Solution 23.19

```
% Finite Difference Approximation of slope
% For f(x) = \exp(-2x) - x
       f'(x) = -2*exp(-2*x)-1
% Centered diff. df/dx=(f(i+1)-f(i-1))/2dx
                                                     + O(dx^2)
% Fwd. diff.
                df/dx=(-f(i+2)+4f(i+1)-3f(i))/2dx + O(dx^2)
% Bkwd. diff.
                  df/dx=(3f(i)-4f(i-1)+f(i-2))/2dx + O(dx^2)
x=2;
fx=exp(-2*x)-x;
dfdx2=-2*exp(-2*x)-1;
%approximation
dx=0.5:-0.01:.01;
for i=1:length(dx)
  x-values at i+-dx and +-2dx
  xp(i)=x+dx(i);
  x2p(i)=x+2*dx(i);
  xn(i)=x-dx(i);
  x2n(i)=x-2*dx(i);
  f(x)-values at i+-dx and +-2dx
  fp(i)=exp(-2*xp(i))-xp(i);
  f2p(i) = exp(-2*x2p(i))-x2p(i);
  fn(i) = exp(-2*xn(i)) - xn(i);
  f2n(i) = exp(-2*x2n(i))-x2n(i);
  %Finite Diff. Approximations
  Cdfdx(i) = (fp(i) - fn(i)) / (2*dx(i));
  Fdfdx(i) = (-f2p(i)+4*fp(i)-3*fx)/(2*dx(i));
  Bdfdx(i) = (3*fx-4*fn(i)+f2n(i))/(2*dx(i));
end
dx0=0;
plot(dx,Fdfdx,'--',dx,Bdfdx,'-.',dx,Cdfdx,'-',dx0,dfdx2,'*')
title('Forward, Backward, and Centered Finite Difference approximation - 2nd
Order Correct')
xlabel('Delta x')
ylabel('df/dx')
gtext('Centered'); gtext('Forward'); gtext('Backward')
```

Solution continued on the next page...

Copyright © McGraw-Hill Education. This is proprietary material solely for authorized instructor use. Not authorized for sale or distribution in any manner. This document may not be copied, scanned, duplicated, forwarded, distributed, or posted on a website, in whole or part.

