

### Exercise 3

A mathematical plane surface of area  $S$  has an orientation given by a unit normal vector  $\mathbf{n}$ , pointing downstream of the surface. A fluid of density  $\rho$  flows through this surface with a velocity  $\mathbf{v}$ . Show that the mass rate of flow through the surface is  $w = \rho(\mathbf{n} \cdot \mathbf{v})S$ .