Problem 1 (10 Points) Solve the following ordinary differential equation for $t \geq 0$.

$$\frac{dx}{dt} = -sign(x(t)) , \quad x(0) = 0$$

Comment on the topic of (local) existence of solutions of ODEs.

Problem 2 (10 Points) Solve the following ordinary differential equation for $t \geq 0$.

$$\frac{dx}{dt} = -x^2(t) , \quad x(0) = -1$$

Comment on the topic of (global) existence of solutions of ODEs.

Problem 3 (10 Points) Solve the following ordinary differential equation for $t \geq 0$.

$$\frac{dx}{dt} = x^{1/3}(t) , \quad x(0) = 0$$

How many different solutions can you find for this system? Comment on uniqueness of solutions of ODEs.

State and prove sufficient conditions for the uniqueness of solutions to ODEs.

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