Math 246, Professor David Levermore
Group Work Exercises for Discussion
Wednesday, 9 September 2020

First Set of Group Work Exercises [3]

Find an explicit general solution for each of the following differential equations.

(1) $\dfrac{\mathrm{d}x}{\mathrm{d}t} = 3x - x^2$

(2) $\dfrac{\mathrm{d}u}{\mathrm{d}x} = e^{-3u}\cos(3x)$

(3) $\dfrac{\mathrm{d}y}{\mathrm{d}r} = e^{-r}\big(4 + y^2\big)$

Second Set of Group Work Exercises [3]

Find the explicit solution for each of the following initial-value problems.

(1) $\dfrac{\mathrm{d}x}{\mathrm{d}t} = 3x - x^2\,, \qquad x(0) = 1\,.$

(2) $\dfrac{\mathrm{d}u}{\mathrm{d}x} = e^{-3u}\cos(3x)\,, \qquad u(0) = 0\,.$

(3) $\dfrac{\mathrm{d}y}{\mathrm{d}r} = e^{-r}\big(4 + y^2\big)\,, \qquad y(0) = 2\,.$

Third Set of Group Work Exercises [4]

Consider the differential equation

$$\frac{\mathrm{d}v}{\mathrm{d}t} = \frac{(v+5)^2(v+1)^3(7-v)}{v-3}\,.$$

Let $v_1(t)$ and $v_2(t)$ be the solutions of it that satisfy $v_1(2) = -3$ and $v_2(-1) = 5$. (You do not need to find these solutions!)

(1) Sketch the phase-line portrait for the equation over the interval $[-8, 8]$. Identify points where solutions are undefined with a $\circ$. Identify stationary points with a $\bullet$. Indicate the direction that solutions move as t increases along each interval between such points with an arrow.
(2) Classify each stationary point as being either stable, unstable, or semistable.
(3) For each stationary point identify the set of initial-values $v(0)$ such that the solution $v(t)$ converges to that stationary point as $t \to -\infty$.
(4) Evaluate $\lim_{t\to\infty}\big(v_2(t) - v_1(t)\big)$.