Wave Motion

Objective: Use SageMathCell to model wave motion.

Theory: When given the equation for a wave y(x) = 1.6e −0.75x^ 2 + e −0.5(x−3)^2 and the starter code for SageMathCell. I will be able to create a plot showing a wave at t = 0s, t = 1s, t = 2s, animate the wave by modifying the given starter code, and lastly animate a left moving wave interfering with a right moving wave.

Procedure:
Part 1

At t = 0 a wave is given by y(x) = 1.6e −0.75x^ 2 + e −0.5(x−3)^2 and moves to the right with speed v. Choose a value for v (anything besides 5 m/s since that is used in the example figure below) and create a plot showing the wave at t = 0, 1, and 2 s.
Code given:

```
y1, y2, y3, x = var("y1, y2, y3, x")

y1 = x + 1
y2 = x^2
y3 = x^3 – 1

p1 = plot(y1, (x, -2, 2), color="black")
p2 = plot(y2, (x, -2, 2), color="blue")
p3 = plot(y3, (x, -2, 2), color="red")

g = Graphics()
g += p1
g += p2
g += p3
g.show()
```

Code modified:

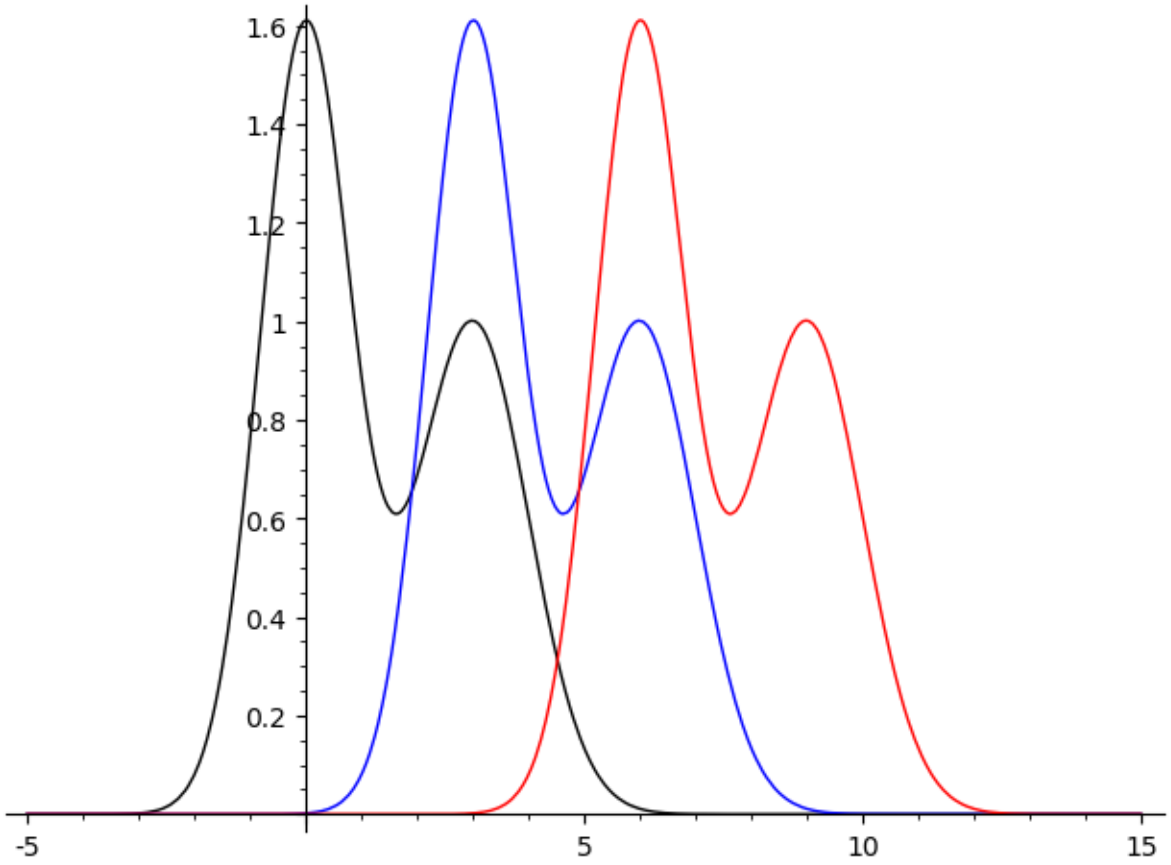
```
y1, y2, y3, x = var("y1, y2, y3, x")

y1 = 1.6*e^(-0.75*x^2) + e^(-0.5*(x-3)^2)
y2 = 1.6*e^(-0.75*(x-3)^2) + e^(-0.5*(x-6)^2)
y3 = 1.6*e^(-0.75*(x-6)^2) + e^(-0.5*(x-9)^2)

p1 = plot(y1, (x, -5, 15), color="black")
p2 = plot(y2, (x, -5, 15), color="blue")
p3 = plot(y3, (x, -5, 15), color="red")

g = Graphics()
```

```
g += p1
g += p2
g += p3
g.show()
```



