ANSWER TO THE QUESTION NO. 2

In [2]:
```
#import libraries
import numpy as np
import matplotlib.pyplot as plt
```

Initialization Variable

In [3]:
```
x = np.zeros(100)
y = np.zeros(100)
theta = np.ones(100)
omega = np.zeros(100)
x, y, theta, omega
```

Out[3]:
```
(array([0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]),
 array([0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]),
 array([1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
        1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
        1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
        1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
        1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
        1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.]),
 array([0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]))
```

In [4]:
```
tFinal = int(input())
tInitial = int(input())
delT = float(input())
```

```
10
0
0.1
```

In [5]:
```
arraySize = int((tFinal - tInitial)/delT)
arraySize
```

Out[5]:
```
100
```

In [6]:
```
a = np.ones(100)
a
```

Out[6]:
```
array([1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
       1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.])
```

In [7]:
```
w = np.full(100, 5)
w
```

Out[7]:
```
array([5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5])
```

In [8]:
```
v = np.random.rand(100)
v
```

Out[8]:
```
array([0.20373569, 0.41397633, 0.84726575, 0.91915546, 0.38602564,
       0.61767418, 0.68085607, 0.11408293, 0.56235574, 0.39237227,
       0.14831201, 0.63099094, 0.99185819, 0.44353554, 0.7836436 ,
       0.33475613, 0.65218747, 0.96906428, 0.19284759, 0.72989751,
       0.3251536 , 0.84750296, 0.33686442, 0.34544696, 0.10739345,
       0.44944041, 0.78874138, 0.55039337, 0.16650181, 0.27684044,
       0.94383783, 0.50379263, 0.27679405, 0.73361961, 0.00498619,
       0.91050177, 0.67082566, 0.94451998, 0.40784116, 0.78932032,
       0.20839113, 0.97856133, 0.35192277, 0.99806488, 0.43079157,
       0.5478283 , 0.84257671, 0.95623638, 0.43833283, 0.72220308,
       0.56489767, 0.10691466, 0.62922223, 0.24979695, 0.24603629,
       0.88842329, 0.5035592 , 0.41984101, 0.27208613, 0.92654276,
       0.67380272, 0.73249654, 0.43614425, 0.67834065, 0.82101686,
       0.07197849, 0.4005767 , 0.71916554, 0.81768565, 0.06887851,
       0.94464082, 0.29459422, 0.7952232 , 0.26879655, 0.26890839,
       0.69220238, 0.57224599, 0.29803723, 0.98860219, 0.01475171,
       0.66195813, 0.86429532, 0.49705815, 0.41577778, 0.17901675,
       0.829132  , 0.71598023, 0.78157135, 0.21204559, 0.67990144,
       0.07567952, 0.86798792, 0.51509197, 0.64956488, 0.69719723,
       0.19193652, 0.15616633, 0.70879178, 0.2352627 , 0.96612662])
```

Condition

In [9]:
```
for i in range(100):
  v[i] = 1
  w[i] = 0

  if i>=5 and i<=15:
    w[i] = 3
  if i>=20 and i<=30:
    w[i] = -3
  if i>=40 and i<=50:
    w[i] = -3
  if i>=60 and i<=70:
    w[i] = 3
  if i>=80 and i<=90:
    w[i] = -3



w,v
```

Out[9]:
```
(array([ 0,  0,  0,  0,  0,  3,  3,  3,  3,  3,  3,  3,  3,  3,  3,  3,  0,
         0,  0,  0, -3, -3, -3, -3, -3, -3, -3, -3, -3, -3, -3,  0,  0,  0,
         0,  0,  0,  0,  0,  0, -3, -3, -3, -3, -3, -3, -3, -3, -3, -3, -3,
         0,  0,  0,  0,  0,  0,  0,  0,  0,  3,  3,  3,  3,  3,  3,  3,  3,
         3,  3,  3,  0,  0,  0,  0,  0,  0,  0,  0,  0, -3, -3, -3, -3, -3,
        -3, -3, -3, -3, -3, -3,  0,  0,  0,  0,  0,  0,  0,  0,  0]),
 array([1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
        1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
        1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
        1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
        1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
        1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.]))
```

Main Program

In [10]:
```
d = 0
for i in range(99):
  x[i+1] = x[i] + (0.1 * (np.cos(theta[i])) * v[i])
  y[i+1] = y[i] + (0.1 * (np.sin(theta[i])) * v[i])
  theta[i+1] = theta[i] + (0.1 * w[i])
  d = d+1



x,y, theta
```

