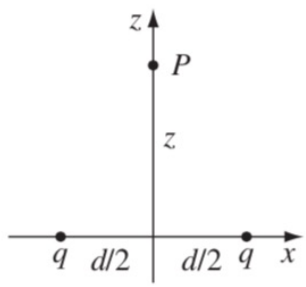
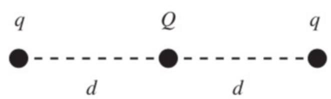
PHY209 Electromagnetism
Assignment 1
Handed out: August 11, 2019

Problem 1



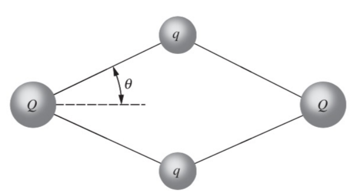
Find the electric field a distance z above the midpoint between two equal charges (q), a distance d apart.

Problem 2



Two positive charges q are each located a distance d from a charge Q. What should the charge Q be so that the system is in equilibrium; that is, so that the force on each charge is zero? Check that the equilibrium is an unstable one by looking at longitudinal displacements of the charge Q.

Problem 3



Four positively charged bodies, two with charge Q and two with charge q, are connected by four unstretchable strings of equal length. In the absence of external forces they assume the equilibrium configuration shown above. Show that $\tan^3\theta = \frac{q^2}{Q^2}$. Hint: the total force on each body, the vector sum of string tension and electrical repulsion, is zero.

Problem 4

Two positive point charges Q are located at points $(\pm l,\ 0)$. A particle with positive charge q and mass m is initially located midway between them and is then given a tiny kick. If it is constrained to move along the line joining the two charges Q, show that it undergoes simple harmonic motion (for small oscillations), and find the frequency.

Problem 5

A charge $2q$ is at the origin, and a charge $-q$ is at $x = a$ on the x axis.
(a) Find the point on the x axis where the electric field is zero.
(b) Consider the vertical line passing through the charge $-q$, that is, the line given by $x = a$. Locate a point on this line where the electric field is parallel to the x axis.

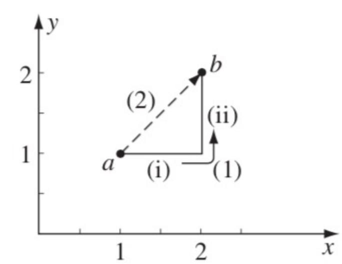
Problem 6

Using the dot product method, find the angle between the face diagonals of a cube.

Problem 7

Find the separation vector $\boldsymbol{r}$ from the source point (2,8,7) to the field point (4,6,8). Determine its magnitude (r), and construct the unit vector $\hat{\boldsymbol{r}}$.

Problem 8



Calculate the line integral of the function $\boldsymbol{v} = y^2\hat{\boldsymbol{x}} + 2x(y+1)\hat{\boldsymbol{y}}$ from the point $\boldsymbol{a}$=(1,1,0) to the point $\boldsymbol{b}$ = (2,2,0), along the paths (1) and (2) in the above Fig. What is $\oint \boldsymbol{v} \cdot d\boldsymbol{l}$ for the loop that goes from $\boldsymbol{a}$ to $\boldsymbol{b}$ along (1) and returns to $\boldsymbol{a}$ along (2)?

Problem 9

Evaluate the integral $\int_0^\infty xe^{-x}dx$.

Problem 10

Consider a particle moving with constant velocity $\boldsymbol{v} = u\hat{\boldsymbol{x}}$ along the line $y = 2$. Describe $\boldsymbol{v}$ in polar coordinates: $\boldsymbol{v} = v_r\hat{\boldsymbol{r}} + v_\theta\hat{\boldsymbol{\theta}}$.