NAME: Solution	Quiz #2: Phys142

(a) (5 pts) Use Gauss's law to find the magnitude of the electric field a distance "d" above an infinite flat sheet that is uniformly and positively charged with a surface charge density of σ. Draw your Gaussian surface on the diagram below, and explain why you chose that particular shape.

We use a "pillbox" surface here b/c $\vec{E}$-field lines are perpendicular to end caps and parallel to walls. Gauss's law:

$$\int \vec{E}\cdot d\vec{A} = 0 + 2EA = \frac{q_{in}}{\epsilon_0} \Rightarrow 2EA = \frac{\sigma A}{\epsilon_0} \Rightarrow \vec{E} = \frac{\sigma}{2\epsilon_0}\hat{z}$$

↳ 2 b/c field leaves both sides of sheet (indep. of d.)

(b) (1 pts) Draw directly on the diagram 4 or 5 representative electric FIELD LINES emanating from the infinite sheet.

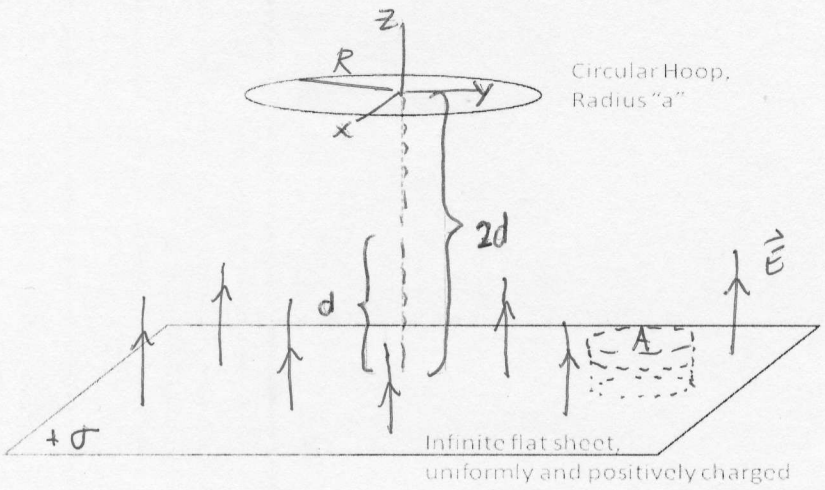
(c) (2 pts) What is the magnitude of the electric flux through a circular hoop of radius "R" a distance 2d above the surface, oriented such that the plane of the hoop is parallel to the infinitely charged sheet (exactly as depicted in the diagram)? Use your results from part (a) in your answer.

for const $\vec{E}$-field:

$$\Phi_e = \vec{E}\cdot\vec{A} = \left(\frac{\sigma}{2\epsilon_0}\right)(\pi R^2) = \frac{\pi\sigma R^2}{2\epsilon_0}$$

(d) (2 pts) What is the electric flux through the same hoop, but rotated about the x axis by 45 degrees?

$$\Phi_e = \vec{E}\cdot\vec{A} = \left(\frac{\sigma}{2\epsilon_0}\right)(\pi R^2)\cos 45 = \frac{\pi\sqrt{2}\,\sigma R^2}{4\epsilon_0}$$


z
R
y
x
Circular Hoop,
Radius "a"
2d
d
$\vec{E}$
A
+σ
Infinite flat sheet,
uniformly and positively charged