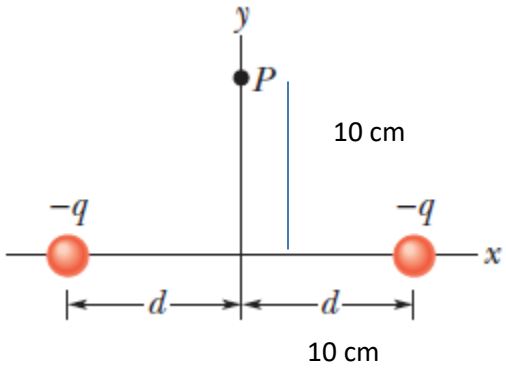
Practice problem sheet Course: PHY 2105 Summer: 2024

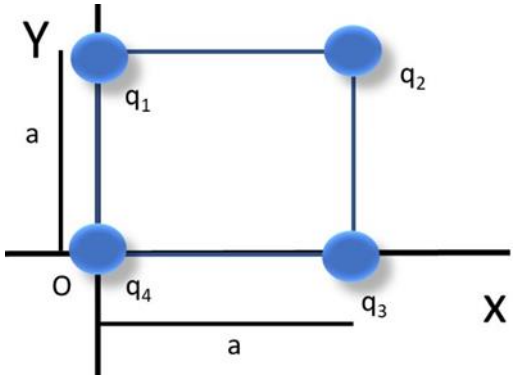
Title: Physics Content: Electric Field

1. Four charges +2q, +4q, +2q and –2q are placed at the corners of a square. (i) Draw the arrangement of the charges (ii) Calculate the magnitude and direction of electric field at the intersection of the diagonals of the square of side 10 cm if q =57×10^{-9}C.
2. Two equal charges q=12×10^{-7}C are placed at the two corners an equilateral triangle of side r =10cm. Draw the triangle with charges. Find the resultant electric field and it's direction at third corner of the triangle.
3. A charge of -1.0 μC is located at the coordinates (0,2) while a second charge of +1.0 μC is located at the coordinates (1,0). Draw the charge arrangement and determine the value of the following quantities at the origin: (i) the magnitude of the electric field E, (ii) the direction of the electric field.
4. Two point charges +4q and +q are placed 30 cm apart. At what point on the line joining them the electric field is zero?
5. A dipole is placed in a uniform electric field with its axis parallel to the field. What is the Torque on it?
6. Two charges 10×10^{-9} C and 20×10^{-9}C are placed at the two corners of a base of an isosceles right angle triangles. The length of the arms is 0.03 m. Calculate the net electric field and direction at the third corner of the triangles.
7. Two equal charges of 10×10^{-5} C are shown in fig below; each produces an electric field at point *P* on Y axis. (a) What is the magnitudes of the fields of each charge at *P*? (b) what is direction of each field? (c) What is the magnitudes of the net field at *P*? (d) What is the direction of the net field? and (e) Find the X and Y components of the field vector.



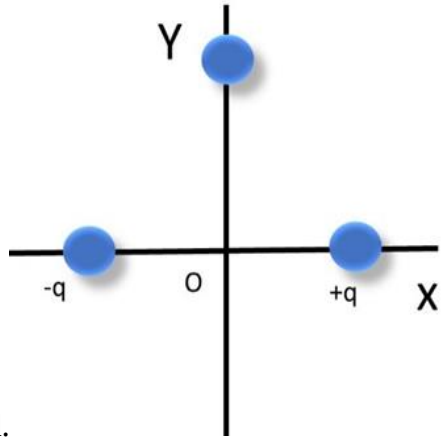
8. A charged particle produces an electric field with a magnitude of 5.0 N/C at a point that is 60 cm away from the particle. What is the magnitude of the particle's charge?
9. An electric dipole consists of charge + 2e and -2e separated by 0.75nm. It is in an electric field of strength 5.4×10^{-8} N/C. Calculate the magnitude of the torque on the dipole when the dipole moment is (a) parallel to (b) perpendicular to the electric field.
10. How much work is required to turn an electric dipole 180^0 in a uniform electric field of magnitude E = 56.0 N/C if the dipole moment has a magnitude of p = 3.2×10^{-24} Cm and the initial angle 65^0.

11. In the figure, the four particles form a square of edge length a=5.00 cm and have charges q_1 = +10.00 nC, q_2 = -20.0 nC, q_3 = +20.0 nC and q_4 = -10.0 nC. In unit vector notation, what net electric field



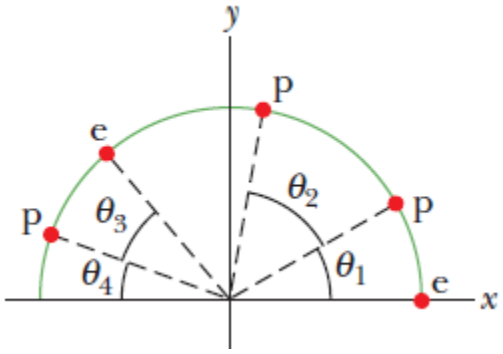
does the particle produce at the square's center? What is the net field direction?

