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 Φ is then: $\Phi = \int \vec{E} \cdot d\vec{A}$ (general case) $\Phi = \int (E\cos\theta)\, dA$ (general case) 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