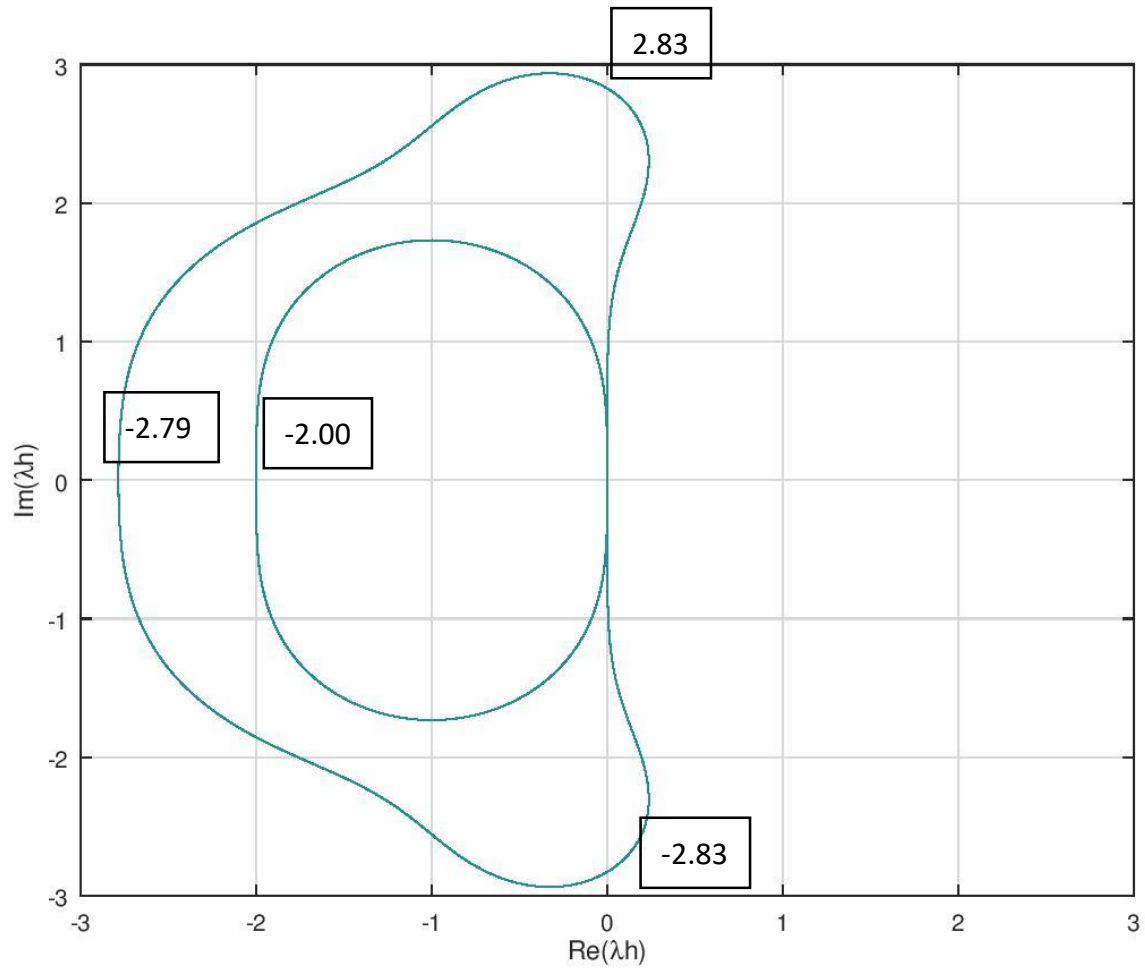


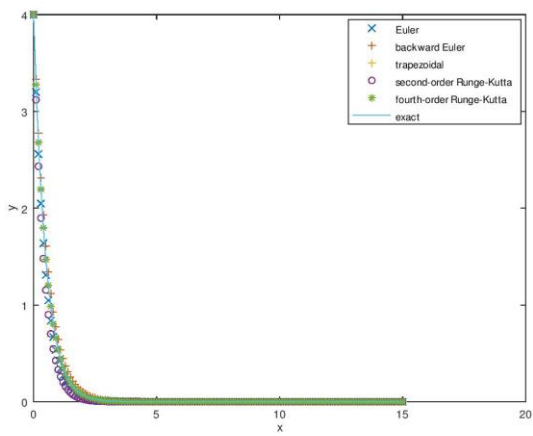
<pre> a. clear clc a=[]; xv=linspace(-3,3,100); yv=linspace(-3,3,100); [x,y]=meshgrid(xv,yv); z=x+i*y; g=1+z+1/2*z.^2; gmag=abs(g); g4=1+z+z.^2/2+z.^3/6+z.^4/24; gmag4=abs(g4); contour(x,y,gmag,[1 1]); hold on; contour(x,y,gmag4,[1 1]); axis([-3,3,-3,3]); xlabel('Re(\lambda)'); ylabel('Im(\lambda)'); grid on; </pre>	<pre> b. n1=0.1; x1=0:n1:15; euler=backeuler=trap=rknd=rkth=[]; euler(1)=backeuler(1)=trap(1)=rknd(1)=rkth(1)=4; %%%%%Euler for i=2:length(x1) euler(i)=euler(i-1).*(1-n1*(2+0.01*(x1(i)).^2)); end %%%%%backward Euler for i=1:(length(x1)-1) backeuler(i+1)=backeuler(i).*(1/(1+n1*(2+0.01*(x1(i)).^2))); end %%%%%trapezoidal for i=2:length(x1) trap(i)=trap(i-1).*(1- n1*(2+0.01*(x1(i)).^2)/2)./(1+n1*(2+0.01*(x1(i)).^2)/2); end %%%%second RK for i=2:length(x1) rknd(i)=rknd(i-1).*(1-n1*(2+0.01*(x1(i)).^2)- (n1*(2+0.01*(x1(i)).^2))^2/2); end %%%%forth RK for i=2:length(x1) rkth(i)=rkth(i-1).*(1+(-n1*(2+0.01*(x1(i)).^2))+(- n1*(2+0.01*(x1(i)).^2)).^2/2+(-n1*(2+0.01*(x1(i)).^2)).^3/6+(- n1*(2+0.01*(x1(i)).^2)).^4/24); end x=linspace(0,15); y=4*(exp(-2*x-(0.01/3)*x.