1. Interpolation is a process for
   a) extracting feasible data set from a given set of data
   b) finding a value between two points on a line or curve.
   c) removing unnecessary points from a curve
   d) all of the mentioned

Solution: (b) Interpolation is the process of finding a value between two points on a line or curve.

2. Given two data points $(a, f(a))$ and $(b, f(b))$, the linear Lagrange polynomial $f(x)$ that passes through these two points are given as

   a) $f(x) = \frac{x-b}{a-b} f(a) + \frac{x-a}{a-b} f(b)$

   b) $f(x) = \frac{x}{a-b} f(a) + \frac{x}{b-a} f(b)$

   c) $f(x) = f(a) + \frac{f(b)-f(a)}{b-a} f(b)$

   d) $f(x) = \frac{x-b}{a-b} f(a) + \frac{x-a}{b-a} f(b)$

Solution: (d)
Given a set of n points, Lagrange interpolation formula is

$$f(x) = \sum_{i=0}^{n-1} L_i(x) f(x_i)$$

$$L_i(x) = \prod_{\substack{j=0 \\ j\neq i}}^{n-1} \frac{x - x_j}{x_i - x_j}$$

Thus, $f(x) = \frac{x-b}{a-b} f(a) + \frac{x-a}{b-a} f(b)$

3. To solve a differential equation using Runge-Kutta method, necessary inputs from user to the algorithm is/are
   a) the differential equation dy/dx in the form x and y
   b) the step size based on which the iterations are executed.
   c) the initial value of y.
   d) all the above

Solution: (d) The differential equation, step size and the initial value of y are required to solve differential equation using Runge-Kutta method.

4. A Lagrange polynomial passes through three data points as given below

x	10	15	20
$f(x)$	3	5.2	6.8

   The polynomial is determined as $f(x) = L_0(x).3 + L_1(x).(5.2) + L_2(x).(6.8)$
   The value of $L_1(x)$ at $x = 18$ is
   a) 0.64
   b) 3.33
   c) 2.67
   d) 0.56

Solution: (a)

$$L_1(x) = \prod_{\substack{j=0 \\ j\neq 1}}^{2} \frac{x - x_j}{x_1 - x_j} = \frac{(18-10)(18-20)}{(15-10)(15-20)} = \frac{16}{25} = 0.64$$

5. The value of $\int_0^{3.2} xe^x dx$ by using one segment trapezoidal rule is
   a) 172.7
   b) 125.6
   c) 136.2
   d) 142.8

Solution: (b)

$$\int_a^b f(x)dx = (b-a)\frac{f(b)-f(a)}{2}$$

Here, $a = 0, b = 3.2, f(a) = 0$ and $f(b) = 78.5$. Hence, $\int_0^{3.2} xe^x dx = 125.6$

6. Accuracy of the trapezoidal rule increases when
   a) integration is carried out for sufficiently large range
   b) instead of trapezoid, we take rectangular approximation function
   c) number of segments are increased
   d) integration is performed for only integer range

Solution: (c) Approximation increases with the increase of the number of segments between the lower and upper limit.

7. Solve the ordinary differential equation below using Runge-Kutta 4th order method. Step size h=0.2.

$$5\frac{dy}{dx} + xy^3 = \cos(x), y(0) = 3$$

   The value of y(0.2) is (upto two decimal points)
   a) 2.86
   b) 2.93
   c) 3.13
   d) 3.08

Solution: (b)

8. Which of the following cannot be a structure member?
   a) Another structure
   b) function
   c) array
   d) none of the above

Solution: (b) A function cannot be a structure member.

9. Using Bisection method, negative root of x^3 - 4x + 9 = 0 correct to three decimal places is

   a) -2.506
   b) -2.706
   c) -2.406
   d) None

Solution: (b) -2.706

10. Match the following

A. Newton Method	1. Integration
B. Lagrange Polynomial	2. Root finding
C. Trapezoidal Method	3. Differential Equation

D. Runge Kutta Method 4. Interpolation

a) A-2, B-4, C-1, D-3
b) A-3, B-1, C-2, D-4
c) A-1, B-4, C-3, D-2
d) A-2, B-3, C-4, D-1

Solution: (a)

11. The value of $\int_{2.5}^{4} \ln x \, dx$ calculated using the Trapezoidal rule with five subintervals is (* range is given in output rather than single value to avoid approximation error)
    a) 1.45 to 1.47
    b) 1.74 to 1.76
    c) 1.54 to 1.56
    d) 1.63 to 1.65

Solution: (b) 1.74 to 1.76

12. The real root of the equation $5x - 2\cos x - 1 = 0$ (up to two decimal accuracy) is [You can use any method known to you. A range is given in output rather than single value to avoid approximation error]
    a) 0.53 to 0.56
    b) 0.45 to 0.47
    c) 0.35 to 0.37
    d) 0.41 to 0.43

Solution: (a) 0.53 to 0.56

13. Which of the statement is correct?

    a) For recursion the stack is used to store the set of new local variables and parameters each time the function is called whereas iteration does not use stack.
    b) For iteration the stack is used to store the set of new local variables and parameters each time it's called whereas recursion does not use stack
    c) Both recursion and iteration use stacks for storing values
    d) None of the above.

Solution: (a) For recursion the stack is used to store the set of new local variables and parameters each time the function is called whereas iteration does not use stack.

14. Consider a recursive C function that takes two arguments as below

```
unsigned int func(unsigned int n, unsigned int r)
{
  if (n  > 0) return (n % r +  func (n / r, r ));
  else return 0;
}
```

What is the return value of the function when it is called as func(513, 2)?

a) 9
b) 8
c) 5
d) 2

Solution: (d) 2

func(513, 2) will return 1 + func(256, 2). All subsequent recursive calls (including func(256, 2)) will return 0 + func(n/2, 2) except the last call func(1, 2) . The last call func(1, 2) returns 1. So, the value returned by func(513, 2) is 1 + 0 + 0…. + 0 + 1=2.

15. What is the output?

```
#include <stdio.h>
 int fun(int n)
{
    if (n == 4)
       return n;
    else return 2*fun(n+1);
}
 int main()
{
   printf("%d ", fun(2));
   return 0;
}
```

a) 4
b) 8
c) 16
d) Error

Solution: (c) 16