12. In figure, two charged particles on an x-axis: -q = -4.8 × 10^{-19} C is at x = -3.00 m and q = 4.80 × 10^{-19} C is at x = 3.00 m. What are the (a) magnitude and (b) direction of the net electric field produced at point P in the Y axis at y = 4.00 m. (c) if –q=0 C and at O position (0,0) +2q charge is inserted then also find out

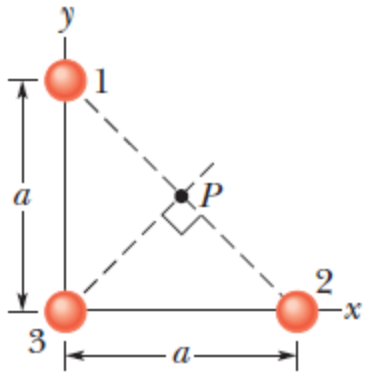


the direction and magnitude of the net electric field.

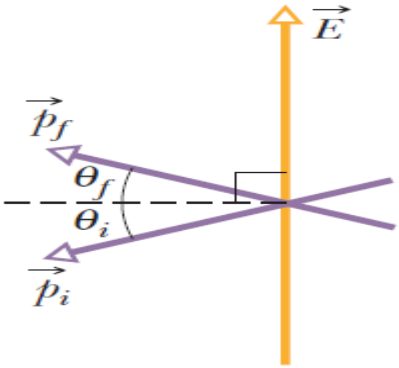
13. Calculate the Electric Field due to a proton at the location of the electron in the H atom. The radius of the electron orbit is 0.5x10^{-10}m.
14. Water (H_2O) is a molecule that has a permanent dipole moment is 6.2 x 10^{-30} C m. What is the dipole distance of water molecule? If the molecule is placed in an electric field of 1.5 × 10^4 N/C, what maximum torque can the field exert on it?
15. Figure shows an uneven arrangement of electrons (e) and protons (p) on a circular arc of radius r=2.00 cm, with angles θ_1=30^0, θ_2=50^0, θ_3=30^0, and θ_4=20^0. What are the (a) magnitude and (b) direction (relative to the positive direction of the x axis) of the net electric field produced at the center of the arc?



16. The three particles are fixed in place and have charges $q_1 = q_2 = +e$ and $q_3 = +2e$. Distance $a = 6.00\ \mu m$. What are the (a) magnitude and (b) direction of the net electric field at point P due to the particles?



17. An electric dipole with dipole moment $\vec{P} = (3\hat{\imath}+4\hat{\jmath})(1.24\times10^{-30})$ Cm is found in an electric field $\vec{E} = (4000\text{N/C})\ \hat{\imath}$ (a) What is the potential energy of the electric dipole? (b) What is the torque acting on it? (c) If an external agent turns the dipole until its electric dipole moment is $\vec{P} = (-4\hat{\imath}+3\hat{\jmath})(1.24\times10^{-30})$ Cm, how much work is done by the agent?
18. An electron enters a region of uniform electric field with an initial velocity of 40km/s in the same direction as the electric field, which has magnitude E =50N/C. (a) What is the speed of the electron 1.5ns after entering this region? (b) How far does the electron travel during 1.5ns the interval?
19. An electron on the axis of an electric dipole is 25nm from the center of the dipole. What is the magnitude of the electrostatic force on the electron if the dipole moment is 3.6×10^{-29} Cm? Assume that 25nm is much larger than the separation of the charged particles that form the dipole.
20. A charged cloud system produces an electric field in the air near Earth's surface. A particle of charge -2.0×10^{-9} C is acted on by a downward electrostatic force of 3.0×10^{-6} N when placed in this field. (a) What is the magnitude of the electric field? What are the (b) magnitude and (c) direction of the electrostatic Force $\vec{F}_{el}$ on the proton placed in this field? (d)What is the magnitude of the gravitational force $\vec{F}_g$ on the proton? (e) What is the ratio $\vec{F}_{el}/\vec{F}_g$ in this case?
21. In Figure below, an electric dipole with dipole distance 1.2 fm swings from an initial orientation *i* (θ_i =20.0°) to a final orientation *f* (θ_f=20.0°) in a uniform external electric field $\vec{E}$. The electric dipole moment is1.60×10^{-27} Cm and the field magnitude is 3×10^6 N/C. What is the change in the dipole's potential energy? What is the change in electric potential?



22. Fair weather atmospheric electricity is acting downward 100 km high in the ionosphere. The ionosphere voltage is $3x10^6$ V. What is the electric field required for producing high voltage?