PHYS 301
HOMEWORK #7

Due : 20 March 2013

You may use Mathematica to verify results, but must show all work by hand.

1. For the vector :

$$\mathbf{v} = x^2\,\hat{\mathbf{x}} + y\,\hat{\mathbf{y}} + x\,y\,z\,\hat{\mathbf{z}}$$

find the value of the line integral

$$\int_C \mathbf{v} \cdot d\mathbf{l}$$

a) along the path that goes from the origin to (1, 1, 1) in three steps : from the origin to (1, 0, 0), then to (1, 1, 0) then to (1, 1, 1)

b) along the straight line path from the origin to (1, 1, 1)

2. If **r** is the position vector, find the value of the line integral

$$\oint \mathbf{r} \cdot d\mathbf{r}$$

along the circle defined by

$$x^2 + y^2 = a^2$$

3. If **r** is the position vector, find the value of

$$\int_S \mathbf{r} \cdot d\mathbf{a}$$

where S is the surface of the unit cube with corners at the origin and (1, 1, 1).

4. For the vector

$$\mathbf{v} = 4\,y\,\hat{\mathbf{x}} + x\,\hat{\mathbf{y}} + 2\,z\,\hat{\mathbf{z}}$$

evaluate $\int_S (\nabla \times \mathbf{v}) \cdot d\mathbf{a}$

over the hemisphere represented by the upper half plane of

$$x^2 + y^2 + z^2 = a^2$$

(this is the upper half of the sphere of radius a centered on the origin).

5. For the vector :

$$\mathbf{F} = 3\,x\,y\,\hat{\mathbf{x}} - y^2\,\hat{\mathbf{y}}$$

evaluate :

$$\int_C \mathbf{F} \cdot d\mathbf{r}$$

along the path $y = 2x^2$ from the origin to (1, 2)