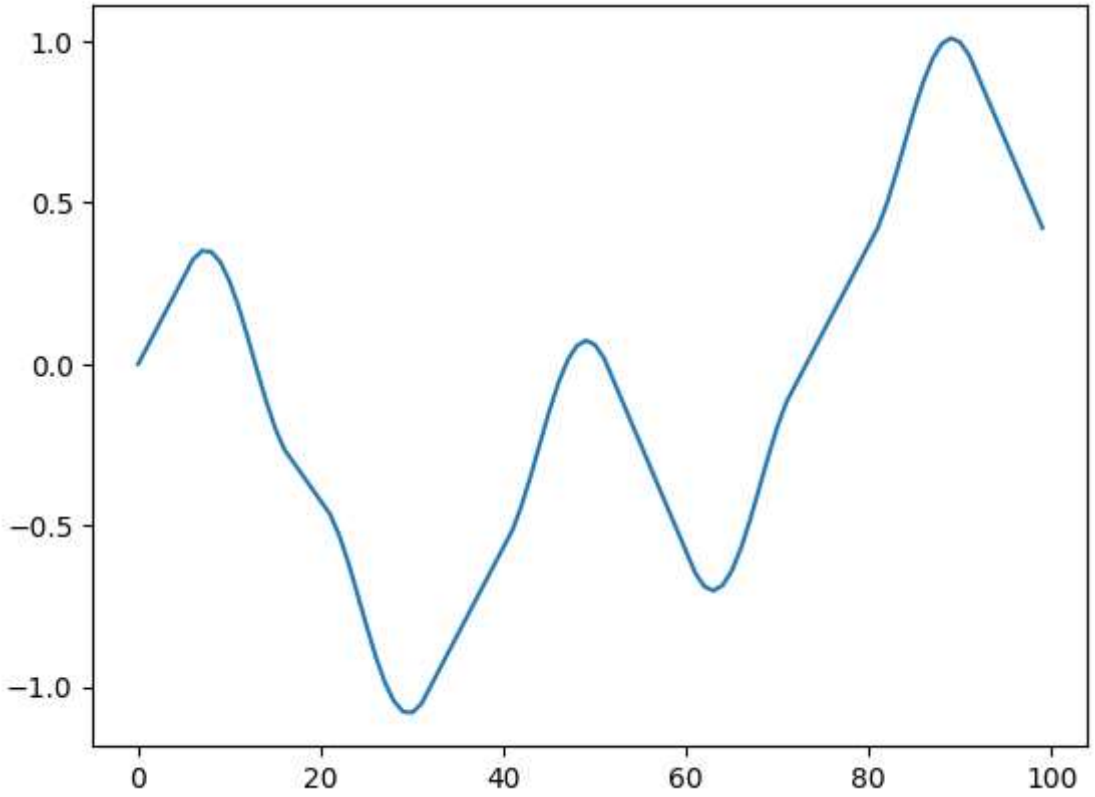
Out[10]:
```
(array([ 0.        ,  0.05403023,  0.10806046,  0.16209069,  0.21612092,
         0.27015115,  0.32418138,  0.35093127,  0.34801131,  0.31568236,
         0.25683225,  0.17671788,  0.08249565, -0.01741786, -0.11409768,
        -0.19890769, -0.26427205, -0.30435197, -0.34443188, -0.3845118 ,
        -0.42459172, -0.46467164, -0.530036  , -0.614846  , -0.71152582,
        -0.81143934, -0.90566157, -0.98577593, -1.04462604, -1.076955  ,
        -1.07987495, -1.05312507, -0.99909484, -0.94506461, -0.89103438,
        -0.83700415, -0.78297392, -0.72894368, -0.67491345, -0.62088322,
        -0.56685299, -0.51282276, -0.43633854, -0.34423244, -0.24473203,
        -0.14672537, -0.05896711,  0.01070356,  0.05606317,  0.07305988,
         0.06017543,  0.01856075, -0.04806685, -0.11469445, -0.18132206,
        -0.24794966, -0.31457726, -0.38120486, -0.44783246, -0.51446007,
        -0.58108767, -0.64771527, -0.68932995, -0.7022144 , -0.68521769,
        -0.63985808, -0.57018741, -0.48242915, -0.38442249, -0.28492208,
        -0.19281598, -0.11633176, -0.06230153, -0.0082713 ,  0.04575893,
         0.09978916,  0.15381939,  0.20784963,  0.26187986,  0.31591009,
         0.36994032,  0.42397055,  0.50045477,  0.59256087,  0.69206128,
         0.79006794,  0.8778262 ,  0.94749687,  0.99285648,  1.00985319,
         0.99696874,  0.95535406,  0.88872646,  0.82209886,  0.75547125,
         0.68884365,  0.62221605,  0.55558845,  0.48896085,  0.42233324]),
 array([ 0.        ,  0.0841471 ,  0.1682942 ,  0.2524413 ,  0.33658839,
         0.42073549,  0.50488259,  0.60123841,  0.70119577,  0.79582578,
         0.87667542,  0.93652263,  0.97002145,  0.97417951,  0.9486254 ,
         0.89564179,  0.81996154,  0.72834495,  0.63672835,  0.54511176,