^3)); plot(x1,euler,'x',x1,backeuler,'@',x1,trap,'+',x1,rknd,'o',x1,rkth,'*',x,y); legend('Euler','backward Euler','trapezoidal','second-order Runge- Kutta','fourth-order Runge-Kutta','exact'); xlabel("x"); ylabel("y"); </pre>
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<pre> c.1 clear clc h=0.01; f1=f2=f3=k1=k2=k3=k4=[]; f2(1)=f3(1)=0; f1test=linspace(0.1,1,(1- 0.1)/0.005+1); for j=1:length(f1test) f1(1)=f1test(j); for i=1:1000 k1=h.*[- f1(i).*f3(i),f1(i),f2(i)]; k2=h.*[- (f1(i)+1/2*k1(1)).*(f3(i)+1/2 *k1(3)),(f1(i)+1/2*k1(1)),(f2 (i)+1/2*k1(2))]; k3=h.*[- (f1(i)+1/2*k2(1)).*(f3(i)+1/2 *k2(3)),(f1(i)+1/2*k2(1)),(f2 (i)+1/2*k2(2))]; k4=h.*[- (f1(i)+k3(1)).*(f3(i)+k3(3)),(f 1(i)+k3(1)),(f2(i)+k3(2))]; f1(i+1)=f1(i)+1/6*k1(1)+1/3 *(k2(1)+k3(1))+1/6*k4(1); f2(i+1)=f2(i)+1/6*k1(2)+1/3 *(k2(2)+k3(2))+1/6*k4(2); f3(i+1)=f3(i)+1/6*k1(3)+1/3 *(k2(3)+k3(3))+1/6*k4(3); end f2test(j)=f2(1001); end plot(f1test,f2test); </pre>	<pre> c.2 clear clc h=0.01; f1=f2=f3=k1=k2=k3=k4=[]; f2(1)=f3(1)=0; f1test(1)=1; f1test(2)=0.5; for j=1:2 f1(1)=f1test(j); for i=1:1000 k1=h.*[-f1(i).*f3(i),f1(i),f2(i)]; k2=h.*[- (f1(i)+1/2*k1(1)).*(f3(i)+1/2*k1(3)),(f1 (i)+1/2*k1(1)),(f2(i)+1/2*k1(2))]; k3=h.