

## Exam 2: Take-Home

Name: \_\_\_\_\_

Math 230: Differential Equations

Due Wednesday, November 14, at the beginning of class time

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### Take-Home Instructions:

1. *For this part of the exam, you may use your textbook, your notes, the course web site, and computing technology (e.g. Mathematica).*
  2. *Do not consult other sources, people, web sites, etc.*
  3. *Answer the following questions. Write your answers on separate paper. Check your work.*
  4. *Consider the pledge at the end of this page. Turn this page, along with your solutions, at the beginning of the final exam session.*
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1. (8 points) Find the solution to the following initial-value problem:

$$y'' + 16y = 2 \sin(5t), \quad y(0) = 0, y'(0) = 1$$

Show work that justifies your answer.

Then find the frequency of the beats and the frequency of the rapid oscillations.

2. (10 points) Consider the one-parameter family of linear systems:

$$\begin{aligned} \frac{dx}{dt} &= ax + y \\ \frac{dy}{dt} &= -a^2x + 4y \end{aligned}$$

- (a) Identify all different types of phase portraits that this system exhibits as the parameter  $a$  varies along the real line.
- (b) Identify all bifurcation values of  $a$ , and say how the phase portrait changes as  $a$  crosses each bifurcation value.

**St. Olaf Honor Pledge:** I pledge my honor that on this examination I have neither given nor received assistance not explicitly approved by the professor and that I have seen no dishonest work.

Signed: \_\_\_\_\_

I have intentionally not signed the pledge. (Check the box if appropriate.)