Homework #3

Problem 4 - 3.6.2:

If $\mathbf{A}$ is irrotational

$$\nabla \times \mathbf{A} = 0. \tag{1}$$

To show that $\mathbf{A} \times \mathbf{r}$ is solenoidal we need to show that

$$\nabla.(\mathbf{A} \times \mathbf{r}) = 0. \tag{2}$$

Using the result of problem (3.5.9)

$$\nabla.\mathbf{A} \times \mathbf{B} = \mathbf{B}.(\nabla \times \mathbf{A}) - \mathbf{A}.(\nabla \times \mathbf{B}), \tag{3}$$

we obtain

$$\nabla.\mathbf{A} \times \mathbf{r} = \mathbf{r}.(\nabla \times \mathbf{A}) - \mathbf{A}.(\nabla \times \mathbf{r}) = 0, \tag{4}$$

since the first term vanishes because of (1) and the second since $\nabla \times \mathbf{r} = 0$.