I hereby affirm that the work on this exam is my own (aided only by the text and my lecture notes) and that I have given no aid to another on this exam. Further, I understand that violation of either of these two conditions may result in a score of zero on this exam as well as more serious consequences.

SIGNATURE  

DATE

chapter two fall 18 -- due wed, sep 19 -- staple inside front cover of large exam booklet

Multiple Choice
Identify the choice that best completes the statement or answers the question. Show work or explain your choice, as appropriate.

1. If \( a > 0 \) and \( b > 0 \), the autonomous differential equation \( \frac{dP}{dt} = P(a - bP) \) has a solution that is
   _____.
   
   a. increasing everywhere  
   b. decreasing everywhere  
   c. increasing if \( 0 < P < a/b \)  
   d. decreasing if \( 0 < P < a/b \)  
   e. increasing if \( P > a/b \)

2. The autonomous differential equation \( \frac{dx}{dt} = x(x - 1)(x + 1) \) has a solution that is
   _____.
   
   a. increasing everywhere  
   b. decreasing everywhere  
   c. increasing if \( 0 < x < 1 \)  
   d. decreasing if \( -1 < x < 0 \)  
   e. increasing if \( x > 1 \)

3. The differential equation \( (x^2 + y^2)y' = xy \) is
   _____.
   
   a. linear  
   b. homogeneous  
   c. separable  
   d. exact  
   e. Bernoulli

4. The differential equation \( xy' = 2y + \sin x \) is
   _____.
   
   a. linear  
   b. homogeneous  
   c. separable  
   d. exact  
   e. Bernoulli

5. An integrating factor for the linear differential equation \( y' - y/x = x \) is
   _____.
   
   a. \( x \)  
   b. \( x^2 \)  
   c. \( 1/x \)  
   d. \( 1/x^2 \)  
   e. \( e^{-x} \)

6. The differential equation \( xydx + (x^2 + y^2)dy = 0 \) is
   _____.
   
   a. exact with solution \( x^2y/2 + y^3/3 = c \)  
   b. exact with solution \( x^2y/2 + y^3/2 = c \)  
   c. exact with solution \( x^2y/2 + y^3/3 + c \)  
   d. not exact but having an integrating factor \( x \)  
   e. not exact but having an integrating factor \( y \)
7. The autonomous differential equation \( \frac{dx}{dt} = x^2(x - 4) \) has a solution that is _____.
   a. increasing everywhere
   b. decreasing everywhere
   c. increasing if \( 0 < x < 4 \)
   d. decreasing if \( x > 4 \)
   e. increasing if \( x > 4 \)

8. The differential equation
   \[
   \left( y^3 + 6xy^4 \right)dx + \left( 3xy^2 + 12x^2y^3 \right)dy = 0
   \]
   is _____.
   a. exact with solution \( y^4/4 + 6xy^5/5 + 3x^2y^2/2 + 4x^3y^3 + c \)
   b. exact with solution \( y^4/4 + 6xy^5/5 + 3x^2y^2/2 + 4x^3y^3 = c \)
   c. exact with solution \( xy^3 + 3x^2y^4 = c \)
   d. exact with solution \( xy^3 + 3x^2y^4 + c \)
   e. not exact

9. Solve the problem \( y' = xy, \ y(1) = 2 \) numerically for \( y(1.2) \) using \( h = 0.1 \).
   a. 2.1
   b. 2.442
   c. 2.242
   d. 2.421
   e. 2.4

**Short Answer**
Be sure to include justification for your answer (i.e., show work or give explanation, as appropriate).

10. Solve the differential equation \( y' - y = x \).

11. Solve the differential equation \( y' = x^2y \).

12. Solve \( (x - 2y)dx + ydy = 0 \).

13. Solve the differential equation \( y' + y/x = y^2 \).

14. Solve the differential equation \( y' = \sqrt{2x - y + 1} + 2 \).