Student Name:	BJUT ID:	UCD ID:

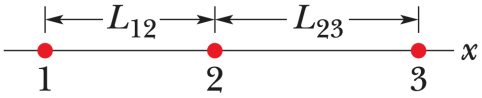
Institution: Beijing-Dublin International College
Module: University Physics 2 (BDIC2008J)
Lecturer: Dr. Hao Zhu

Problem Set 1

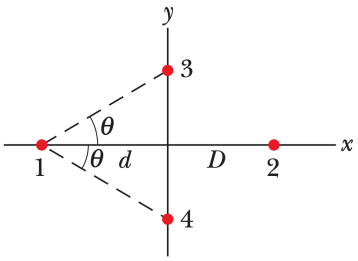
Electric Charge and Electric Field

Problem 1. *Of the charge Q initially on a tiny sphere, a portion q is to be transferred to a second, nearby sphere. Both spheres can be treated as particles and are fixed with a certain separation. For what value of q/Q will the electrostatic force between the two spheres be maximized?*

Problem 2. *Three charged particles lie on an x axis. Particles 1 and 2 are fixed in place. Particle 3 is free to move, but the net electrostatic force on it from particles 1 and 2 happens to be zero. If $L_{23} = L_{12}$, what is the ratio q_1/q_2?*



Problem 3. *The figure shows an arrangement of four charged particles, with angle* $\theta = 30.0°$ *and distance* $d = 2.00\text{cm}$. *Particle 2 has charge* $q_2 = +8.00 \times 10^{-19}\text{C}$*; particles 3 and 4 have charges* $q_3 = q_4 = -1.60 \times 10^{-19}\text{C}$. ***(a)*** *What is distance* D *between the origin and particle 2 if the net electrostatic force on particle 1 due to the other particles is zero?* ***(b)*** *If particles 3 and 4 were moved closer to the* x *axis but maintained their symmetry about that axis, would the required value of* D *be greater than, less than, or the same as in part (a)?*

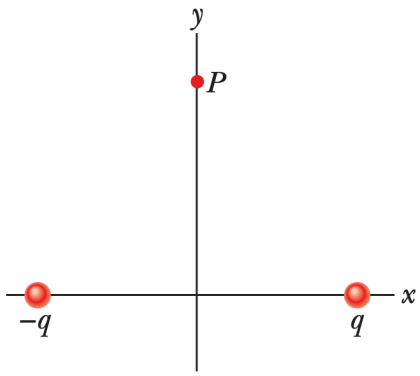


Problem 4. *The magnitude of the electrostatic force between two identical ions that are separated by a distance of* $5.0 \times 10^{-10}\text{m}$ *is* $3.7 \times 10^{-9}\text{N}$. ***(a)*** *What is the charge of each ion?* ***(b)*** *How many electrons are "missing" from each ion (thus giving the ion its charge imbalance)?*

Problem 5. ***(a)*** *What equal positive charges would have to be placed on Earth and on the Moon to neutralize their gravitational attraction?* ***(b)*** *Why don't you need to know the lunar distance to solve this problem?* ***(c)*** *How many kilograms of hydrogen ions (that is, protons) would be needed to provide the positive charge calculated in (a)? (Hint: The mass of Earth is* $M = 5.98 \times 10^{24}\text{kg}$*, the mass of Moon is* $m = 7.36 \times 10^{22}\text{kg}$*, and the mass of ion is* $m_i = 1.67 \times 10^{-27}\text{kg}$*).*

Problem 6. *Sketch qualitatively the electric field lines both between and outside two concentric conducting spherical shells when a uniform positive charge q_1 is on the inner shell and a uniform negative charge $-q_2$ is on the outer. Consider the cases $q_1 > q_2$, $q_1 = q_2$, and $q_1 < q_2$.*

Problem 7. *The figure shows two charged particles on an x axis: $-q = -3.20 \times 10^{-19}$C at $x = -3.00$m and $q = 3.20 \times 10^{-19}$C at $x = +3.00$m. What are the **(a)** magnitude and **(b)** direction (relative to the positive direction of the x axis) of the net electric field produced at point P at $y = 4.00$m?*



Problem 8. *In Millikan's experiment, an oil drop of radius* $1.64\mu\text{m}$ *and density* 0.851g/cm^3 *is suspended in the chamber when a downward electric field of* $1.92\times10^5\text{N/C}$ *is applied. Find the charge on the drop, in terms of* e*.*

Problem 9. *A 10.0*g *block with a charge of* $+8.00 \times 10^{-5}$C *is placed in an electric field* $\vec{E} = (3000\vec{i} - 600\vec{j})$N/C. *What are the* ***(a)*** *magnitude and* ***(b)*** *direction (relative to the positive direction of the* x *axis) of the electrostatic force on the block? If the block is released from rest at the origin at time* $t = 0$, *what are its* ***(c)*** x *and* ***(d)*** y *coordinates at* $t = 3.00$s*?*

Problem 10. *An electric dipole consisting of charges of magnitude* 1.50nC *separated by* 6.20μm *is in an electric field of strength* 1100N/C. *What are* ***(a)*** *the magnitude of the electric dipole moment and* ***(b)*** *the difference between the potential energies for dipole orientations parallel and antiparallel to* E*?*