

Lecture Questions I: 110.302 Differential Equations

Professor Richard Brown

Mathematics Department

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Question 1

Determine the truth of the following two statements:

- (1) Every separable ODE can be written as an exact ODE.
- (2) Every linear ODE can be written as a separable ODE.

- A. Both are true.
- B. (1) is true and (2) is false.
- C. (1) is false and (2) is true.
- D. Both are false.

Question 2

Let $\dot{x} = x^2 - 2x + c$ be an autonomous, first-order ODE with parameter $c \in \mathbb{R}$. For parameter value $c = -15$, the phase line for the ODE has the following characteristics:

- A. A sink at $x = -3$ and a source at $x = 5$.
- B. A source at $x = -3$ and a sink at $x = 5$.
- C. A sink at $x = -5$ and a source at $x = 3$.
- D. A source at $x = -5$ and a sink at $x = 3$.
- E. Not enough information to tell.

Question 3

The ODE

$$\left(\sin t + \sqrt{2-t}\right) y + e^{t \ln(t+1)} (t^2 - 10^{-2000}) y' = t^4$$

is linear. By the Existence and Uniqueness Theorem for first-order linear ODEs, we know the following:

- A. Solutions are not guaranteed to exist at all at the point $(0, 2) \in \mathbb{R}^2$.
- B. Solutions are guaranteed to exist but may not be unique at $(0, 2)$.
- C. A solution exists and is unique passing through $(0, 2)$.
- D. There is not enough information to determine whether solutions exist and/or are unique at $(0, 2)$.
- E. I have no idea.