Closest point

Sphere, at
the closest point
will be ll to pHnorm.

Normal to

Sphere, ll to
plane norm.

Closest point has

Normal ll to
plane norm.
Normal to plane 
$x + 2y + 3z = 8$

1. Look it up on sheet.
2. Grad $(x + 2y + 3z)$
#33

curved surface

curve
Problematic
§3.2 Flow lines. Scalar field \( \phi(x, y, z) = \phi(\vec{r}) \)

Vector field.

\[ \vec{F}(x, y, z) = \vec{F}'(\vec{r}) \]

Example. \( \nabla \phi(\vec{r}) \).

Electric field \( \vec{E}(\vec{r}) \). Magnetic field \( \vec{B}(\vec{r}) \).

Flow velocity field \( \vec{v}(\vec{r}) \).
A streamline (line of flow) is a curve which is everywhere tangent to the vector field.
\[ \nabla \cdot \vec{F} = \frac{\partial F_1}{\partial x} + \frac{\partial F_2}{\partial y} + \frac{\partial F_3}{\partial z} = \text{div} \vec{F} \]

\[ \nabla \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ F_1 & F_2 & F_3 \end{vmatrix} = \text{curl} \vec{F} \]
Flux

How many particles go through the window in a short time \( dt \)?

area \( A \)

Every particle in this box gets through the window in \( dt \).

These are velocities.

Size of box = \( A \cdot (1 \vec{v}) \cdot dt \)

density = \# of particles per unit volume = " \( \ldots \)"

So \( \vec{v} \cdot A \cdot (1 \vec{v}) \cdot dt \) penetrate in \( dt \)

\( \vec{v} \cdot A \cdot (1 \vec{v}) \) = \# of particles per unit time