Homework 2

Due Monday, September 18, before class.

1. **Problem.** *(Problem in three dimensions.)* Calculate the divergence of the vector field:

\[ \mathbf{F}(\mathbf{r}) = \mathbf{v}(\mathbf{r}) \times \mathbf{B}(\mathbf{r}), \]  

where \( \mathbf{v}(\mathbf{r}) = (x, y, 0) \) and \( \mathbf{B}(\mathbf{r}) = (0, 0, B_0 x) \).

2. **Problem.** *(Problem in two dimensions.)* Calculate the line integral:

\[ \int_C \mathbf{F} \cdot d\mathbf{r}, \]

for the field \( \mathbf{F}(\mathbf{r}) = (4, 0) \) along the path

\[ C : \mathbf{r}(t) = (2 \cos t, 2 \sin t). \]

from the point \( a = (2, 0) \) to the point \( b = (0, 2) \). Note that the path - given in parametric form by Eq. (3) - is a quarter of a circle of radius 2 in the first quadrant of the plane (that is, the quarter-plane in which \( x \) and \( y \) are both positive) and the integration counter-clockwise goes from the "three o’ clock" position to "noon".

3. **Problem.** Calculate the two vectors tangent to a sphere of radius 2 at the point \( P = (0, 2, 0) \).