

## Phys 3010 Mathematical Physics

### Assignment 2

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The first part of this assignment uses the Maple definition of a function (as opposed to a substitution), for example

$$f:=x \rightarrow x^2+8$$

1. Define the function  $y = \frac{4x}{\sqrt{1+x^2}}$ . Then use it to find
  1.  $y$  when  $x=3$
  2.  $y$  when  $x=10^6$ . (Use enough significant figures to see the difference between your result and the integer 4. Check the help on *evalf* to see how to do that.)
  3.  $\Delta y/\Delta x$  between  $x=3$  and  $x=3.1$
  4.  $\Delta y/\Delta x$  between  $x=3$  and  $x=3.0001$  (If you remember these differences are the basis for calculus.)
  5.  $dy/dx$  when  $x=3$ .
2. When we get to look at the different coordinate systems, the conversion from spherical polar coordinates  $(r, \theta, \varphi)$  contains the equation  $x = r \sin\theta \cos\varphi$ . Define  $x$  as a function of  $r$ ,  $\theta$ , and  $\varphi$  and use it find  $x$  when
  1.  $r=3$ ,  $\theta=\pi/2$ , and  $\varphi=0$
  2.  $r=3$ ,  $\theta=\pi/2$ , and  $\varphi=\pi/2$
  3.  $r=3$ ,  $\theta=\pi/3$ , and  $\varphi=\pi/6$
  4.  $r=3$ ,  $\theta=\pi/12$ , and  $\varphi=\pi/6$

For the rest of the assignment, make the plots/animation, and then have fun playing with it, changing options, so that you can see what is available to you. For the animation try running it, with the animation set to loop.

3. Make a 3D plot of the function  $z = \sqrt{1 + \sin\left(\frac{2\pi x}{5}\right)} e^{y/10} \sin\left(\frac{2\pi y}{9}\right)$  for  $0 < x < 10$ , and  $0 < y < 9$ .
4. Make an animation of the wave function  $y = 20 \cos\left(\frac{2\pi x}{5} - \frac{2\pi t}{5} + 0.3\right)$  between  $0 < x < 20$ , and  $0 < t < 10$ .