude of the new electric field if (a) the magnitude of the point charge doubles in value? (b) the distance between the charge and point X doubles? (c) the distance between the charge and point X reduces by a factor of 3? (d) the magnitude of the charge triples and the distance is reduced to 1/4 of its original value?

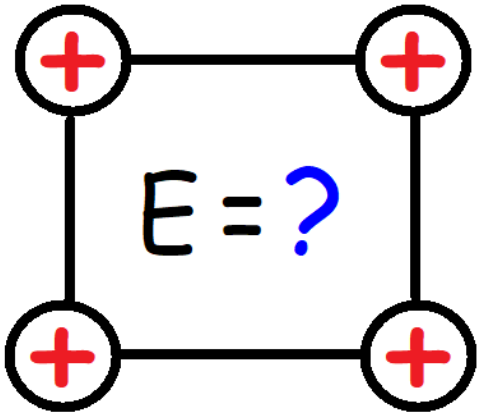
8. Two identical point charges with a magnitude of +100 μC are separated by a distance of 1m along the x-axis. (a) At what point along this axis will the net electric field be equal to zero? (b) If the 2nd charge doubles to +200 μC, where along the x-axis relative to the 1st charge will the net electric field be equal to zero?

9. Three identical point charges with a magnitude of -100 µC form an equilateral triangle. The distance between each point charge is 1 meter. Point P is the midpoint of Q1 and Q3. Calculate the magnitude and direction of the net electric field at point P.



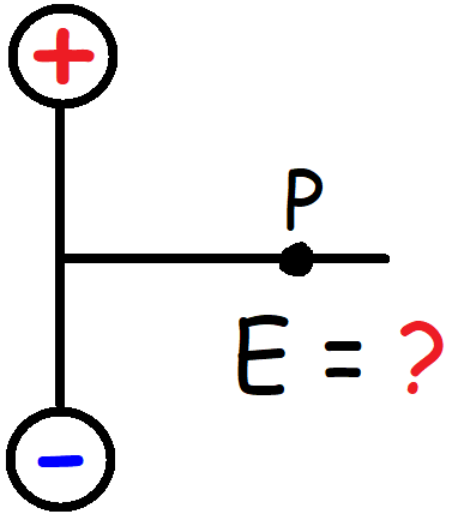
10. An unknown charge placed at the origin exerts a downward force of 25N on a +40 µC charge that is located at (0, 60cm) relative to the origin.
(a) Calculate the magnitude of the electric field acting on the +40 µC. (b) What is the magnitude and sign of the unknown charge?

11. Four identical point charges of magnitude +100 µC form a square with a side length of 1 meter. What is the magnitude and direction of the net electric field at the center of the square?

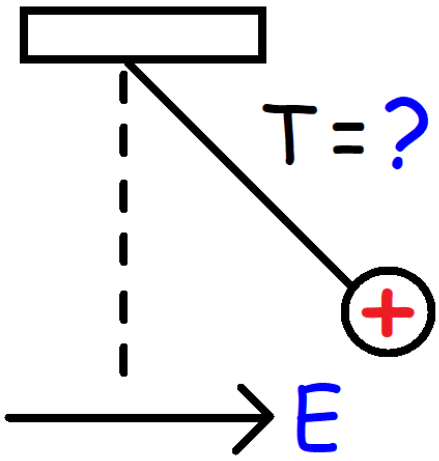


12. A +40 µC is located at the origin and a +30 µC charge is located at (3m, -2m). Calculate the magnitude and direction of the net electric field at point P (3m, 0).

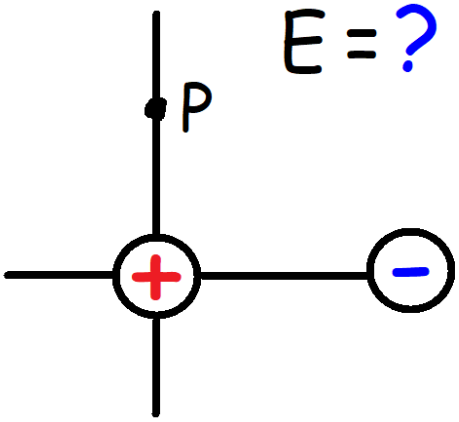
13. A +200 µC charge and a -200 µC charge is located at (0, 3m) and (0, -3m) respectively. Calculate the magnitude and direction of the net electric field at point P (4m, 0).



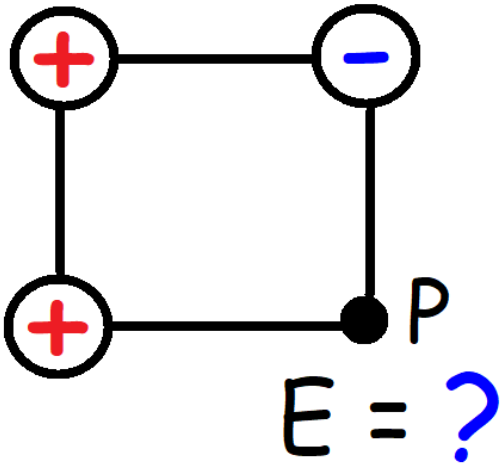
14. A +900 µC charge with a spherical mass of 1kg is suspended vertically on a string. A horizontal electric field of 1 x 10^4 N/C is applied causing the charge to be lifted slightly upward to the right. Calculate the tension force in the string as well as the angle that the string makes with the vertical when the system reaches equilibrium.



15. A +50 µC charge is located at the origin and a -80 µC charge is located at (5m, 0). What is the magnitude and direction of the net electric field at point P (0, 4m)?



16. A square is formed using a +100 nC charge at the origin, another +100 nC charge at (0, -1m), a -100 nC charge at (1m, 0), and point P at (1m, -1m). What is the magnitude and direction of the net electric field vector at point P?



17. A -10 nC point charge is placed at the origin. Calculate the magnitude and direction of the electric field at point P (3m, 4m).

Answers:

1. 5×10^6 N/C directed south.
2. 0.255 Kg
3. 2.27×10^{-5} N/C due west.
4a. 14,400 N/C directed east.
4b. 14,400 N/C at 53.1^0 above the +x-axis.
5a. 3.52×10^{15} m/s^2
5b. 8.39×10^6 m/s
6a. 1.8×10^7 N/C due east.
6b. 2.89×10^7 N/C due west.
7a. 200 N/C
7b. 25 N/C
7c. 900 N/C
7d. 4,800 N/C
8a. 0.5m to the right of the 1st charge.
8b. 0.414m to the right of the 1st charge.
9. 1.2×10^6 N/C due north.
10a. 6.25×10^5 N/C
10b. -25 µC
11. $E_{net} = 0$
12. 78,462 N/C at 59.3^0 above the +x-axis.
13. 86,400 N/C directed south.
14. 13.3 N at 42.6^0 east of north.
15. 22,000 N/C at 51^0 above the +x-axis.
16. 1,350 N/C at 25.5^0 above the +x-axis.
17. 3.6 N/C at 233^0 counterclockwise from the +x-axis. $E_{net} = -2.16i - 2.88j$.