         0.45349517,  0.36187857,  0.28619832,  0.23321471,  0.2076606 ,
         0.21181866,  0.24531748,  0.30516469,  0.38601433,  0.48064434,
         0.5806017 ,  0.67695752,  0.76110462,  0.84525172,  0.92939882,
         1.01354592,  1.09769301,  1.18184011,  1.26598721,  1.35013431,
         1.43428141,  1.51842851,  1.58285028,  1.62179211,  1.63177545,
         1.61190852,  1.56396596,  1.49223036,  1.40310962,  1.30456465,
         1.20539817,  1.11446842,  1.0398979 ,  0.96532738,  0.89075686,
         0.81618634,  0.74161582,  0.6670453 ,  0.59247477,  0.51790425,
         0.44333373,  0.36876321,  0.27783347,  0.17866699,  0.08012201,
        -0.00899872, -0.08073433, -0.12867689, -0.14854382, -0.13856048,
        -0.09961864, -0.03519687,  0.04895023,  0.13309732,  0.21724442,
         0.30139152,  0.38553862,  0.46968572,  0.55383282,  0.63797991,
         0.72212701,  0.80627411,  0.87069588,  0.90963771,  0.91962106,
         0.89975412,  0.85181157,  0.78007596,  0.69095522,  0.59241025,
         0.49324377,  0.40231403,  0.32774351,  0.25317298,  0.17860246,
         0.10403194,  0.02946142, -0.0451091 , -0.11967962, -0.19425014]),
 array([ 1. ,  1. ,  1. ,  1. ,  1. ,  1. ,  1.3,  1.6,  1.9,  2.2,  2.5,
         2.8,  3.1,  3.4,  3.7,  4. ,  4.3,  4.3,  4.3,  4.3,  4.3,  4. ,
         3.7,  3.4,  3.1,  2.8,  2.5,  2.2,  1.9,  1.6,  1.3,  1. ,  1. ,
         1. ,  1. ,  1. ,  1. ,  1. ,  1. ,  1. ,  1. ,  0.7,  0.4,  0.1,
        -0.2, -0.5, -0.8, -1.1, -1.4, -1.7, -2. , -2.3, -2.3, -2.3, -2.3,
        -2.3, -2.3, -2.3, -2.3, -2.3, -2.3, -2. , -1.7, -1.4, -1.1, -0.8,
        -0.5, -0.2,  0.1,  0.4,  0.7,  1. ,  1. ,  1. ,  1. ,  1. ,  1. ,
         1. ,  1. ,  1. ,  1. ,  0.7,  0.4,  0.1, -0.2, -0.5, -0.8, -1.1,
        -1.4, -1.7, -2. , -2.3, -2.3, -2.3, -2.3, -2.3, -2.3, -2.3, -2.3,
        -2.3]))
```

