

MATH 251  
Exam I  
February 28, 2008

ANSWER KEY

1. 3rd order, linear; 2nd order, nonlinear; 1st order, linear
2. D
3. D
4. C
5. A
6. C
7. D
8. B
9. (a)  $y = -4, 0, 2$   
(b)  $y = -4$  is (asymptotically) stable,  $y = 0$  is semistable, and  $y = 2$  is unstable.  
(c)  $\lim_{t \rightarrow \infty} y(t) = 0$   
(d)  $\lim_{t \rightarrow \infty} y(t) = -4$
10. (a)  $Q' = 30 - \frac{3}{3t + 800}Q, \quad Q(0) = 0$   
(b)  $P(t) = \frac{4t^2 + 240t + 120}{t + 30}$
11. (a)  $\frac{\partial M}{\partial y} = 16x^3y^3 = \frac{\partial N}{\partial x}$   
(b)  $x^4y^4 + x^2 - 2y = 4$

12. (a)  $y_c = C_1 e^{-5t} + C_2 t e^{-5t}$
- (b)  $Y = (At + B)e^{2t} \cos 5t + (Ct + D)e^{2t} \sin 5t + E e^{-t}$
- (c)  $Y = (At^4 + Bt^3 + Ct^2)e^{-5t} + Dt^2 + Et + F$
13. (a)  $u(t) = 2 e^{-2t} \cos 4t + e^{-2t} \sin 4t$
- (b)  $\mu = 4$  (radians/second)
- (c) True (b/c the system is underdamped)