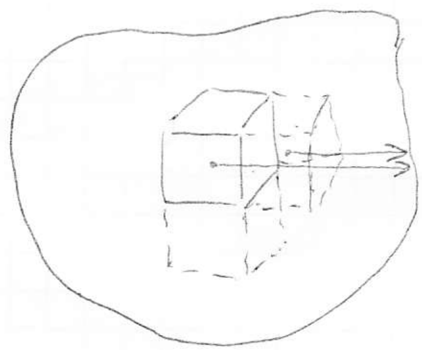
THE DIVERGENCE THEOREM

$$\boxed{\oint_S \bar{F} \cdot \hat{n}\, da = \int_V (\nabla \cdot \bar{F})\, dv}$$

THE FLUX OF A VECTOR FIELD THROUGH A CLOSED SURFACE IS EQUAL TO THE INTEGRAL OF THE DIVERGENCE OF THAT FIELD OVER THE ENCLOSED VOLUME.

INFORMAL PROOF

CONSIDER THE VOLUME V SUBDIVIDED IN VERY SMALL CUBIC VOLUMES.



CONSIDER ANY DIRECTION, AND SINCE THE FACES OF THE SMALL CUBES ARE SHARED, THE FLUX THAT COMES OUT AT THE SURFACE OF THE BOUNDARY IS CONTRIBUTED JUST BY THE FACES 'DEFINING' THAT SURFACE.

IT IS TRIVIAL TO OBTAIN THE DIFFERENTIAL EXPRESSIONS OF GAUSS LAWS FOR $\bar{B}$ AND $\bar{E}$ FROM THEIR RESPECTIVE INTEGRAL EXPRESSIONS USING THE DIVERGENCE THEOREM.