PHY1202

Assignment 1

Due Date: 11:59 pm Tuesday, September 29th, 2020

Please submit your assignment:

1) To the Collection Box outside PHY GO Yeung G6702
2) Upload the softcopy of your assignment to Canvas

Lecture 01: Vectors

L01-01 (8 marks) What is the sum of the following four vectors in (a) unit-vector notation? For that sum, what are the (b) the magnitude, (c) the angle in degrees, and (d) the angle in radian.

$\vec{E}$: 6.00 *m at* $+0.900$ *rad*

$\vec{F}$: 5.00 *m at* -75.0°

$\vec{G}$: 4.00 *m at* $+1.20$ *rad*

$\vec{H}$: 6.00 *m at* -210°

L01-02 (6 marks) If $\vec{B}$ is added to $\vec{A}$, the result is $6.0\hat{i}+1.0\hat{j}$. If $\vec{B}$ is subtracted from $\vec{A}$, the result is $-4.0\hat{i}+7.0\hat{j}$. Find $\vec{A}$ and $\vec{B}$.

L01-03 (10 marks) Vector $\vec{A}$ and $\vec{B}$ lie in xy plane (with no z components), $\vec{A}$ has magnitude 8.00 and angle 130°, $\vec{B}$ has component $B_x = -7.72$ and $B_y = -9.20$.

a) What is $5\vec{A}\cdot\vec{B}$?
b) What is $4\vec{A}\times 3\vec{B}$ in unit-vector notation?
c) What is the angle between $\vec{A}$ and $4\vec{A}\times 3\vec{B}$?
d) What is $\vec{A}+3.00\,\hat{k}$ in unit-vector notation and in magnitude-angle notation with spherical coordinates R,θ,ϕ.

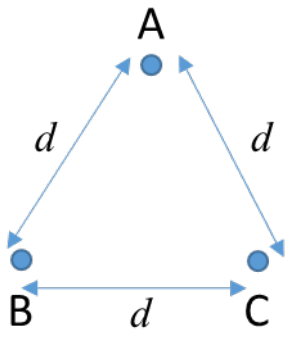
Lecture 02: Electric Charge

L02-01 (10 marks) Point charges of $q_1 = +6.0\ \mu C$ and $q_2 = -4.0\ \mu C$ are placed on an x axis, at $x = 8\ m$ and $x = 16\ m$, respectively. What charge q_3 must be placed at $x = 24\ m$ so that any charge q placed at the origin would experience no electrostatic force?

L02-02 (12 marks) Three identical conducting spheres as shown in the diagram form an equilateral triangle of side length $d = 30.0\ cm$. The sphere radii are much smaller than d, so that they can be considered as point charges with $q_A = -2.00\ nC$, $q_B = -4.00\ nC$, and $q_C = +8.00\ nC$. The following steps are then taken:

i. A and B are connected by a thin wire and then disconnected
ii. B is then grounded
iii. B and C are connected by a thin wire and then disconnected.

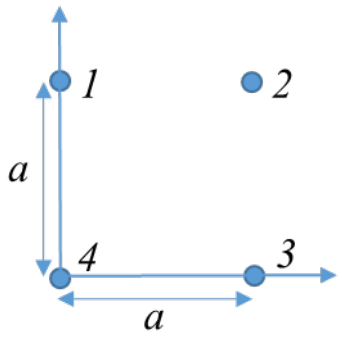
a) What was the electrostatic force between spheres *A* and *C* before step (i), (before A and B were connected by the thin wire)?
b) What are the new charges on A, B and C, after steps (i), (ii) and (iii)?
c) What is the magnitude of the electrostatic force between A and C after step (iii)?
d) What is the magnitude of the electrostatic force between A and B after step (iii)?



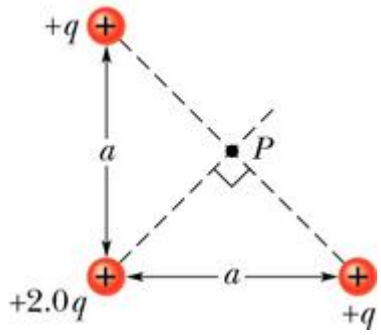
L02-03 (10 marks) We know that the negative charge on the electron and the positive charge on the proton are equal. Suppose, however, that these magnitudes differ from each other by 0.00010%. With what force would two copper coins, placed 1.0 m apart, repel each other? Assume that each coin contains 3×10^{22} copper atoms. (*Hint:* A neutral copper atom contains 29 protons and 29 electrons.) What do you conclude?

Lecture 03: Electric Field

L03-01 (10 marks) Four particles form a square of edge length $a = 5.00\,\text{cm}$ and have charges $q_1 = +10.0\,\text{nC}$, $q_2 = -20.0\,\text{nC}$, $q_3 = +20.0\,\text{nC}$, and $q_4 = -10.0\,\text{nC}$. In unit-vector notation, what net electric field do the particles produce at the square's center?



L03-02 (12 marks) Calculate the direction and magnitude of the electric field at point P in the figure, due to the three point charges.



L03-03 (12 marks) The Figure below shows three circular arcs centered on the origin of a coordinate system. On each arc, the uniformly distributed charge is given in terms of $Q = 2.00\,\mu\text{C}$. The radii are given in terms of $R = 100\,\text{cm}$. What are a) magnitude and b) direction (relative to the positive x direction) of the net electric field at the origin due to the arcs?