Homework 4 - Math 142 **Name:** ______________________

Due by 5:00pm Friday, March 12. Send a PDF with your solutions to `blins@hsc.edu`.

1. If you drop a rock, it accelerates due to gravity. But as the rock falls faster, air resistance reduces the acceleration until the rock reaches terminal velocity. A differential equation for the velocity v (in meters per second) of the rock as it falls is

$$\frac{dv}{dt} = -9.8 + 0.002v^2.$$

What is the terminal velocity of the rock? Hint: You don't need to solve the differential equation! Just figure how fast the rock needs to fall so that its velocity stops changing.

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2. A simple electrical circuit has a 12-volt battery connected to a 6-ohm resistor and a 2-henry inductor. The current I (in amps) flowing through the circuit at time t (seconds) is determined by the differential equation

$$2\frac{dI}{dt} + 6I = 12.$$

(a) Sketch a slope field for this differential equation.

(b) What is the limiting value of the current I as time goes on?

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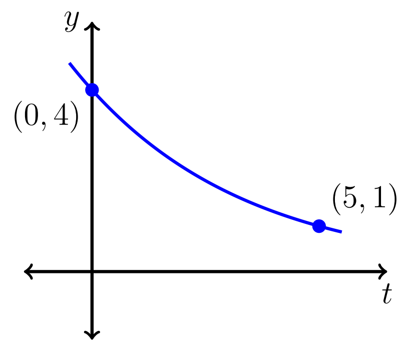
3. Find the constants C and k for the exponential function $y = Ce^{kt}$ that passes through the two points shown below.



4. Solve $x^2 + 6y\dfrac{dy}{dx} = 0$.

5. Find the solution $P(t)$ of the differential equation

$$\frac{dP}{dt} = P^2 \cos t$$

that satisfies the initial condition $P(0) = \frac{1}{2}$.