Practical 13 : - Euler' s Method

Approximate the function values for the given differential equation.

$$Q1 : \frac{dx}{dt} = 1 + \frac{x}{t}, \quad 1 \le t \le 6, \quad x(1) = 1$$

In[191]:=
```
Clear[t, x, a, b, n, h, i, w];
f[t_, x_] := 1 + x/t;
n = 10; a = 1; b = 6;
h = (b - a)/n;
Array[w, n, 0];
w[0] = 1;
For[i = 1, i ≤ n, ++i,
 w[i] = w[i - 1] + h * f[(a + (i - 1) * h), w[i - 1]];
]
For[i = 0, i ≤ n, ++i,
 Print["x : ", N[a + i * h, 2], " = ", N[w[i], 10]]
]
```

```
x : 1.0 = 1.000000000

x : 1.5 = 2.000000000

x : 2.0 = 3.166666667

x : 2.5 = 4.458333333

x : 3.0 = 5.850000000

x : 3.5 = 7.325000000

x : 4.0 = 8.871428571

x : 4.5 = 10.48035714

x : 5.0 = 12.14484127

x : 5.5 = 13.85932540

x : 6.0 = 15.61926407
```

Q2 : $\frac{dx}{dt} = \frac{t}{x}$, $0 \le t \le 5$, $x(0) = 1$

In[207]:=
```
Clear[t, x, a, b, n, h, i, w];
f[t_, x_] := t/x;
n = 10; a = 0; b = 5;
h = (b - a)/n;
Array[w, n, 0];
w[0] = 1;
For[i = 1, i ≤ n, ++i,
 w[i] = w[i - 1] + h * f[(a + (i - 1) * h), w[i - 1]];
]
For[i = 0, i ≤ n, ++i,
 Print["x : ", N[a + i * h, 2], " = ", N[w[i], 10]]
]
```

```
x : 0 = 1.000000000
x : 0.50 = 1.000000000
x : 1.0 = 1.250000000
x : 1.5 = 1.650000000
x : 2.0 = 2.104545455
x : 2.5 = 2.579707442
x : 3.0 = 3.064258511
x : 3.5 = 3.553773346
x : 4.0 = 4.046207677
x : 4.5 = 4.540497679
x : 5.0 = 5.036038071
```

Q3 : $\frac{dx}{dt} = tx^3 - x$, $0 \le t \le 1$, $x(0) = 1$

In[215]:=
```
Clear[t, x, a, b, n, h, i, w];
f[t_, x_] := t/x;
n = 4; a = 0; b = 1;
h = (b - a)/n;
Array[w, n, 0];
w[0] = 1;
For[i = 1, i ≤ n, ++i,
 w[i] = w[i - 1] + h * f[(a + (i - 1) * h), w[i - 1]];
]
For[i = 0, i ≤ n, ++i,
 Print["x : ", N[a + i * h, 2], " = ", N[w[i], 10]]
]
```

```
x : 0 = 1.000000000
x : 0.25 = 1.000000000
x : 0.50 = 1.062500000
x : 0.75 = 1.180147059
x : 1.0 = 1.339025563
```