

MATH 251  
Spring 2003  
Midterm Exam I

1. i. linear, order 2; ii. nonlinear, order 1; iii. linear, order 3; iv. nonlinear, order 2.
2. (a); 3. (c); 4. (c); 5. (d).
6. (a) equilibrium solutions:  $y = -2, 0, 2$ ; (b)  $y = -2$  asymptotically stable;  $y = 0$  unstable;  $y = 2$  asymptotically stable; (c)  $y(t) = 2$ .
7. (a)  $Q(t) = -6e^{-t/200} + 6$ ; (b) it will never happen (or, when  $t$  approaches infinity).
8. (b)  $x \ln y + x^2 y + \sin 2x = C$ .
9. (a) yes; (b) yes:  $W(y_1, y_2) = -4t$ , which is not equal to zero when  $t$  is not zero; (c) since  $y_1$  and  $y_2$  are two linearly independent solutions, the general solution is therefore  $y(t) = C_1 t^3 + C_2 t^{-1}$ .
10. (a)  $y(t) = C_1 e^{-4t} + C_2 e^t$ ; (b)  $y(t) = C_1 e^{-4t} + C_2 e^t - 3 \cos 2t - 4 \sin 2t$ .
11.  $y(t) = 3e^{-3t} + 8te^{-3t}$ .