

1. Prove the so-called *Helmholtz–Zorawski criterion*, that is prove the following statement:

Let  $\mathbf{v}$  denotes the Eulerian velocity field. The curves that are tangent to the vector field  $\mathbf{q}$  are material curves if and only if

$$\mathbf{q} \times \left( \frac{\partial \mathbf{q}}{\partial t} + \text{rot}(\mathbf{q} \times \mathbf{v}) + \mathbf{v} \text{div} \mathbf{q} \right) = \mathbf{0},$$

holds at each time instant for all points on the given curve.