Electromagnetic Theory: Homework 3
Due: 28 August 2014

This assignment will be graded immediately after the due date. If you get all problems correct, then you will receive 100%. If you have made any errors, then I will deduct 10%, point the errors out and you must submit a corrected assignment by 2 September 2014. If there are still errors, then I will deduct another 10% and you must submit the corrected assignment by 4 September 2014. This will continue until you have solved every problem correctly.

1 Divergence and curl of vector fields
Consider the following vector fields in the $xy$ plane:

$$v_1 = \frac{x}{2} \hat{x} - \frac{y}{2} \hat{y} \quad \text{and}$$
$$v_2 = -\frac{y^3}{2} \hat{x} + \frac{x^3}{2} \hat{y}.$$

For each of these answer the following questions.

a) Sketch the vector field.
b) Determine the divergence of $v_i$.
c) Determine the curl of $v_i$. Is this consistent with what you expect from the sketch of the vector field?


3 Divergence and curl of a vector field with three components
Let

$$v = zx \hat{x} + xy \hat{y} + zy \hat{z}.$$ 

Determine the divergence and curl of $v$.

4 Differentiating products
Consider

$$A = x \hat{x} + y \hat{y} \quad \text{and}$$
$$B = y \hat{x}.$$ 

Show, by direct substitution into either side that

$$\nabla (A \cdot B) = A \times (\nabla \times B) + B \times (\nabla \times A) + (A \cdot \nabla) B + (B \cdot \nabla) A.$$ 

for these vector fields.