§4.4

#6. The flow lines are given by $\mathbf{c}(t) = (c_1 e^{-3t}, c_2 e^{-t})$. The vector field and the flow lines:

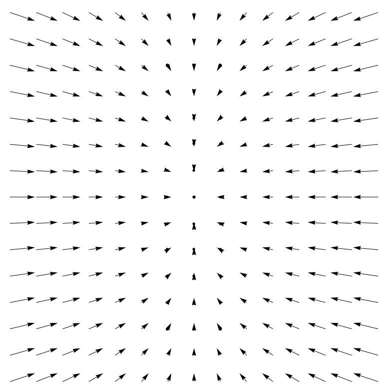

Figure 1: Vector field given by $\mathbf{F} = -3x\mathbf{i} - y\mathbf{j}$

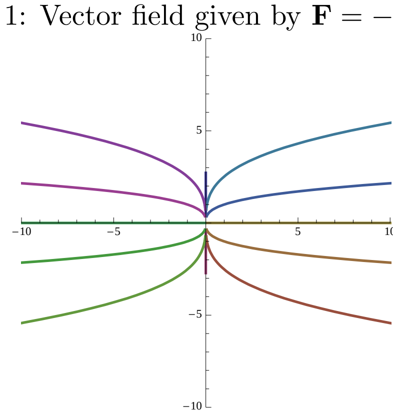

Figure 2: Flow lines in the vector field $\mathbf{F} = -3x\mathbf{i} - y\mathbf{j}$.

Div($\mathbf{F}$) $= -4$ which makes sense because the vector field is always compressing!

#16. $\nabla \times \mathbf{F} = 1/(x^2 + y^2 + z^2)(2x^3\mathbf{i} + 2y(x^2 - z^2)\mathbf{j} - 2z^3\mathbf{k})$.

#26. Since the curl of any gradient field is zero, if we show this vector field has non-zero curl, then it is not a gradient vector field.

#31. Does $\nabla \times \mathbf{F}$ have to be perpendicular to $\mathbf{F}$? Answer: No. For example, $\mathbf{F} = z\mathbf{i} + z^2\mathbf{j}$ does NOT satisfy $(\nabla \times \mathbf{F}).\mathbf{F} = 0$.

§5.1

#5. $\frac{2}{3}r^3 \tan\theta$.

§5.2

#6.

$$\int_0^1 \int_0^{\pi/2} \sin y \, dy \, dx = \int_0^1 \, dx = 1.$$