Homework 1 (Due: 10/18)

(1) Solve the following DE (It is OK to express the solution in the implicit form)

$$\frac{dy}{dx} = \frac{xy + 3x - y - 3}{xy - 2x + 4y - 8}$$

(2) Find an explicit solution of the given initial-value problem

$$\sqrt{1 - y^2}\, dx - \sqrt{1 - x^2}\, dy = 0, \quad y(0) = \frac{\sqrt{3}}{2}$$

(3) Use a technique of integration or a substitution to find an explicit solution of the given differential equation or initial-value problem

$$\frac{dy}{dx} = \frac{e^{\sqrt{x}}}{y}, \quad y(1) = 4$$

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(4) Solve the following DE. Also, indicate the transient term in the solution.

$$xy' + (1 + x)y = e^{-x} \sin 2x$$

(5) Solve the following DE. Also, indicate the transient term in the solution. (It is OK to express the solution in the implicit form)

$$y\,dx = (ye^{y} - 2x)\,dy$$

(6) A thermometer is taken from an inside room to the outside, where the air temperature is 5° C. After 1 minute the thermometer reads 55° C, and after 5 minutes it reads 30° C. What is the initial temperature of the inside room?

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(7) A model for the population $P(t)$ in a suburb of a large city is given by the initial-value problem

$$\frac{dP}{dt} = P(10^{-1} - 10^{-7}P), \quad P(0) = 5000,$$

where t is measured in months. What is the limiting value of the population? At what time will the population be equal to one-half of this limiting value?

(8) Solve the following DE. It is OK to express the solution as the explicit form.

$$(2y \sin x \cos x - y + 2y^2 e^{xy^2})\, dx$$
$$= (x - \sin^2 x - 4xye^{xy^2})\, dy$$

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(9) Solve the following DE by converting it into an exact equation. an appropriate DE. It is OK to express the solution as the implicit form.

$$(y^2 + xy^3)\,dx + (5y^2 - xy + y^3 \sin y)\,dy = 0$$

(10) Solve the given differential equation by using an appropriate substitution. It is OK to express the solution as the implicit form.

$$\frac{dy}{dx} = \frac{x + 3y}{3x + y}$$