Part 2

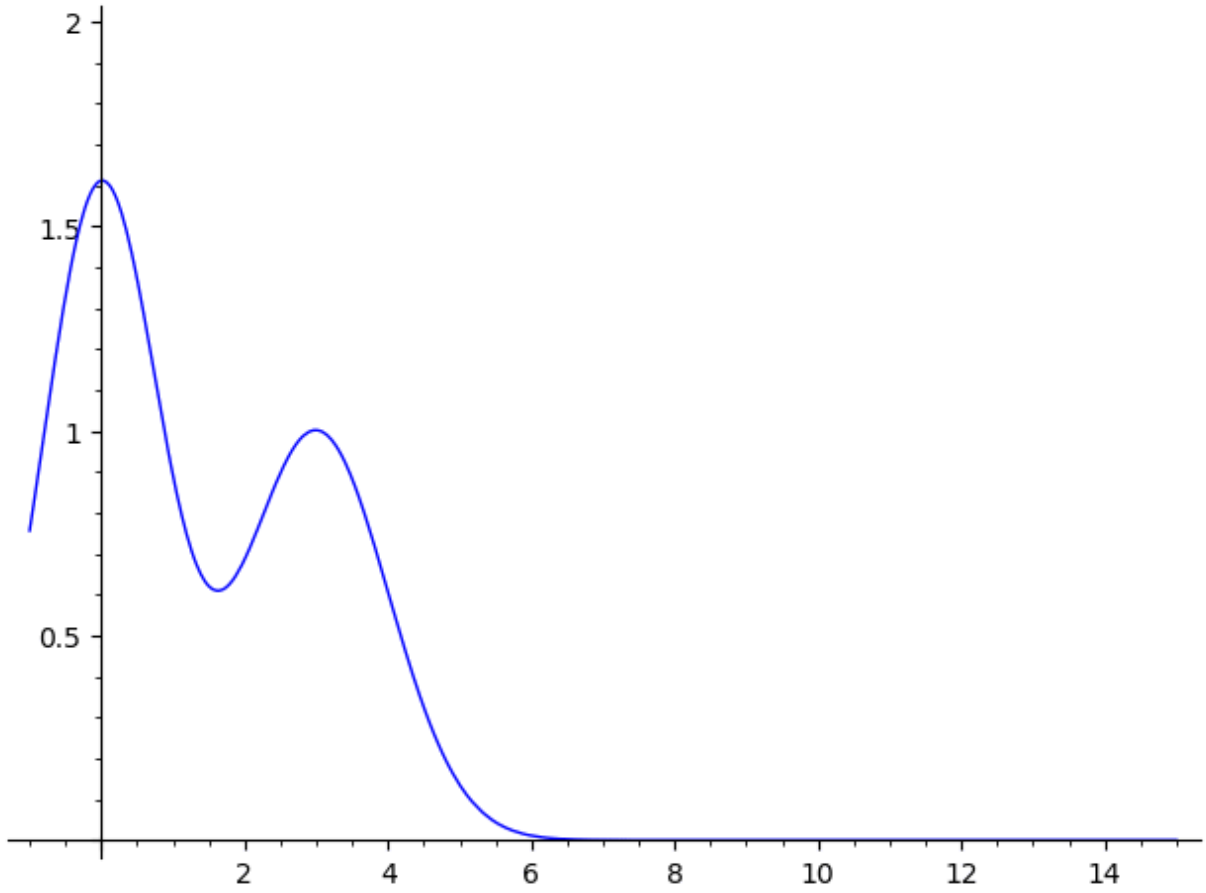
Create an animated version of the plot from part 1.