In [11]:
```
d
```

Out[11]:
```
99
```

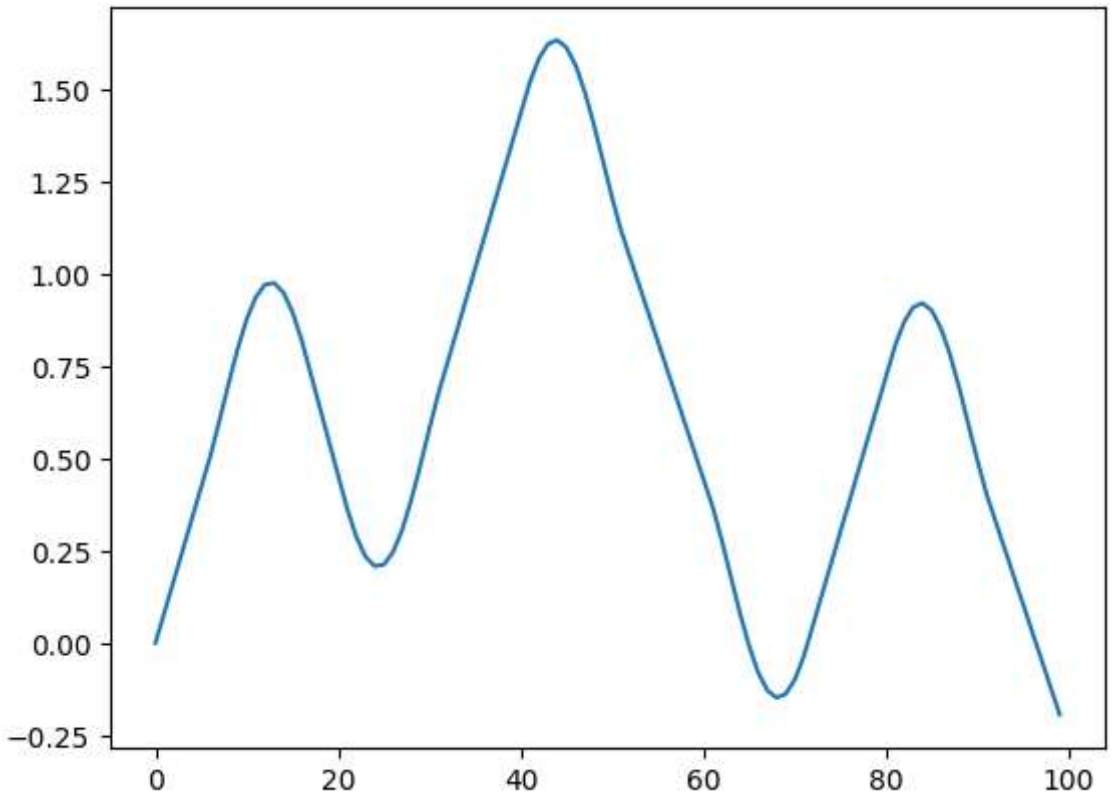
In [19]:
```
indices = np.arange(100)
plt.plot(indices, x)
```

