Worksheet #6 - PHY102 (Spr. 2003)

Generating and plotting lists of numbers,
"Do" loops and animation - **due Feb. 26th**

We often ask a computer to do an operation many times. There are a large number of ways of doing these "iterative"tasks in Mathematica. Here are two that you will need this week (look them up in the online help):

Table, Do

You will also need to learn how to plot lists of numbers using:

ListPlot, ListPlot3D

Finally, animation is very simple in mathematica. Simply generate a series of frames (e.g. using a "Do" loop) and then double click on one of the frames. This automatically animates the set of frames.

Problem 1.
(i) Listplot plots a list of numbers on the y axis of a graph. To see how this works, enter the following code

```
sintable=Table[Sin[x], { x,0,20,.1 } ]
ListPlot[sintable]
```

(ii) Three dimensional plots are just as easy. Enter and run the following code

```
sintable3D=Table[Sin[x*y],{x,0,4,.1},{y,0,4,0.1}]
ListPlot3D[sintable3D]
```

(iii) Using the Table function, generate points to represent a circle for $y > 0$. Plot this data using ListPlot.

Problem 2.
Here is a code to sum the first n integers, with n running from 1 to 100. The first command sets up an array which is used to store the sums.

```
sumintegers=Range[100];
```

```
sumintegers[[1]]=1;
Do[
{sumintegers[[n]]=sumintegers[[n-1]]+n},
{n,2,100,1}
]
ListPlot[sumintegers]
```

The Riemann zeta function is defined by $\zeta(p) = \sum_{n=1,\infty} 1/n^p$. This sum is convergent for $p > 1$(why?). Write a program to find $\zeta(p)$ as a function of the number of terms, N, included in the sum. Plot the value of this sum for $p = 3$ as a function of N. How many terms do you need to take until your answer appears to be correct to 4 digit accuracy(how big does N need to be)?

Problem 3. Enter and run the following code which animates circular motion.

```
timestep = 0.1 Pi
tstart = 0
tend = timestep
x[a_]:= Cos[a]
y[a_]:= Sin[a]
Do[
{ParametricPlot[{x[t],y[t]},{t,tstart,tend},
PlotRange->{{-1,1},{-1,1}}];
        tstart=tend;
        tend=tend+timestep},
               {i,1,20}
]
```

Modify this code to animate the following projectile motion problem: A mass of 20kg is fired from a height of 2000 meters, with initial angle to the horizontal of 60 degrees and initial speed of 500m/s (ignore drag). Your animation should begin at firing and end when the mass hits ground level. **DO NOT print out the frames used to produce your animation**. Instead show your animation to your TA. However DO hand in your *Mathematica* code.