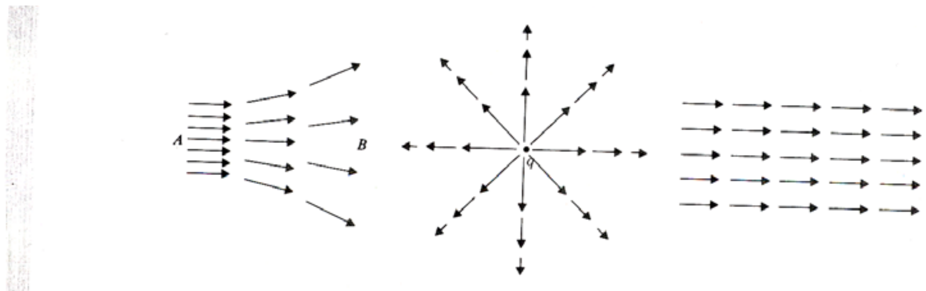
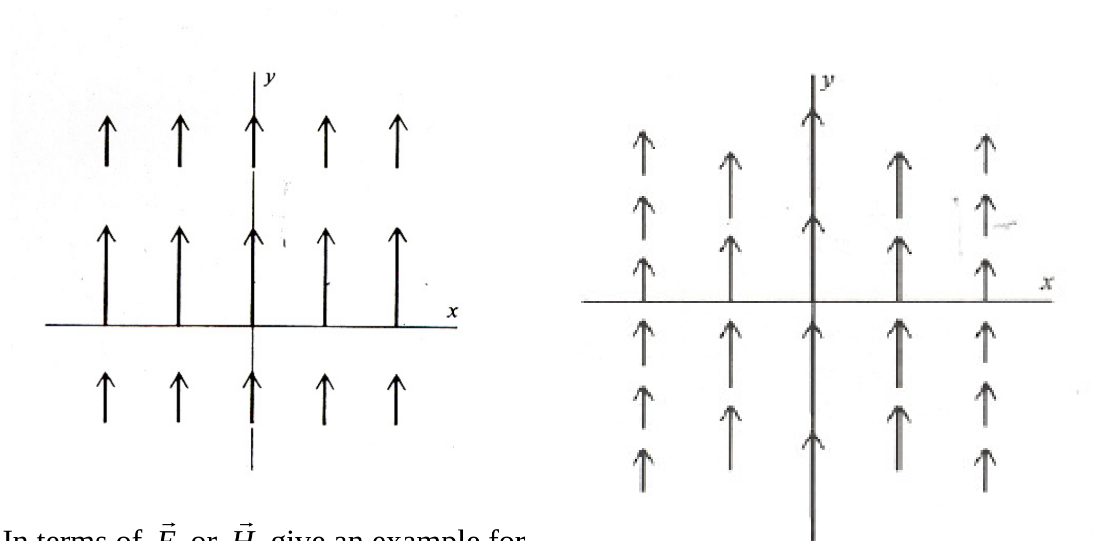
Homework # 1 ECE 1228

1) For the electric fields graphically shown below indicate whether the fields are solenoidal (divergence free) or not. In the case of non-solenoidal fields indicate the charge generating the filed is positive or negative. Justify your answer.



2) Can either or both of the vector fields shown below represent an electrostatic field ($\vec{E}$). Justify your answer.

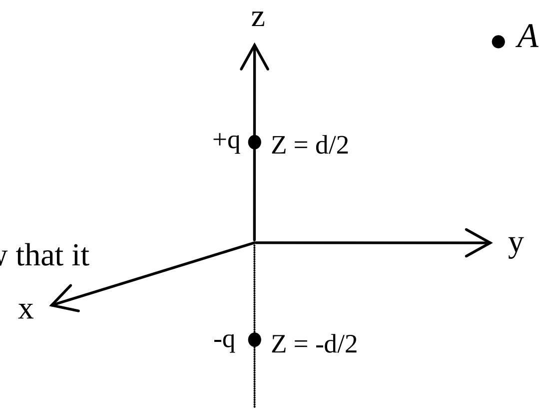


3) In terms of $\vec{E}$ or $\vec{H}$ give an example for each of the following conditions:

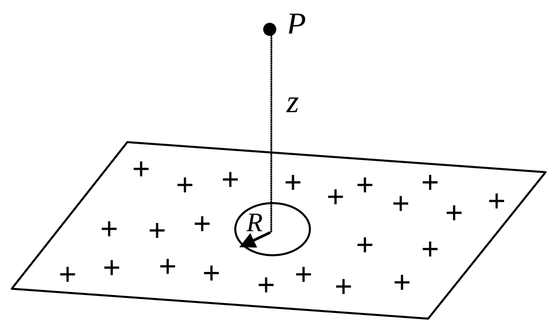
a) Filed is solenoidal and irrotational
b) Field is solenoidal and rotational
c) Field is irrotational and non-solenoidal
d) Field is non-solenoidal and rotational

4) An electric dipole is shown in the figure.

a) Find the Potential (V) at an arbitrary point A.
b) Calculate the filed ($\vec{E}$) from the above potential (show that it is the same result we obtained in the class).



5) Figure shows a flat, positive, non-conducting sheet of charge with uniform charge density σ [C/m^2]. A small circular hole of radius R is cut in the middle of the surface as shown. Calculate the electric field intensity (E) at point P, a distance z from the center of the hole along its axis.
Hint 1: Ignore the field fringe effects around all edges.
Hint 2: Calculate the field due to a disk of radius R and use superposition.



6) The instantaneous electric field inside a conducting parallel plate waveguide is given by

$$\vec{E}(r,t) = \hat{a}_y\ E_0 \sin\left(\frac{\pi}{a}x\right)\cos(\omega\, t - \beta_z\ z)$$

where β_z is the waveguide's phase constant and a is the waveguide width (a constant). Assuming there are no sources within the free-space-filled pipe, determine
a) The corresponding instantaneous magnetic field components inside the conducting pipe.
b) The phase constant β_z.