In [1]:
```
#A routine for plotting quantities relevant to
#part a of promen 3.28

from numpy import *
import pylab as pyl
from matplotlib import  *
import math
```

In [60]:
```
#Defining my starting variables
xfin = 2*pi
x = linspace(0,xfin,100); a0=1;phi=0; N = 50#number of terms

#Building phi with a for loop

for i in range(N):

    phi = phi + a0*cos(i*pi)*x**(2.*i)/math.factorial(2.*i+1.)


#finding the x intercept
count = 0
for i in phi:
    if i<0:
        ind1=count-1
        break
    count = count +1
```

In [13]:
```
xint = str(x[ind])[0:5]
#plotting \phi(x)
rc('text', usetex=True)
pyplot.figure()
p1=pyplot.plot(x,phi,linewidth=2)
p2=pyplot.plot([pi]*2,[-1,max(phi)+.1*max(phi)],'--k',linewidth=2)
pyplot.plot([0,xfin+.05*xfin],[0,0],'--k',linewidth=2)
pyplot.xlim([0,xfin+.05*xfin])
pyplot.ylim([-1,max(phi)+.1*max(phi)])
#pyplot.plot([0,0],[min(phi)+.7*min(phi),max(phi)+.2*max(phi)],'--k',linew
pyplot.grid(True)
pyplot.title(r'Special Case $n=1$',fontsize=16)
pyplot.xlabel(r'$x$',fontsize=14)
pyplot.ylabel(r'$\phi(x)$',fontsize=14)
pyplot.legend([p1[0],p2[0]],[r'\phi(x)',r'$x=\pi$'])
pyplot.savefig('LanEmdNeq1.png')
pyplot.show()
```

In [50]:
```
#the slope of phi, derived from its analytical form a_{0}sin(x)/x

Dphi = a0*(x*cos(x)-sin(x))/x**2

#finding finding the local minimum of the slope

for i in array(range(len(Dphi)))+2:
    if count>0:
        if Dphi[i]-Dphi[i-1]>0:
            ind=i-1
            break
```

In [59]:
```
#plotting d\phi(x)/dx
pyplot.figure()
pyplot.plot(x,Dphi,linewidth=2)
pyplot.plot([pi]*2,[-.5,.2],'-k',linewidth=1)
p1=pyplot.plot([x[ind]]*2,[-.5,.2],'--k',linewidth=2)
p2 = pyplot.plot([pi],0,'*k', markersize=15)
pyplot.plot([0,xfin+.05*xfin],[0,0],'-k',linewidth=1)
pyplot.xlim([0,xfin+.05*xfin])
pyplot.ylim([-.5,.2])
pyplot.title(r'Slope of $\phi(x)$',fontsize=16)
pyplot.xlabel(r'$x$',fontsize=14)
pyplot.ylabel(r'$d\phi(x)/dx$',fontsize=14)
pyplot.grid(True)
xint = str(x[ind])[0:4]
pyplot.legend([p1[0],p2[0]],[r'$x='+xint+'$',r'$\rho=0$'],loc=4)
pyplot.savefig('SlopePhi.png')
pyplot.show()
```