Out[19]:
```
[<matplotlib.lines.Line2D at 0x7e96f83a92d0>]
```



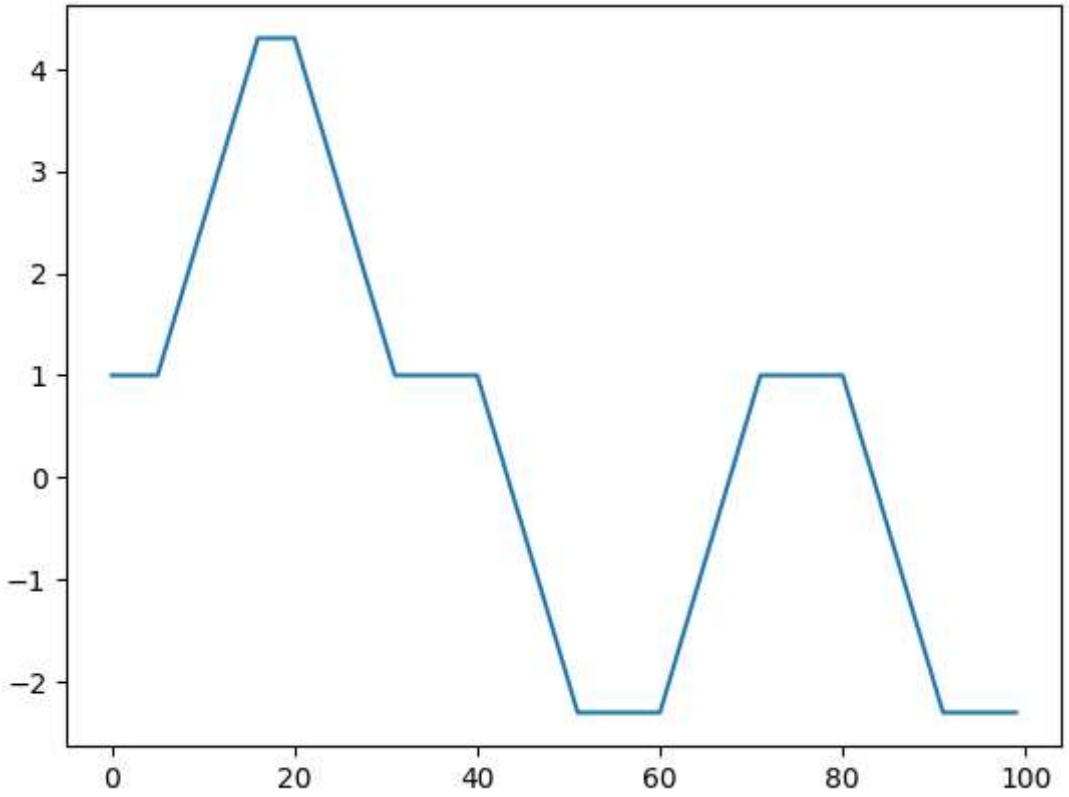
In [13]:
```
plt.plot(indices, y)
```

Out[13]:
```
[<matplotlib.lines.Line2D at 0x7e96f8672e30>]
```



In [14]:
```
plt.plot(indices, theta)
```

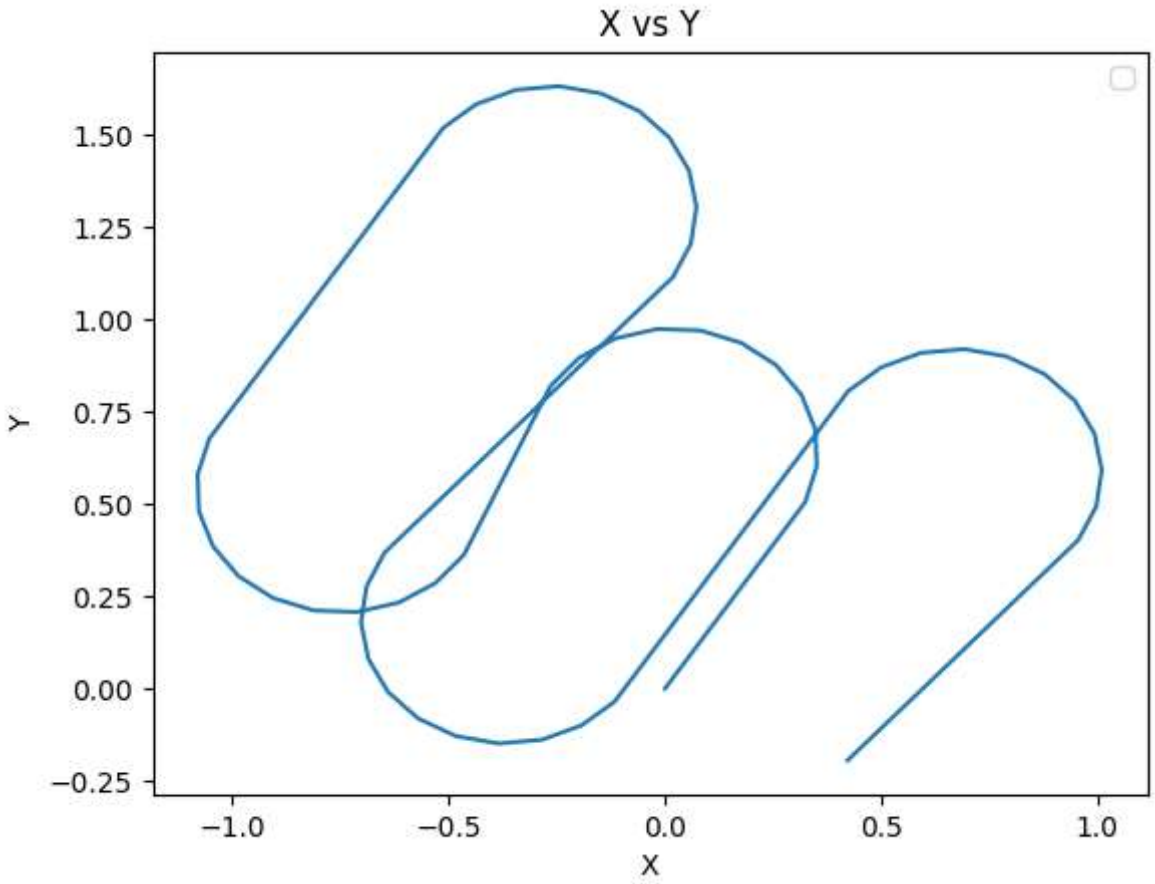
Out[14]:
```
[<matplotlib.lines.Line2D at 0x7e96f850d150>]
```



In [18]:
```
plt.plot(x,y)
plt.xlabel('X')
plt.ylabel('Y')
plt.legend()
plt.title('X vs Y')
```

```
WARNING:matplotlib.legend:No artists with labels found to put in legend.  Note tha
t artists whose label start with an underscore are ignored when legend() is called
with no argument.
```

Out[18]:
```
Text(0.5, 1.0, 'X vs Y')
```


X vs Y
1.50
1.25
1.00
0.75
0.50
0.25
0.00
−0.25
Y
−1.0
−0.5
0.0
0.5
1.0
X