



Figure 1: Sketch of the vector field  $\vec{v} = -\omega y\hat{x} + \omega x\hat{y}$

### Solution to Quiz 1

1(a): The displacement vector is given by  $\vec{t} = 3\hat{x} + 6\hat{y} + 7\hat{z} - (2\hat{x} + 8\hat{y} + 5\hat{z}) = \hat{x} - 2\hat{y} + 2\hat{z}$ .

(b):  $t = |\vec{t}| = \sqrt{1^2 + (-2)^2 + 2^2} = 3$  in meters. The unit vector is  $\hat{t} = \frac{\vec{t}}{t} = \frac{1}{3}\hat{x} - \frac{2}{3}\hat{y} + \frac{2}{3}\hat{z}$ .

(c):  $W = \vec{f} \cdot \vec{t} = (0 - 6 + 8) = 2$  J.

2(a)  $\vec{v} = \omega\hat{z} \times (x\hat{x} + y\hat{y} + z\hat{z}) = -\omega y\hat{x} + \omega x\hat{y}$ .

(b) The sketch (Fig.1) shows a flow rotating about the  $\hat{z}$  direction.

(c)  $\vec{\nabla} \times \vec{v} = \hat{z} \left( \frac{\partial v_y}{\partial x} - \frac{\partial v_x}{\partial y} \right) = 2\omega\hat{z}$ .

(d) The curl of this flow field is just twice the angular velocity of the rotating flow.