1. Which of the functions does not satisfy the Lipschitz condition on the domain D?

   (a) $f(t,y) = \dfrac{ty}{2t+1} + y\cos t$ on $D = \{(t,y)| -1 \le t \le 1\}$ _____(correct)

   (b) $f(t,y) = \dfrac{t\sin y}{t^2+1}$ on $D = \{(t,y)| -1 \le t \le 1,\ -2 \le y \le 2\}$

   (c) $f(t,y) = \sin(ty) + \ln y$ on $D = \{(t,y)|0 \le t \le 2,\ 1 \le y \le 3\}$

   (d) $f(t,y) = t^2 + y^2$ on $D = \{(t,y)|2 \le t \le 3,\ -1 \le y \le 2\}$

   (e) $f(t,y) = \dfrac{y+t}{t+1}$ on $D = \{(t,y)|1 \le t \le 2\}$

2. The Euler Method is used to approximate the solution of the initial-value problem

   $$y' = \frac{y^2+y}{t},\ 2 \le t \le 3,\ y(2) = \frac{1}{2},\ \text{with}\, h = 0.1,\ 0 \le y \le 1.$$

   If $y(t) = \dfrac{2t}{1-2t}$ is the exact solution, then the bound for approximation error to $y(2.3)$ is equal to:

   (a) 0.0056 _____(correct)

   (b) 0.1431

   (c) 0.2451

   (d) 0.0245

   (e) 0.0345

3. The Euler method used to approximate the solution of the Initial-Value Problem $y' = e^{t-y}$, $0 \leq t \leq 1$, $y(0) = 1$ $h = 0.2$. If $y(t) = \ln(e^t + e - 1)$ is the exact solution, then the actual error at $t = 0.4$ is equal to:

(a) 0.0092 (correct)

(b) 0.1061

(c) 0.0501

(d) 0.7161

(e) 0.5501

4. If the Midpoint Method is used to approximate the solution of the initial-value problem
$y' = te^{3t} - 2y$, $0 \leq t \leq 1$, $y(0) = 0$, with $h = 0.5$, then w_1 is equal to

(a) 0.2646 (correct)

(b) 2.1200

(c) 3.1710

(d) 3.1500

(e) 2.130

5. If the Runge-Kutta method of order 4 is used to approximate the soltuion of the initial-value problem

$$y' = 1 + (t - y)^2,\ 2 \le t \le 3,\ y(2) = 1,\ \text{with}\ h = 0.5\ \text{then}\ w_1\ \text{is equal to}$$

(a) 1.833 _____ (correct)

(b) 1.8120

(c) 1.5712

(d) 1.7012

(e) 2.7812

6. The value of B so that the linear system

$$\begin{aligned} x_1 - 2Bx_2 &= 3 \\ 2x_1 + x_2 &= B \end{aligned}$$

has no solution is

(a) -0.25 _____ (correct)

(b) -0.5

(c) 0

(d) -1

(e) 1

7. The row interchanges required to solve the linear system

$$\begin{aligned} -3x_1 + x_2 + x_3 &= 0 \\ 3x_1 + x_2 - x_3 &= 1 \\ 2x_1 - 5x_2 &= -1 \end{aligned}$$

using partial pivoting are,

(a) rows 2 and 3 only _____ (correct)

(b) rows 1 and 2 only

(c) rows 1 and 3, then 2 and 3

(d) rows 1 and 2, then 2 and 3

(e) no row interchanges

8. Consider the linear system

$$\begin{aligned} 2x_1 - x_2 + x_3 &= 0 \\ 3x_1 + 3x_2 + 9x_3 &= 1 \\ 3x_1 + 3x_2 + 5x_3 &= 1 \end{aligned}$$

The matrix form is $Ax = b$, $A = LU$ and $LY = b$ is solved for $Y = (y_1, y_2, y_3)^t$, then $y_1 + y_2 + y_3 =$

(a) 1 _____ (correct)

(b) 2

(c) 3

(d) 1.5

(e) 2.5

9. If $A = \begin{bmatrix} 1 & 2 & -1 \\ 2 & 4 & 0 \\ 0 & 1 & -1 \end{bmatrix}$, find the permutation matrix P then $\underline{AP} =$

(a) $\begin{bmatrix} 1 & -1 & 2 \\ 2 & 0 & 4 \\ 0 & -1 & 1 \end{bmatrix}$ (correct)

(b) $\begin{bmatrix} 0 & 1 & -1 \\ 1 & 2 & -1 \\ 2 & 4 & 0 \end{bmatrix}$

(c) A

(d) $\begin{bmatrix} 1 & 2 & -1 \\ 0 & 1 & -1 \\ 2 & 4 & 0 \end{bmatrix}$

(e) A^t

10. If $A = \begin{bmatrix} 2 & -1 & 3 \\ 0 & 2 & 1 \\ 1 & 2 & 0 \end{bmatrix}$ and $V = (4, 0, -3)^t$, then $\|A\|_\infty \cdot \|V\|_2 =$

(a) 30 (correct)

(b) 20

(c) 24

(d) 25

(e) 35

11. If $A = \begin{bmatrix} 0 & -4 \\ 0 & 3 \end{bmatrix}$, then $\|A\|_2$ is equal to

(a) 5 _____ (correct)

(b) 3

(c) 0

(d) 15

(e) 4

12. If the linear system

$$\begin{aligned} -2x_1 + x_2 + \tfrac{1}{2}x_3 &= 4 \\ x_1 - 2x_2 - \tfrac{1}{2}x_3 &= -4 \\ x_2 + 2x_3 &= 0 \end{aligned}$$

is solved by using the Jacobi method with $X^{(0)} = 0$, then $x_1^{(2)} + x_2^{(2)} =$

(a) 0 _____ (correct)

(b) 1

(c) 2

(d) -1

(e) -2

13. If the linear system

$$\begin{aligned} -2x_1 + x_2 + \tfrac{1}{2}x_3 &= 4 \\ x_1 - 2x_2 - \tfrac{1}{2}x_3 &= -4 \\ x_2 + 2x_3 &= 0 \end{aligned}$$

is solved by using the Gauss-Seidel method with $X^{(0)} = 0$, then $x_1^{(2)} + x_2^{(2)} =$

(a) -0.3125 _____(correct)

(b) -1

(c) 0

(d) -0.4125

(e) -0.3725

14. The matrix $A = \begin{bmatrix} 2 & 1 & 1 \\ 2 & 3 & 2 \\ 1 & 1 & 2 \end{bmatrix}$. Which one of these is an eigenvector of A corresponding to
eigenvalue $\lambda = 1$

(a) $(1, -1, 0)^t$ _____(correct)

(b) $(1, 2, 2)^t$

(c) $(1, 0, 1)^t$

(d) $(3, -2, 0)^t$

(e) $(1, 0, 2)^t$