

# Traveling Waves

```
In[42]:= ClearAll["Global`*"]  
Off[General::spell, General::spell1]
```

## 1. Introduction

In this exercise you will investigate the behavior of traveling waves.

## 2. *Mathematica* Notebooks and Commands

The lines below display definitions of the functions from your assignment that you are to plot in their *Mathematica* format. Please note several things. The software interprets a blank space or the character "\*" as multiplication (each character is used randomly in the definitions below). Notice the need for the trailing underscore, "x\_", when defining the function and the use of ":=". To actually define these functions in *Mathematica* place the pointer anywhere in the cell (note cell bracket on the right) and click by pressing down briefly on the mouse button. The editing cursor should now appear and will be located somewhere within the cell. Now press "Enter" (not "Return") on the keyboard. Notice how the bracket of the cell changes shape. This means *Mathematica* is executing the commands you have given it. When it is done the bracket will return to its original shape.

```
In[44]:= psi4[x_] := A*Cos[w*t] Sin[k*x + B]  
psi2[x_] := A*Cos[k*(x - c*t)]  
psi3[x_] := A*Exp[- 0.02*(x + c*t)^2]*Cos[k*(x + c*t)]
```

## Plotting Commands

The lines below display some of the commands needed to plot the functions defines above. First one must assign values to the constants in the problem. Place the pointer in the cell below and click. After the editing cursor appears hit "Enter".

```
In[47]:= A = 1.0  
k = 1.0  
B = 3.14  
c = 1.0  
w = 1.0  
t = 41.5
```

```
Out[47]= 1.
```

```
Out[48]= 1.
```

```
Out[49]= 3.14
```

```
Out[50]= 1.
```

```
Out[51]= 1.
```

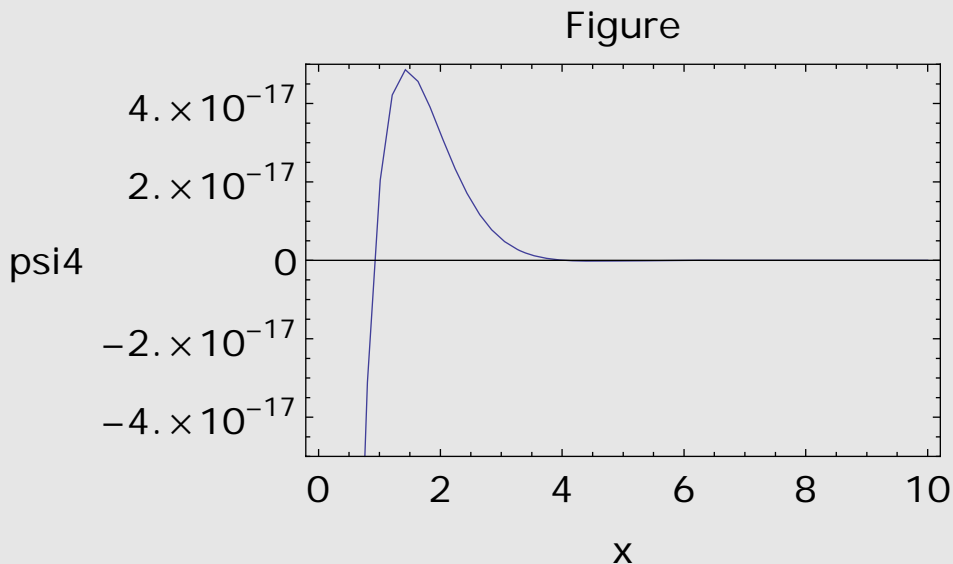
```
Out[52]= 41.5
```

In the cell below is the command to plot the first function defined above ( $\text{psi1}[x]$ ). Several options of the "Plot" command have been used to illustrate their function and to produce a clear, well-labelled graph. The *Mathematica* book by Wolfram contains detailed descriptions of the meaning of each option. To evaluate the commands in the cell place the pointer anywhere in the cell and click. After the editing cursor appears hit "Enter". Try different values for the numbers to see how they affect the plot. You can

edit them by placing the pointer just to the right of the number you want to change and clicking. The editing cursor will appear and you can use the delete key to remove the original values and then enter the ones you desire with the keyboard.

```
In[53]:= Plot[psi3[x], {x,0,10},  
  Frame->True,  
  PlotRange->{-5*10-17,5*10-17},  
  FrameLabel->{"x",  
    "psi4",  
    "Figure",  
    " "},  
  RotateLabel->False]
```

Out[53]=



## Printing

To print a portion of your work highlight the brackets on the right of the notebook. This is done by placing the pointer over the top bracket first. The pointer will change shape. Now press and hold the mouse button down and drag the pointer through the brackets you want to print (this is known as clicking and dragging). The brackets will be highlighted if this is done correctly. Release the mouse button and go to the "File" menu at the top of the screen. Press the mouse button down and you will see a number of options. Holding the mouse button down drag the pointer down to "Print Selection". When the mouse is correctly positioned the text for this option will be highlighted. Now release the button. You will be presented with a dialog box. Place the pointer in the box that says "PRINT" and click the mouse button. Your output will soon appear at the laser printer.

## Making Movies

If you really want to demonstrate your mastery of the *Mathematica* package, use the following commands to create a 'movie' of a function developing in time. After the 'MoviePlot' command is executed select all the different frames by clicking on the bracket that encloses the movie frames. Then, choose the command 'Animate Selected Graphics' from the 'Graph menu above.

In[54]:=

```
(* The command below reads in some more Mathematica  
commands from a file on the hard disk. It has to  
be executed only once. *)
```

```
Needs["Graphics`Animation`"];
```

In[57]:=

(\* This last command defines a function,  $f[x,time]$ , that is used to make the movie. \*)

```
f[x_,time_] := Sin[x] + 0.2*Sin[5.0(x - 0.2*time)]
MoviePlot[f[x,time],
  {x,-10,10},
  {time,0,2*Pi,2*Pi/10},
  Frame->True,
  PlotRange->{-1.4,1.4},
  FrameLabel->{"x",
    "f(x)",
    " ",
    " "},
  RotateLabel->False
]
```

Out[60]=

