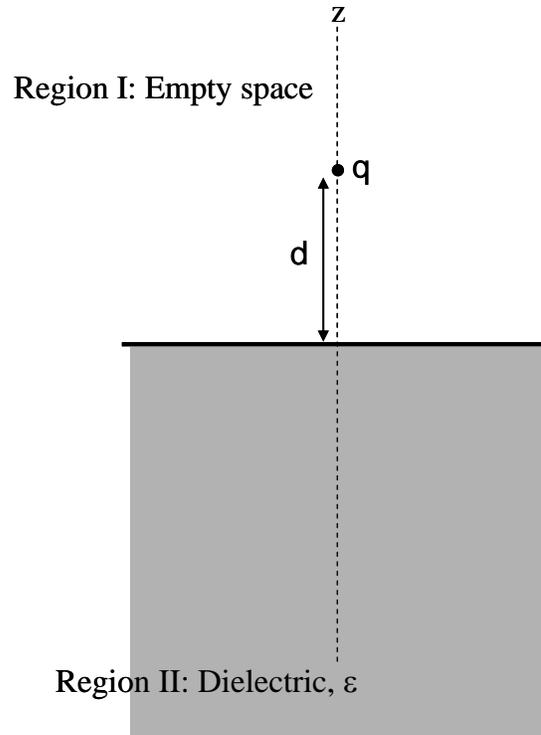


3

A point charge, q , is placed in empty space (Region I) at a perpendicular distance d along the z -axis from an infinite planar surface (x - y plane) separating the region of empty space ($\epsilon=1$) from a region filled with a dielectric, $\epsilon>1$ (Region II), as shown in the diagram. Assume the origin of the coordinate system referred to below is at the intersection of the z -axis and the planar boundary between the two regions.



- (a) State the boundary conditions for $\vec{E}(\vec{r})$ and $\vec{D}(\vec{r})$ at the planar surface between regions I and II.

Using the method of images or otherwise,

- (b) Obtain an expression for the electric potential in region I at position z, R , where $R=(x^2+y^2)^{1/2}$.
- (c) Obtain an expression for the electric potential in region II at position $-z, R$.
- (d) Obtain an expression for the force on charge q .
- (e) Copy the figure above into your exam booklet and sketch the field lines representing $\vec{D}(\vec{r})$.