*[- (f1(i)+1/2*k2(1)).*(f3(i)+1/2*k2(3)),(f1 (i)+1/2*k2(1)),(f2(i)+1/2*k2(2))]; k4=h.*[- (f1(i)+k3(1)).*(f3(i)+k3(3)),(f1(i)+k3(1)), (f2(i)+k3(2))]; f1(i+1)=f1(i)+1/6*k1(1)+1/3*(k2(1)+k3 (1))+1/6*k4(1); f2(i+1)=f2(i)+1/6*k1(2)+1/3*(k2(2)+k3 (2))+1/6*k4(2); f3(i+1)=f3(i)+1/6*k1(3)+1/3*(k2(3)+k3 (3))+1/6*k4(3); end f2test(j)=f2(1001); end </pre>	<pre> for j=3:5 f1test(j)=f1test(j-1)+((f1test(j- 1)-f1test(j-2))/(f2test(j-1)- f2test(j-2)))*(1-f2test(j-1)); f1(1)=f1test(j); for i=1:1000 k1=h.*[- f1(i).*f3(i),f1(i),f2(i)]; k2=h.*[- (f1(i)+1/2*k1(1)).*(f3(i)+1/2*k1(3)),(f1(i)+1/2*k1(1)),(f2(i)+1/2*k1(2))]; k3=h.*[- (f1(i)+1/2*k2(1)).*(f3(i)+1/2*k2(3)),(f1(i)+1/2*k2(1)),(f2(i)+1/2*k2(2))]; k4=h.*[- (f1(i)+k3(1)).*(f3(i)+k3(3)),(f1(i)+k 3(1)),(f2(i)+k3(2))]; f1(i+1)=f1(i)+1/6*k1(1)+1/3*(k2(1)+k3(1))+1/6*k4(1); f2(i+1)=f2(i)+1/6*k1(2)+1/3*(k2(2)+k3(2))+1/6*k4(2); f3(i+1)=f3(i)+1/6*k1(3)+1/3*(k2(3)+k3(3))+1/6*k4(3); endfor f2test(j)=f2(1001); endfor e=linspace(0,10,1001); plot(e,f1,e,f2,e,f3); xlabel('x'); legend("f'", "f'", "f"); </pre>
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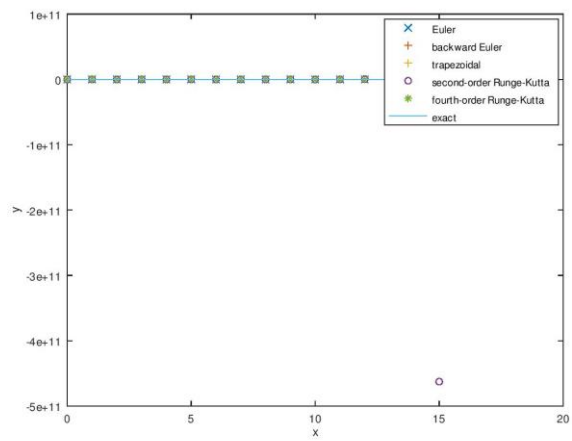
A.



