

1. Flux of the Electric Field Electric flux is the rate of flow of the electric field through a given area (Fig. 1). Electric flux is proportional to the number of electric field lines going through a virtual surface. Figure 1: Electric Flux: Electric flux visualized. The ring shows the surface boundaries. The red arrows for the electric field lines. Flat Surface, Uniform Field: We begin with a flat surface (Fig. 2) with area A in a uniform electric field  $\vec{E}$ . The total flux  $\Phi$  is then:  $\Phi = \int \vec{E} \cdot d\vec{A}$ .  $\vec{E} \cdot d\vec{A} = (E \cos \theta) dA$   $\Phi = \int (E \cos \theta) dA$   $\Phi = (E \cos \theta) \int dA$  When the electric field is uniform and the surface is flat:  $\Phi = (E \cos \theta) A$  (uniform field, flat surface)

Figure 2: An electric field vector pierces a small square patch on a flat s