Practice Problems I

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1. Give an example of a third (3rd) order
   (a) nonlinear differential equation
   (b) linear differential equation
2. Verify $P = \dfrac{ce^t}{1+ce^t}$ is a solution to the differential equation $\dfrac{dP}{dt} = P(1-P)$.
3. Sketch the direction field for the equation
$$\frac{dy}{dx} = 1 - xy$$
for $-4 \leq x, y \leq 4$. Sketch the approximate solution curves that pass through the indicated points (you should have one curve per given point):
   (a) $y(0) = 0$
   (b) $y(-1) = 0$
   (c) $y(2) = 2$
   (d) $y(0) = -4$
4. Solve the following initial value problem:
$$\frac{dy}{dx} = x\sqrt{1-y^2}, \quad y(0) = \frac{1}{2}.$$
5. Solve the following separable equation:
$$\frac{dy}{dx} = \frac{xy + 2y - x - 2}{xy - 3y + x - 3}.$$
6. Solve the following first order linear equation:
$$xy' + (1+x)y = e^{-x}\sin 2x.$$
7. Solve the initial value problem
$$(y^2\cos x - 3x^2y - 2x)dx + (2y\sin x - x^3 + \ln(y))dy = 0, \quad y(0) = e.$$