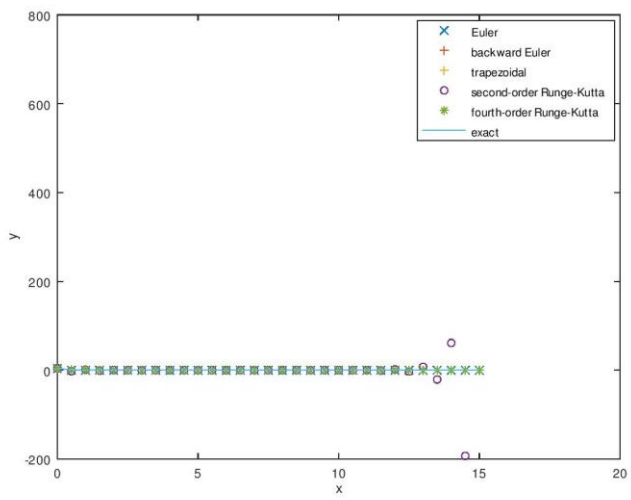
B.1



$\Delta x = 0.1$



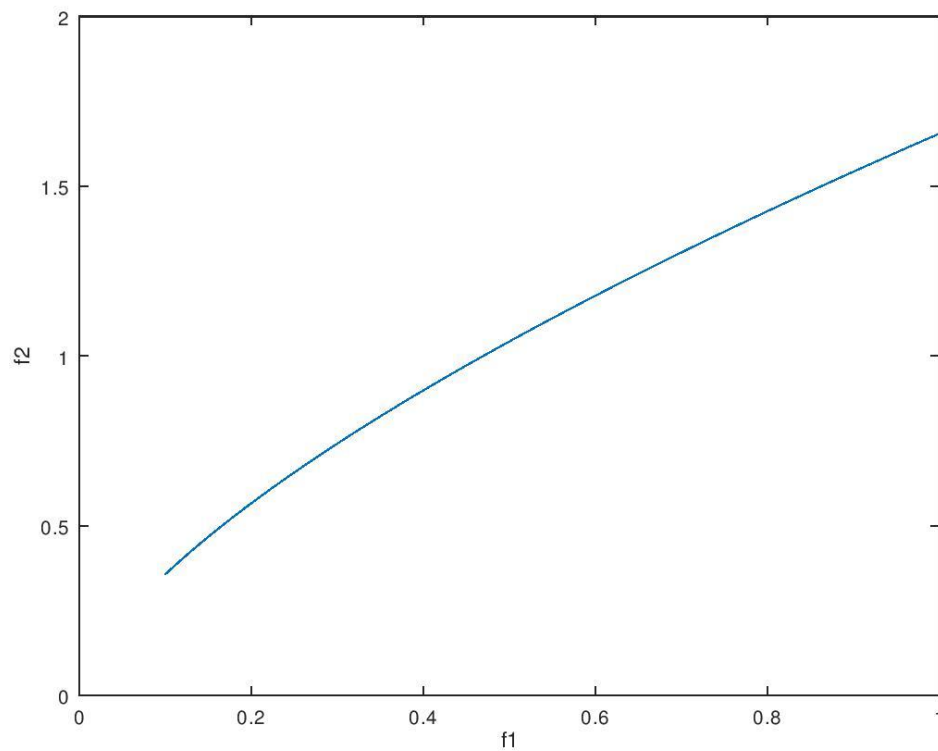
$\Delta x = 0.5$



$\Delta x=1.0$

B.2

c.1



f_2 =

Columns 73 through 84:

