Problem 8

In each of Problems 5 through 10, draw a direction field for the given differential equation and state whether you think that the solutions are converging or diverging.

\[ y' = -ty + 0.1y^3 \]

Solution

The direction field is a two-dimensional vector field that shows what the direction of the solution is at every point in a region. Every solution to the differential equation is a curve drawn such that the direction field vectors are tangent to it at every point.

\[ \langle dt, dy \rangle = \left(1, \frac{dy}{dt}\right) dt = \langle 1, -ty + 0.1y^3 \rangle dt \]

Figure 1: In red are the direction field vectors and in blue are possible solutions to the differential equation, depending what the initial condition is. Solutions with initial conditions below \( y \approx 2.4 \) and above \( y \approx -2.4 \) appear to converge as \( t \to \infty \), but solutions with initial conditions above \( y \approx 2.4 \) and below \( y \approx -2.4 \) appear to diverge as \( t \to \infty \).

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