

Question # 1: Which of the following is the correct expression for the Central Difference method for numerical derivative?

☐  $\frac{f(x+h) - f(x)}{2h}$ .

☐  $\frac{f(x+h) - f(x-h)}{h}$ .

☐  $\frac{f(x) - f(x-h)}{2h}$ .

☒ None of the above.

Question # 2: It is given that  $x = (3.0, 3.1, 3.2, 3.3)$  and the corresponding value of  $f(x) = (2.9, 3.8, 4.2, 4.4)$  respectively. The value of the first derivative of  $f(x)$  at  $x = 3.1$ , using Central Difference method, will be

☐ 7.

☒ 6.5.

☐ 3.5.

☐ None of the above.

Question # 3: What is the order of convergence for the Bisection method?

☐ Greater than 1.

☐ 0.

☒  $\frac{1}{2}$ .

☐ 1.

Question # 4: A fixed point for  $g(x)$  occurs when the graph of  $y = g(x)$  intercepts with the graph of

☐  $y = x - g(x)$ .

☒  $y = x$ .

☐  $y = g(x) - x$ .

☐ None of the above.

Question # 5: Let's say a function is continuous in the interval  $[1.5, 3]$  and the upper bound error is **0.00001**. How many times do we need to iterate to approximate the root?

☐ 12.

☐ 15.

☐ 10.

☒ None of the above.

Question # 6: Consider the quadratic equation  $x^4 - x - 8 = 0$ . Starting with the initial guess of 1 and 2, find the approximated value of  $x_2$  using the Secant Method.

☒ 1.571.

☐ 4.567.

☐ 7.538.

☐ 7.345.

Question # 7: An equation for  $f(x)$  is given as  $x^2 - 4 = 0$ . If the initial approximation is  $x = 6$ , then what will be the value of the next iteration using Newton's method?

☐ 4.33.

☐ 2.33.

☐ 1.33.

☒ 3.33.

Question # 8: Rate of convergence of the Newton Method is generally

☐ Cubic.

☐ Linear.

☒ Super Linear.

☐ Quadratic.

Question # 9: Which of the following statements is true?

- ☐ We need 2 starting points in the Secant method.
- ☐ We can apply Aitken's acceleration to Newton's method.
- ☐ Newton's method fails when reaching turning points.
- ☒ All of them.

Question # 10: Which of the following statements is false about pivoting?

- ☐ Pivoting is used to avoid large multipliers
- ☐ Pivoting means swapping rows or columns.
- ☒ Pivoting swaps 0's and 1's of the left diagonal.
- ☐ Pivoting is used to reduce rounding error.

Question # 11: A linear system is defined by the matrix equation  $Ax = b$ . This system has a unique solution if  $A$  is

- ☐  $\begin{pmatrix} 2 & 0 \\ 2 & 0 \end{pmatrix}$ .
- ☐  $\begin{pmatrix} 0 & 0 \\ 2 & 3 \end{pmatrix}$ .
- ☐  $\begin{pmatrix} 2 & 2 \\ 2 & 2 \end{pmatrix}$ .
- ☒  $\begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix}$ .

Question # 12: How many operations are required to solve a linear system where  $Lx = b$ ? Here,  $L$  is a lower triangular  $3 \times 3$  matrix.

- ☐ 27.
- ☐ 6.
- ☒ 9.
- ☐ 3.

Question # 13: In the  $LU$ -decomposition of the matrix  $\begin{pmatrix} 2 & 3 \\ 4 & 9 \end{pmatrix}$ , we have lower triangular matrix  $\begin{pmatrix} 1 & 0 \\ L_{21} & 1 \end{pmatrix}$ . What will be the value of  $L_{21}$ ?

☐ 4.

☒ 2.

☐ 3.

☐ 1.

Question # 14: What is the norm of the 3d-vector  $(\sqrt{2}, 2, \sqrt{2})$ ?

☐ 8.

☐ 2.

☐ 4.

☒  $2\sqrt{2}$ .

Question # 15: A set is orthonormal if

- (i) every pair of vectors are orthogonal.
- (ii) only one pair of vectors are orthogonal.
- (iii) all the vectors are unit vector.
- (iv) only the vectors not included in orthogonal pairs are unit vectors.

☐ (ii) and (iii) only.

☒ (i) and (iii) only.

☐ (ii) and (iv) only.

☐ (i) only.