1. Which of the following is a particular solution of the equation $y'' - y = e^t$?
   
   (a) $te^t/2 + e^{-t}$.
   (b) $e^t/2$.
   (c) $te^t + 5e^t$.
   (d) $2e^t + 3e^{-t}$.

2. A nonlinear system is given by
   
   $x_1' = x_1^2 - x_2 x_3 x_1$.
   
   $x_2' = x_2 - x_1$.

   How many equilibrium points does this system have?
   
   (a) 5.
   (b) 2.
   (c) 6.
   (d) 3.

3. A mass of 5 kg stretches a spring by 9.8 cm in equilibrium. You subject the same mass-spring system to oscillatory forcing. You should expect particularly large oscillations when the period of the oscillation is close to
   
   (a) $\pi/5$ seconds.
   (b) $7\pi/5$ seconds.
   (c) 9.8 seconds.
   (d) 0.1 seconds.

4. The general solution of the system $y' = Ay$, where
   
   $A = \begin{pmatrix} 3 & 1 \\ 1 & 3 \end{pmatrix}$,

   is
   
   (a) $c_1 e^{3t} \cos t \begin{pmatrix} 2 \\ 1 \end{pmatrix} + c_2 e^{3t} \sin t \begin{pmatrix} 3 \\ -2 \end{pmatrix}$. 

(b) \( c_1 e^{3t} \cos t \left( \frac{1}{1} \right) + c_2 e^{3t} \sin t \left( \frac{1}{1} \right) \).

c

c

c

c

c

c

c

c

c

c

c

c

c

c

5. You solve the initial value problem \( y' = 3 + y^2, \ y(1) = 1 \), using the Euler method with \( h = 0.05 \). Then the approximation you find for \( y(1.1) \) is

(a) 1.422.

(b) 1.2.

(c) 1.4.

(d) 1.386.

6. A water tank initially contains 40 gallons of water in which 200 grams of salt are dissolved. Water enters and leaves the tank at a rate of 3 gallons per minute. The incoming solution contains 6 grams of salt per gallon, and the outgoing solution is well-mixed. The amount of salt in the tank, measured in grams, with time measured in minutes, is given by

(a) \( Q(t) = 200 \exp(-3t/40) + 18t. \)

(b) \( Q(t) = 240 - 40 \exp(-3t/40). \)

(c) \( Q(t) = 200 + 18t. \)

(d) \( 200 + 18 \exp(-3t/40). \)

7. The general solution of the equation \( y''' - y' = 0 \) is

(a) \( y = A + Be^t + Cte^t + Dt^2 e^t. \)

(b) \( y = Ae^t + Be^{-t} + C + Dt. \)

(c) \( y = Ae^t + Be^{-t} + C \cos t + D \sin t. \)

(d) \( y = A + Be^t + Ce^{-t/2} \cos(\sqrt{3}t/2) + De^{-t/2} \sin(\sqrt{3}t/2). \)
8. The geometric multiplicity of the eigenvalue $-1$ for the matrix

\[
\begin{pmatrix}
-1 & 0 & 0 & 0 \\
2 & -1 & 0 & 0 \\
3 & 0 & -1 & 0 \\
4 & 2 & 0 & -1
\end{pmatrix}
\]

is

(a) 2.
(b) 1.
(c) 3.
(d) 4.

9. For the system

\[
x' = -3x + 5y,
\]
\[
y' = -5x + 4y,
\]

the origin is a(n)

(a) stable focus.
(b) stable node.
(c) unstable focus.
(d) saddle.

10. Which of the following is a linear equation?

(a) $y'' + \sin y = 0$.
(b) $y' + y = \cos y$.
(c) $y''/y' = \ln(\cos t)$.
(d) $y''' - 4y^2 = \cos t$. 
11. Which of the following is a direction field for the equation \( y' = 2y - t \)?

\[\text{(a)}\]

\[\text{(b)}\]

\[\text{(c)}\]
12. If \( x' = tx^2 \), and \( x(0) = 1/2 \), then \( x(1) \) is
(a) \( \sqrt{\exp(1 - \ln 2)} \).
(b) 1.
(c) 2/3.
(d) \( e/2 \).