

Physics 423, Spring 2019 Homework Set # 2

1. Due Wednesday, Jan 16 (Read §1.3):

(a) For the vector field $\mathbf{v} = x^2\hat{\mathbf{x}} + 2yz\hat{\mathbf{y}} + y^2\hat{\mathbf{z}}$, find $\int \mathbf{v} \cdot d\mathbf{l}$ along the specified paths.

i. $(0, 0, 0) \rightarrow (1, 0, 0) \rightarrow (1, 1, 0) \rightarrow (1, 1, 1)$.

ii. $(0, 0, 0) \rightarrow (0, 0, 1) \rightarrow (0, 1, 1) \rightarrow (1, 1, 1)$.

iii. A straight line from the origin to $1, 1, 1$.

iv. The closed path going out along 1(a)i and back along 1(a)ii.

(b) Show that

$$\oint_{\mathcal{P}} (f \nabla g) \cdot d\mathbf{l} = - \oint_{\mathcal{P}} (g \nabla f) \cdot d\mathbf{l}.$$

2. You might find the following exercises useful if you are rusty with line and surface integrals [this one is not turned in].

(a) Griffiths problem 1.32

(b) Griffiths problem 1.33

3. Due Friday, Jan 18 (Read §1.4):

(a) Let $\mathbf{A} = f(r)\hat{\mathbf{r}}$. Verify Gauss's theorem for the sphere $r = R$.

(b) Use $\mathbf{v} = \hat{\mathbf{z}} \cos s + \hat{\phi} sz$ to verify Stokes' theorem on the finite cylindrical surface $s = R$, $a < z < b$.¹

¹Cylindrical coordinates in Griffiths are s, ϕ, z .