RAMAKRISHNA MISSION VIVEKANANDA CENTENARY COLLEGE'RAHARA

KOLKATA-700118

PHYSICS LEBRATORY NOTEBOOK

PHSA CC-1

REGISTRATION No. : AO1-1152-111-042-2018

EXAMINATION ROLL NO. : 201811040

SEMESTER : 1st SEMESTER

YEAR : 2018

INDEX

QUESTION : 01

Write a program to determine the factorial of first 20 integer number.

Program :

```
//DETERMINATION OF FACTORIAL OF FIRST 20 NUMBERS

#include <stdio.h>
#include <math.h>

int main(void)
{
      printf("\tFACTORIAL OF FIRST 20 NUMBERS\n\v");

      double x;
      int i,n;

      n=20;
      x=1.0;

      for(i=1;i<=n;i++)
      {
            x=x*i;
           printf("\nThe factorial of %d is %0.3f",i,x);
      }
}
```

Output :

FACTORIAL OF FIRST 20 NUMBERS

The factorial of 1 is 1.000
The factorial of 2 is 2.000
The factorial of 3 is 6.000
The factorial of 4 is 24.000
The factorial of 5 is 120.000
The factorial of 6 is 720.000
The factorial of 7 is 5040.000
The factorial of 8 is 40320.000
The factorial of 9 is 362880.000
The factorial of 10 is 3628800.000
The factorial of 11 is 39916800.000
The factorial of 12 is 479001600.000
The factorial of 13 is 6227020800.000
The factorial of 14 is 87178291200.000
The factorial of 15 is 1307674368000.000
The factorial of 16 is 20922789888000.000
The factorial of 17 is 355687428096000.000

The factorial of 18 is 6402373705728000.000
The factorial of 19 is 121645100408832000.000
The factorial of 20 is 2432902008176640000.000

QUESTION : 02

Write the program to determine the value of e^x when the value of x equals to 1 .

Program :

```
//DETERMINATION OF THE VALUE OF e^x

#include <stdio.h>
#include <math.h>

int main(void)
{
      printf("\tTHE VALUE OF e^x\n\v");

      float x,sum,t;
      int i,n,f;

      x=1.0;
      sum=0.0;
      n=5;
      f=1;

      for(i=1;i<=n;i++)
      {
            f=f*i;
            t=pow(x,i)/f;
            printf("\nThe %d no. of term is %f",i,t);

            sum=sum+t;
      }
      printf("\n\vThe value of e^(%0.1f) = %f",x,sum+1);
}
```

Output :

```
      THE VALUE OF e^x


The 1 no. of term is 1.000000
The 2 no. of term is 0.500000
The 3 no. of term is 0.166667
The 4 no. of term is 0.041667
The 5 no. of term is 0.008333

The value of e^(1.0) = 2.716667
```

QUESTION : 03

Write a program to determine the value of sin(x) when x=30° by using Taylor expansion.

Program :

```
//DETERMINATION OF THE VALUE OF sinX

#include <stdio.h>
#include <math.h>

int main(void)
{
      printf ("\tTHE VALUE OF sinX\n\v");

      float x,a,t,sum;
      int i,n,z,f;

      x=30.0;

      a=4*atan(1)*x/180;
      sum=0.0;
      z=1;
      f=1;
      n=12;

      for(i=1;i<=12;i++)
      {
            f=f*i;

            if(i%2==1)
            {
                  z=z+1;
                  t=pow(a,i)*pow(-1,z)/f;
                  printf("The %d no. term is %f\n",i,t);

                  sum=sum+t;
            }
            f=1;
            t=0.0;
      }

      printf("\vThe value of sin(%0.2f) = %0.5f",x,sum);
}
```

Output :

THE VALUE OF sinX

The 1 no. term is 0.523599
The 3 no. term is -0.047849

The 5 no. term is 0.007871
The 7 no. term is -0.001541
The 9 no. term is 0.000329
The 11 no. term is -0.000074

The value of sin(30.00) = 0.48233

QUESTION : 04

Write a program to determine the value of cos(x) when x=60° by using Taylor expansion.

