ASSIGNMENT 2 Soujatya Roy 16CH10046

1.

|  |  |
| --- | --- |
| k | RKG |
| 0 | 1.02954 |
| 1 | 1.06045 |
| 2 | 1.09286 |
| 3 | 1.12686 |
| 4 | 1.16259 |
| 5 | 1.20018 |
| 6 | 1.23979 |
| 7 | 1.2816 |
| 8 | 1.32578 |
| 9 | 1.37256 |

#include <iostream>

#include <math.h>

using namespace std;

int main()

{

int i=0;

double y=1, h=0.01, k1, k2, k3, k4, y1;

for(i=1;i<=10;i++)

{

k1=2\*y\*y;

k2=(y+(h\*k1)/2)\*(y+(h\*k1)/2);

k3=2\*pow(((1/pow(2,0.5)-1/2)\*h\*k1+(1-1/pow(2,0.5))\*h\*k2+y), 2);

k4=2\*pow((y-(1/pow(2,0.5)\*h\*k2)+(1+1/pow(2,0.5)\*h\*k3)), 2);

y1=y+(h/6)\*(k1+(2-pow(2,0.5))\*k2+(2+pow(2,0.5))\*k3+k4);

cout<<"\n"<<y1;

y=y1;

}

return 0;

}

2.

RK4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| k | t | RK4(x) | Analytical(x) | error |
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0.1 | 0.081219 | 0.07305985 | 0.00816 |
| 2 | 0.2 | 0.163772 | 0.14708899 | 0.016683 |
| 3 | 0.3 | 0.249082 | 0.22310884 | 0.025973 |
| 4 | 0.4 | 0.338762 | 0.30225114 | 0.036511 |
| 5 | 0.5 | 0.434749 | 0.38582957 | 0.048919 |
| 6 | 0.6 | 0.539487 | 0.47543494 | 0.064052 |
| 7 | 0.7 | 0.656203 | 0.57306973 | 0.083133 |
| 8 | 0.8 | 0.789361 | 0.68134803 | 0.108013 |
| 9 | 0.9 | 0.94541 | 0.80380644 | 0.141604 |
| 10 | 1 | 1.13414 | 0.94540963 | 0.18873 |

#include <iostream>

#include <math.h>

using namespace std;

int main()

{

int i=0;

double x=0, h=0.1, k1, k2, k3, k4, x1;

for(i=1;i<=10;i++)

{

k1=x\*x+0.81;

k2=pow((x+0.5\*h\*k1),2)+0.81;

k3=pow((x+0.5\*h\*k2),2)+0.81;

k4=pow((x+h\*k3),2)+0.81;

x1=x+(h/6)\*(k1+2\*k2+2\*k3+k4);

cout<<"\n"<<x1;

x=x1;

}

return 0;

}

RKF45

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| k | t | RKF45(x) | Analytical(x) | error |
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0.1 | 0.113588 | 0.07305985 | 0.040528 |
| 2 | 0.2 | 0.13917 | 0.14708899 | 0.007919 |
| 3 | 0.3 | 0.14437 | 0.22310884 | 0.078739 |
| 4 | 0.4 | 0.145469 | 0.30225114 | 0.156782 |
| 5 | 0.5 | 0.145705 | 0.38582957 | 0.240125 |
| 6 | 0.6 | 0.145756 | 0.47543494 | 0.329679 |
| 7 | 0.7 | 0.145767 | 0.57306973 | 0.427303 |
| 8 | 0.8 | 0.145769 | 0.68134803 | 0.535579 |
| 9 | 0.9 | 0.14577 | 0.80380644 | 0.658036 |
| 10 | 1 | 0.14577 | 0.94540963 | 0.79964 |

#include <iostream>

#include <math.h>

using namespace std;

int main()

{

int i=0;

double x=0, h=0.1, k1, k2, k3, k4, k5, k6, x1, tol=0.000001, x2;

for(i=1;i<=10;i++)

{

k1=x\*x+0.81;

k2=pow((x+k1/4.0),2)+0.81;

k3=pow((x+(3/32.0)\*k1+(9.0/32)\*k2),2)+0.81;

k4=pow((x+(1932.0/2197)\*k1-(7200.0/2197)\*k2+(7296.0/2197)\*k3),2)+0.81;

k5=pow((x+(439.0/216)\*k1-8\*k2+(3680.0/513)\*k3-(845.0/4104)\*k4),2)+0.81;

k6=pow((x-(8.0/27)\*k1+2\*k2-(3544.0/2565)\*k3+(1859.0/4104)\*k4-(11.0/40)\*k5),2)+0.81;

x1=x+h\*((16.0/135)\*k1+(6656.0/12825)\*k3+(28561.0/56430)\*k4-(9.0/50)\*k5+(2/55.0)\*k6);

x2=x+h\*((25.0/216)\*k1+(1408.0/2565)\*k3+(2197.0/4104)\*k4-(1.0/5)\*k5);

h=0.840896\*h\*pow(((tol\*h)/abs(x1-x2)),0.25);

cout<<"\n"<<x1;

x=x1;

}

return 0;

}

At t=1, error of RK4 is 0.18873 and of RKF45 is 0.79964.

Therefore the error of RKF45 is more in this case.