

**Instructions:** Each problem is worth 20 points. Only work on five problems. Clearly indicate on which problem you are not working. You may work on this designated problem to receive extra credit, but only if you have full credit on the other five problems. Only responses entered in the allocated space (no extra space allowed) for each problem will be graded. Present only the complete solution including all explanation (without scratch work, use the back of the assignment sheet for that purpose) neatly. You must support all of your answers in order to receive credit. Do not remove the staples. Do not turn in the assignment sheet. Grades will be posted on the web tonight.

1. Determine all values of  $r$  for which the ODE  $y'' + y' - 6y = 0$  has solutions of the form  $y(t) = e^{rt}$ .
2. Solve the problem  $y' = (1 - 2t)y^2$ ,  $y(0) = -\frac{1}{6}$  by separating the variables. Give the solution explicitly and find its domain.
3. Find the solution to the initial value problem  $-2y' + 2y - 4 = 0$ ,  $y(5) = 10$ .
4. Solve the initial value problem  $y' - 2y = e^{2t}$ ,  $y(0) = 2$ .
5. Suppose that the temperature of a cup of coffee obeys Newton's law of cooling (which states that the temperature of an object changes at a rate proportional to the difference between its temperature and that of its surroundings). If the coffee has a temperature of  $200^\circ\text{F}$  when freshly poured, and one minute later has cooled to  $190^\circ\text{F}$  in a room at  $70^\circ\text{F}$ , determine when the coffee reaches a temperature of  $150^\circ\text{F}$ .
6. Find all equilibrium solutions of  $y' = y^2(y^2 - 1)$  and classify each one as stable, unstable, or semistable.