10. Simpsons Rule

Q1. Solve and integrate the following equation : $\frac{1}{1+x}$

In[1]:=

```
a = Input["Enter the left end limit : "]
b = Input["Enter the right end limit : "]
n = Input["Enter the numbe of sub intervals to be formed : "]
h = (b - a) / n;
y = Table[a + i * h, {i, 1, n}];
f[x] := 1 / (1 + x);
sumodd = 0;
sumeven = 0;
For[i = 1, i < n, i += 2, sumodd += 4 * f[x] /. x → y[[i]]];
For[i = 2, i < n, i += 2, sumeven += 2 * f[x] /. x → y[[i]]];
sn = (h / 3) * ((f[x] /. x → a) + N[sumodd] + N[sumeven] + (f[x] /. x → b));
Print["For n = ", n, " Simpsons estimate is: ", sn]
in = Integrate[1 / (1 + x), {x, 0, 1}]
Print["The value is : ", in]
Print["Absolute Error : ", Abs[sn - in]]
```

Out[1]= 0

Out[2]= 1

Out[3]= 4

```
For n = 4 Simpsons estimate is: 0.693254
```

Out[13]= Log[2]

```
The value is : Log[2]

Absolute Error : 0.000106788
```

Q2. Solve the following equation : $x + 1$

In[63]:=
```
a = Input["Enter the left end limit : "]
b = Input["Enter the right end limit : "]
n = Input["Enter the numbe of sub intervals to be formed : "]
h = (b - a) / n;
y = Table[a + i * h, {i, 1, n}];
f[x] := x + 1;
sumodd = 0;
sumeven = 0;
For[i = 1, i < n, i += 2, sumodd += 4 * f[x] /. x → y[[i]]];
For[i = 2, i < n, i += 2, sumeven += 2 * f[x] /. x → y[[i]]];
sn = (h / 3) * ((f[x] /. x → a) + N[sumodd] + N[sumeven] + (f[x] /. x → b));
Print["For n = ", n, " Simpsons estimate is: ", sn]
in = Integrate[(x + 1), {x, 0, 4}]
Print["The value is : ", in]
Print["Absolute Error : ", Abs[sn - in]]
```

Out[63]= 0

Out[64]= 4

Out[65]= 20

```
For n = 20 Simpsons estimate is: 12.
```

Out[75]= 12

```
The value is : 12

Absolute Error : 0.
```

Q3. Solve the following equation : $\frac{1}{\sqrt{x^2+x-4}}$

In[79]:=
```
a = Input["Enter the left end limit : "]
b = Input["Enter the right end limit : "]
n = Input["Enter the numbe of sub intervals to be formed : "]
h = (b - a) / n;
y = Table[a + i * h, {i, 1, n}];
f[x] := 1 / Sqrt[x^2 + x - 4];
sumodd = 0;
sumeven = 0;
For[i = 1, i < n, i += 2, sumodd += 4 * f[x] /. x → y[[i]]];
For[i = 2, i < n, i += 2, sumeven += 2 * f[x] /. x → y[[i]]];
sn = (h / 3) * ((f[x] /. x → a) + N[sumodd] + N[sumeven] + (f[x] /. x → b));
Print["For n = ", n, " Simpsons estimate is: ", sn]
in = Integrate[1 / Sqrt[x^2 + x - 4], {x, 5, 8}]
Print["The value is : ", in]
Print["Absolute Error : ", Abs[sn - in]]
```

Out[79]= 5

Out[80]= 8

Out[81]= 10

```
For n = 10 Simpsons estimate is: 0.457411
```

Out[91]= $\text{Log}\left[17 + 4\sqrt{17}\right] - \text{Log}\left[11 + 2\sqrt{26}\right]$

The value is : $\text{Log}\left[17+4\sqrt{17}\right]-\text{Log}\left[11+2\sqrt{26}\right]$

Absolute Error : 5.29419×10^{-7}

Q4. Solve : $x + x\text{^}2 + x\text{^}5 + \frac{1}{x}$

In[109]:=
```
a = Input["Enter the left end limit : "]
b = Input["Enter the right end limit : "]
n = Input["Enter the numbe of sub intervals to be formed : "]
h = (b - a) / n;
y = Table[a + i * h, {i, 1, n}];
f[x] := x + x^2 + x^5 + 1/x;
sumodd = 0;
sumeven = 0;
For[i = 1, i < n, i += 2, sumodd += 4 * f[x] /. x → y[[i]]];
For[i = 2, i < n, i += 2, sumeven += 2 * f[x] /. x → y[[i]]];
sn = (h / 3) * ((f[x] /. x → a) + N[sumodd] + N[sumeven] + (f[x] /. x → b));
Print["For n = ", n, " Simpsons estimate is: ", sn]
in = Integrate[x + x^2 + x^5 + 1/x, {x, 1, 10}]
Print["The value is : ", in]
Print["Absolute Error : ", Abs[sn - in]]
```

Out[109]= 1

Out[110]= 10

Out[111]= 50

For n = 50 Simpsons estimate is: 167051.

Out[121]= $167049 + \text{Log}[10]$

The value is : $167049 + \text{Log}[10]$

Absolute Error : 0.0346747