

Problem 3

Problem 3. Gauss's Lans AGauss Law in Matte matrice (GLM) It considers the Solowing guession; Consider a closed surface 3 in R³ and a point P unich is not on 3. P Q. 12 P inside 5 or is P outside 5? [S can be comparisated, the surpost case for as will be a sphere. J 5 Gauss provided a computatitional way to decide this. For this he defined a Vector fieldt=Fp that depends on the paint & The value at a point is PQ FpQ A Fp = deg IPQ PQ Here point P is spacial for this vector field is that (Fp) is de Sined is meaning for everywhere an R3 CX carpt at the point P (A+Q=P the denominator rs 0.) TI. (GLM) SS Fp. dS = 14TT if Possiside S, when S is oniented ordnorde Our goal is to prove this claims, i.e. to explains why this is true.

Proof. H is based on the GDT. SSS div(F) dN = SS F - dS N Dolid (prientation outwards) W Solid Want Check S closer SS Fp. dS = Compute $F_{p}(Q) = \frac{\overline{pQ}}{\overline{pQ}} = \frac{r}{m^{2}}$ $F_{p}(Q) = \frac{\overline{pQ}}{\overline{pQ}} = \frac{r}{m^{2}}$ $F_{p}(Q) = \frac{\overline{pQ}}{\overline{pQ}} = \frac{r}{\overline{pQ}}$ (b) <u>Poulside S</u>: SS Fp-d3 = P Cz Z S dia $div(F_p) = div(\overline{w}) = 0$









Gauss have on Physics (GLP) The fleer (:e. the total flow) of an elecrtic fields F through a closed sursace 3 equals the " Fiere it is know that a particle at a point P that carries change (causes the electric force E in space such that E(Q) = C PQPQPRemark. <u>FQ</u> <u>1</u> FQ? UFQTS <u>1</u> FQ? <u>1</u> FQ1 P Eas = i visionee . unit realor a bissource . The direction from P to Ch. This also appear in the formula for the gravitational serce. LBoth forces are propositional to one over distance squared !] Proof Consider a closed sursece & and changes C: at points Pi for i= 1, -- - - 10 P<P; charge C=Ci-