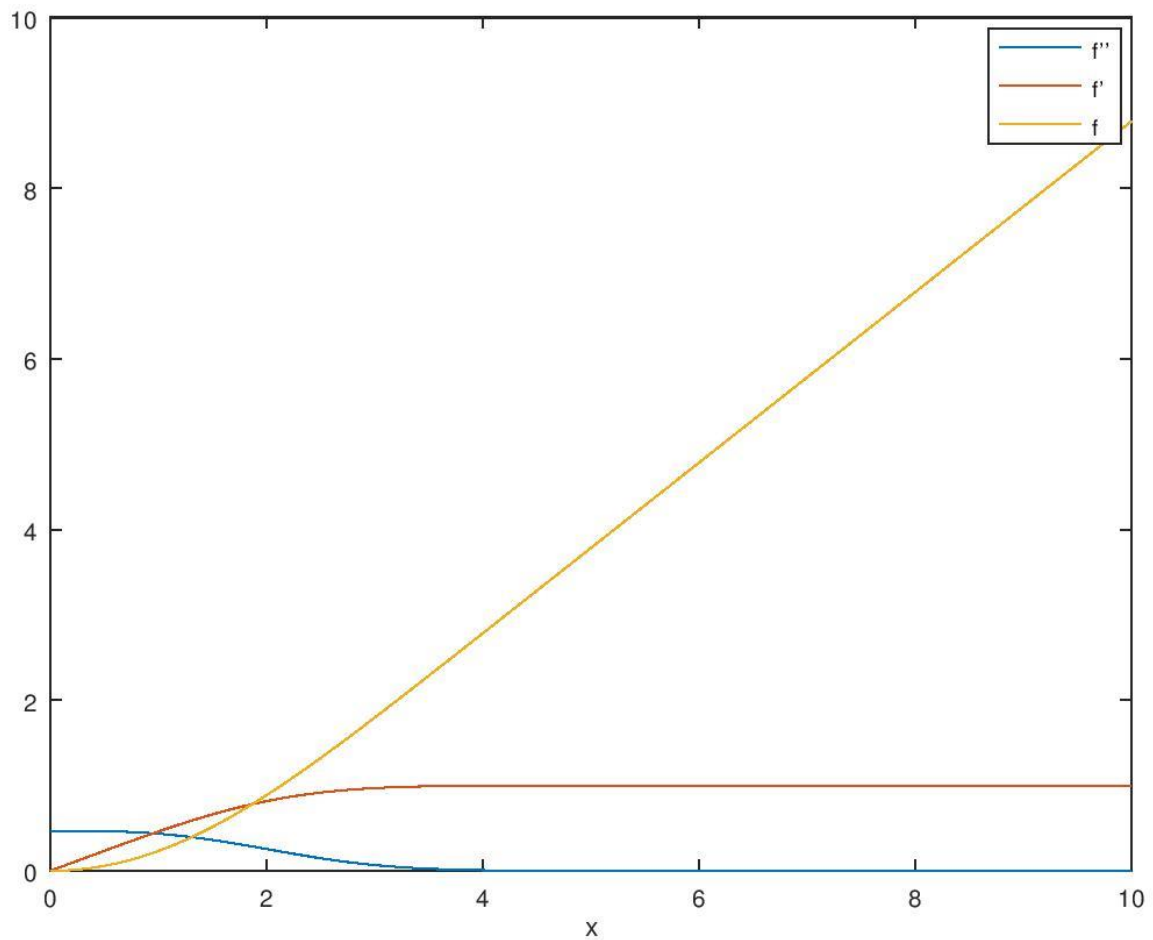
0.98632	0.99346	1.00057	1.00765	1.01471	1.02174	1.02876	1.03574	1.04270
1.04964	1.05656	1.06346						

f_1 =

Columns 73 through 84:

0.46000	0.46500	0.47000	0.47500	0.48000	0.48500	0.49000	0.49500	0.50000
0.50500	0.51000	0.51500						

c.2



How many iterations ($\alpha = ?$) are used to find an 'accepted' value of $f_1(0)$ which is good to 5 decimal points?

Ans: 3

What is this 'accepted' value of $f_1(0)$?

Ans: fltest =

1.00000 0.50000 0.46514 0.46965 0.46960