Program :

```
//DETERMINATION OF THE VALUE OF cosX

#include <stdio.h>
#include <math.h>

int main(void)
{
      printf ("\tTHE VALUE OF cosX\n\v");

      float x,a,t,sum;
      int i,n,z,f;

      x=60.0;

      a=4*atan(1)*x/180;
      sum=1.0;
      n=7;
      z=0;
      f=1;
      i=1;

      do
      {
            i=i+1;
            f=f*i;

            if(i%2==0)
            {
                  z=z+1;
                  t=pow(a,i)*pow(-1,z)/f;
                  printf("\nThe %d no. term is %f",i,t);
                  sum=sum+t;
            }
      }
      while (i<=n);

     printf("\v\nThe value of cos(%0.2f) = %0.5f",x,sum);
}
```

Output :

THE VALUE OF cosX

The 2 no. term is -0.548311

The 4 no. term is 0.050108
The 6 no. term is -0.001832
The 8 no. term is 0.000036

The value of cos(60.00) = 0.50000

QUESTION : 05

Write a program to determine the value of $\log_e x$ for x=5 by using Taylor expansion.

Program :

```
 //DETERMINATION OF THE VALUE OF lnX

#include <stdio.h>
#include <math.h>

int main(void)
{
      printf("\tTHE VALUE OF lnX\v\n");

      float x,y,a,t,sum;
      int i,n;

      x=5.0;

      y=1/x;
      a=y-1.0;
      sum=0.0;
      n=20;
      i=0;

      do
      {
            i=i+1;

            t=pow(a,i)*pow(-1,i+1)/i;
            printf("The %d no. term is %f\n",i,-t);
            sum=sum+t;
      }
      while(i<=n);
      printf("\nThe value of ln(%0.2f) is %f",x,-sum);
}
```

Output :

THE VALUE OF lnX

The 1 no. term is 0.800000
The 2 no. term is 0.320000
The 3 no. term is 0.170667
The 4 no. term is 0.102400
The 5 no. term is 0.065536
The 6 no. term is 0.043691
The 7 no. term is 0.029959
The 8 no. term is 0.020972
The 9 no. term is 0.014913
The 10 no. term is 0.010737
The 11 no. term is 0.007809

The 12 no. term is 0.005727
The 13 no. term is 0.004229
The 14 no. term is 0.003141
The 15 no. term is 0.002346
The 16 no. term is 0.001759
The 17 no. term is 0.001325
The 18 no. term is 0.001001
The 19 no. term is 0.000759
The 20 no. term is 0.000576
The 21 no. term is 0.000439

The value of ln(5.00) is 1.607985

QUESTION : 06

Write a program to determine the value of π by using the Ramanujan's infinite series for π.

Program :

```
//DETERMINATION OF THE VALUE OF π

#include <stdio.h>
#include <math.h>

 int main(void)
 {
      printf("\tTHE VALUE OF π\v\n");

      float a,b,c,d,x,y,t,t0,sum;
      int i,j,k,p,n,u,v;

       a=sqrt(8.0);
       b=9801.0;
       i=0;
       n=5;
       u=1;
       v=-1;

       t0=(1*(1103+26390*0))/(1*1);
       /* as we know that,
            0! = 1
          so,
             (4*0)! = 1
             pow(0!,4) = 1
          and, we also know that,
            pow(396,4*0)= 1 */
       sum=t0;

       do
       {
            i=i+1;
            p=4*i;

            for(j=1;j<=p;j=j+1)
            {
                  u=u*j;
            }

            for(k=1;k<=i;k=k+1)
            {
                  v=v*k;
            }
```

```
            c=u*(1103+26390*i);
            d=pow(v,4)*pow(396,p);

            t=c/d;
            sum=sum+t;
        }
        while(i<=n);
        y=a*sum/b;
        x=1/y;

         printf("The value of π is %f",x);
    }
```

Output :

THE VALUE OF π

The value of π is 3.141593

QUESTION : 07

Write a program to swap the values of two variables without using third variable.

