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

$$x_1' = x_1^2 - x_2^3 x_1.$$

$$x_2' = x_2 - x_1.$$

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

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

(c) $c_1 e^{3t} \begin{pmatrix} 1 \\ 1 \end{pmatrix} + c_2 e^{t} \begin{pmatrix} 1 \\ -1 \end{pmatrix}$.

(d) $c_1 e^{4t} \begin{pmatrix} 1 \\ 1 \end{pmatrix} + c_2 e^{2t} \begin{pmatrix} 1 \\ -1 \end{pmatrix}$.

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) $y'' + \sin y = 0$..

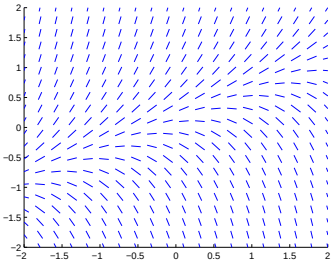
(b) $y' + y = \cos y$.

(c) $y''/y' = \ln(\cos t)$.

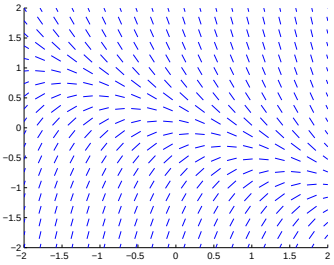
(d) $y''' - 4y^2 = \cos t$.

11. Which of the following is a direction field for the equation $y' = 2y - t$?

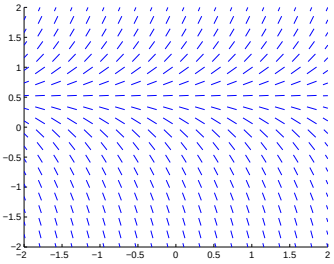
(a)

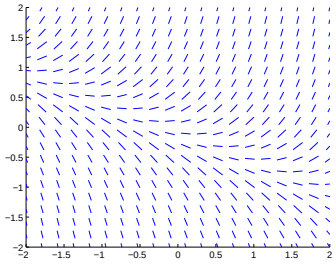


(b)



(c)



(d) 

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) $e/2$.