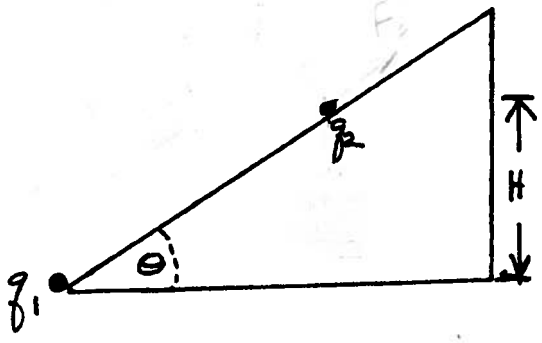
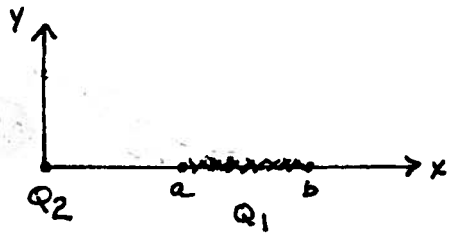
1. (25 points) A tiny ball with positive charge, q_1, is fixed at the bottom of a frictionless inclined plane. A second small ball, with mass m and positive charge, q_2, is placed on the inclined plane at the position shown. If m, q_1, q_2, and θ are known, what must H be if the second ball is to remain at rest?



2. (25 points)A charge Q_1 is uniformly spread along the x axis from $x = a$ to $x = b$. A charge Q_2 is placed at the origin. Find the y component of the electric field at the point $x = 0, y = H$.



3. (25 points)An electric field is measured in some region and found to be given by

$$\vec{E} = \alpha x^2 \vec{i}_x + \beta y^2 \vec{i}_y.$$

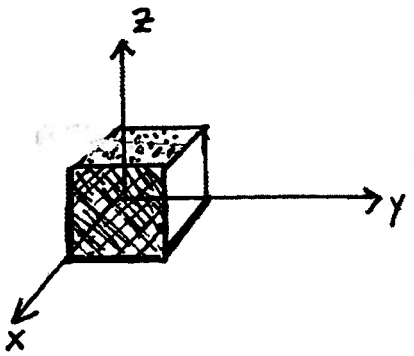
Here α and β are known constants. For this field find the difference in the electric potential between the point $x = 0, y = c$ and the point $x = c, y = 0$. Verify that this field is conservative by evaluating the derivatives of the electric potential function.

4. (25 points)

a. A cube of sides a is located at the origin. An electric field is present given by

$$\vec{E} = bx^2\vec{i}_x + cx\vec{i}_z,$$

Find the electric flux through the shaded side marked on the figure.



Find the electric flux through the top (dotted) of the cube.

b. A point charge q is located at the center of a sphere of radius R. A cone of solid angle Ω_0 is drawn starting at the charge. What is the electric flux through the area of the sphere which is intersected by the cone?