Program :

```
//SWAPPING OF VALUES OF TWO VARIABLES

#include <stdio.h>
#include <math.h>

 int main(void)
 {
      printf("\tSWAPPING OF VALUES OF TWO VARIABLES\v");

      int x,y;

      x=3;
      y=8;
      printf("\nAt first, x= %d and y= %d\n",x,y);

      x=x+y;
      y=x-y;
      x=x-y;
      printf("\nAfter swapping: x= %d and y= %d",x,y);
 }
```

Output :

SWAPPING OF VALUES OF TWO VARIABLES

At first, x= 3 and y= 8

After swapping: x= 8 and y= 3

QUESTION : 08

Write a program to determine the square roots of a number by using Bisection Method.

Program :

```
//DETERMINATION OF SQUARE ROOT OF A NUMBER BY BISECTION METHOD

#include <stdio.h>
#include <math.h>

float f(float x)
{
      return x*x-12;
}
int main(void)
{
      printf("\tDETERMINATION OF SQUARE ROOT\n\v");

      double error,a,b,c,d;

      a=1;
      b=5;
      error=0.000000000000001;

      do
      {
            c=(a+b)/2;
            d=f(c);

            if(d<0)
            {
                  a=c;
            }
            else
            {
                  b=c;
            }
      }
      while(fabs(b-a)>=error);

      printf("The value of square root is %f",c);

}
```

Output :

DETERMINATION OF SQUARE ROOT

The value of square root is 3.464101

QUESTION : 09

Write a program to determine the value of square root of a number by using Newton-Raphson Method.

Program :

```
//DETERMINATION OF THE SQUARE ROOT OF A NUMBER BY USING NEWTON-
RAPHSON METHOD

#include <stdio.h>
#include <math.h>

int main(void)
{
      printf("\tDETERMINATION OF SQUARE ROOT\n\v");

      float n,x0,x1,f,df;

      n=8.0;

      x1=5.0;
      do
      {
            x0=x1;
            f= x0*x0-n;
            df= 2.0*x0;

            x1 = x0-(f/df);
      }
      while(fabs(x1-x0)>=0.000001);

      printf("The root of %0.2f is %f",n,x1);
}
```

Output :

DETERMINATION OF SQUARE ROOT

The root of 8.00 is 2.828427

QUESTION : 10

Write a program to determine the roots and nature of roots of a quadratic equation.

Program :

```
//DETERMINATION OF THE ROOTS AND NATURE OF ROOTS OF A QUADRATIC
EQUATION

#include <stdio.h>
#include <math.h>

int main(void)
{
      printf("\tDETERMINATION OF ROOTS AND NATURE OF ROOTS\v\n");

      double a,b,c,d,r1,r2,r,i;
      /* if the equation is,
                  x*x-6*x+10=0
            then,
                  a= 1.0 , b= -6.0 , c= 10.0
      */
      a=1.0;
      b=-6.0;
      c=10.0;

      d=b*b-4*a*c;

      if(d>0.0)
      {
            printf("The roots are real and distinct");
            r1=(-1*b+sqrt(d))/(2*a);
            r2=(-1*b-sqrt(d))/(2*a);
            printf("\nThe roots are r1= %f and r2= %f",r1,r2);
      }
      else if(d==0.0)
      {
            printf("The roots are real and  equal");
            r1=(-1*b+sqrt(d))/(2*a);
            r2=(-1*b-sqrt(d))/(2*a);
            printf("\nThe roots are r1= %f and r2= %f",r1,r2);
      }
      else
      {
            printf("The roots are complex");
            r=(-1*b)/2*a;
            i=(sqrt(fabs(d)))/(2*a);
            printf("\nThe roots are r1= %f+%fi and r2= %f-
%fi",r,i,r,i);
      }
}
```

Output :

DETERMINATION OF ROOTS AND NATURE OF ROOTS

The roots are complex
The roots are r1= 3.000000+1.000000i and r2= 3.000000-1.000000i

QUESTION : 11

Write a program to integrate a function by using Trapezoidal Method.

Program :

```
//DETERMINATION OF THE INTEGRATION OF A FUNCTION BY USING
TRAPEZOIDAL METHOD

#include <stdio.h>
#include <math.h>

int main()
{
      printf("\tDETERMINATION OF INTEGRATION OF A FUNCTION\n\v");

      float a,b,p,h,fa,fb,fp,s,sum;
      int n,i;

      /* suppose, the function is,
                  f(x)=x*x-6*x+10=0
           and we are going to integrate this from x=3.0 to x=10.0
      */
      a=3.0;
      b=10.0;

      n=100000;
      h=(b-a)/(n-1);
      s=0.0;

      fa=a*a-6*a+10;
      fb=b*b-6*b+10;

      for(i=1;i<n;i++)
      {
            p=a+i*h;
            fp=p*p-6*p+10;

            s=s+fp;
      }
      sum=h*(fa+fb+2*s)/2;

      printf("Integration of the function f(x),from x=%0.2f to
x=%0.2f is  %f",a,b,sum);
}
```

Output :

```
DETERMINATION OF INTEGRATION OF A FUNCTION

Integration of the function f(x),from x=3.00 to x=10.00 is  121.336884
```

QUESTION : 12

Write a program to determine the integration of a function by using Simpson's One-third Method.

Program :

```
//DETERMINATION OF THE INTEGRATION OF A FUNCTION BY USING SIMPSON'S
1/3 METHOD

#include <stdio.h>
#include <math.h>

int main()
{
      printf("\tDETERMINATION OF INTEGRATION OF A FUNCTION\n\v");

      float a,b,p,h,fa,fb,fp,s,sum;
      int n,i;

      /* suppose, the function is,
                f(x)=x*x+x+1=0
           and we are going to integrate this from x=1.0 to x=5.0
      */
      a=1.0;
      b=5.0;

      n=100000;
      h=(b-a)/(n-1);
      s=0.0;

      fa=a*a+a+1;
      fb=b*b+b+1;

      for(i=1;i<n;i++)
      {
            p=a+i*h;
            fp=p*p+p+1;

            if(i%2==1)
            {
                  s=s+4*fp;
            }
            else
            {
                  s=s+2*fp;
            }
      }
      sum=h*(fa+fb+s)/3;
```

```
        printf("Integration of the function f(x),from x=%0.2f to
    x=%0.2f is  %f",a,b,sum);
    }
```

Output :

DETERMINATION OF INTEGRATION OF A FUNCTION

Integration of the function f(x),from x=1.00 to x=5.00 is 57.334579

QUESTION : 13

Write a program to determine the standard deviation of a set of numbers.

Program :

```
//DETERMINATION OF THE STANDARD DEVIATION OF A SET OF NUMBERS

#include <stdio.h>
#include <math.h>

int main(void)
{
      printf("\tDETERMINATION OF STANDARD DEVIATION\v\n");

      float s,s2,m,m2,sd;
      float set[8]={2.2,2.8,2.3,2.9,2.4,3.1,2.7,2.5};
      int i,n;

      n=8;
      s=0.0;
      s2=0.0;

      printf("The set of number is\nset[%d]={",n);
      for(i=0;i<n;i++)
      {
            printf("%0.2f\t",set[i]);

            s=s+set[i];
            s2=s2+set[i]*set[i];
      }
      printf("}");

      m=s/n;
      m2=s2/n;

      sd=sqrt(m2-m);

      printf("\nThe standard deviation of the set of numbers is
%f",sd);
}
```

Output :

```
      DETERMINATION OF STANDARD DEVIATION

The set of number is
set[8]={2.20  2.80   2.30   2.90   2.40   3.10   2.70   2.50  }
The standard deviation of the set of numbers is 2.073343
```