Code given:

```
traveling_wave = [plot(exp(-(x - t)^2), (-1, 4), ymin=0, ymax=2) for t in sxrange (0, 5, 0.1)
animation = animate(traveling_wave)
animation.show(delay=10)
```

Code modified:

```
traveling_wave = [plot((1.6*e^(-0.75*(x-t)^2) + e^(-0.5*(x-t)*8^2)), (-1, 15), ymin=0, ymax=4)
for t in sxrange(0, 7, 0.3)]
animation = animate(traveling_wave)
animation.show(delay=10)
```

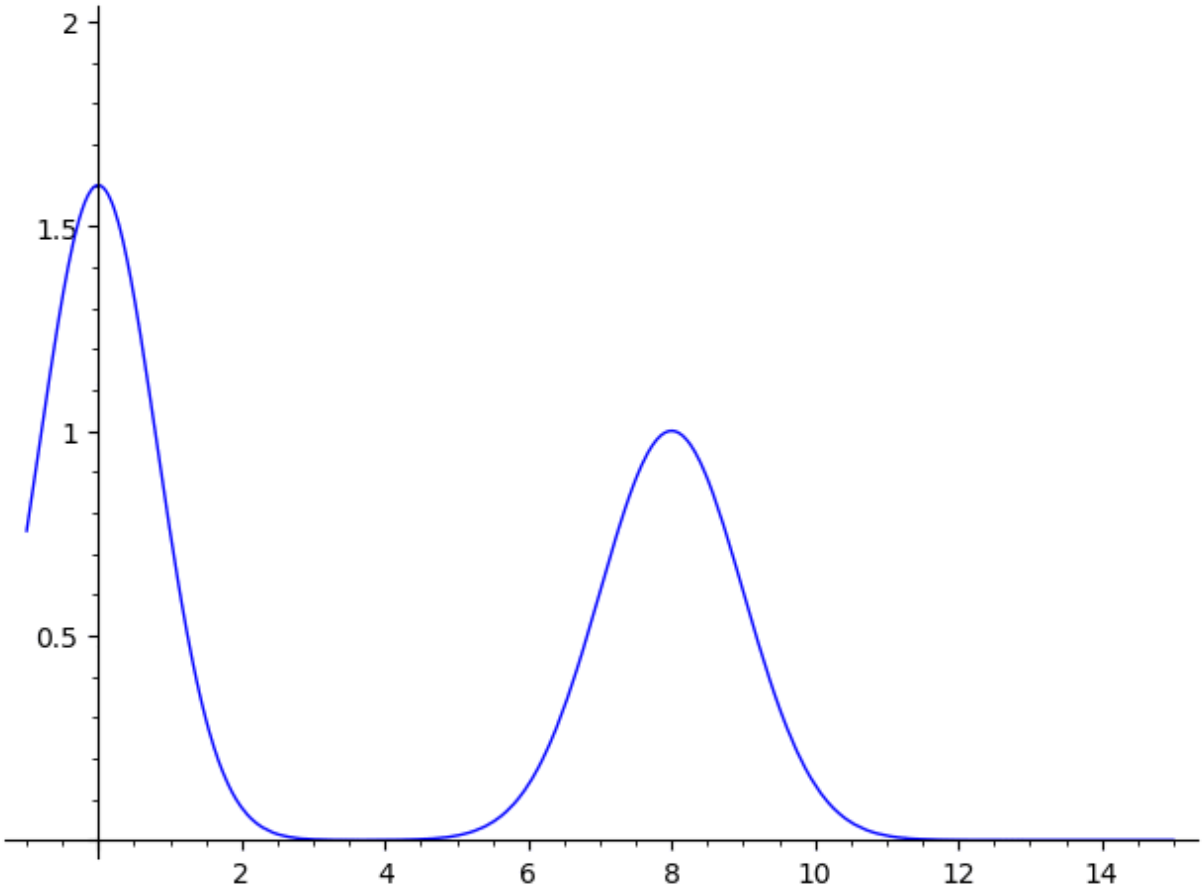


Part 3

Create an animation of a right-moving wave interfering with a left-moving wave.

Code modified:

```
traveling_wave = [plot((1.6*e^(-0.75*(x-t)^2) + e^(-0.5*(x+t)*8^2)), (-1, 15), ymin=0, ymax=4)
for t in sxrange(0, 7, 0.3)]
animation = animate(traveling_wave)
animation.show(delay=10)
```



Data: The original equation for part 1: At t = 0 a wave is given by y(x) = 1.6e −0.75x^2 + e −0.5(x−3)^2. This was modified to:

y1 = 1.6*e^(-0.75*x^2) + e^(-0.5*(x-3)^2)
y2 = 1.6*e^(-0.75*(x-3)^2) + e^(-0.5*(x-6)^2)
y3 = 1.6*e^(-0.75*(x-6)^2) + e^(-0.5*(x-9)^2)

The original code for part 2:

traveling_wave = [plot(exp(-(x - t)^2), (-1, 4), ymin=0, ymax=2) for t in sxrange(0, 5, 0.1)
animation = animate(traveling_wave)
animation.show(delay=10)

This was modified to:

```
traveling_wave = [plot((1.6*e^(-0.75*(x-t)^2) + e^(-0.5*(x-t)^2)), (-3, 10), ymin=0, ymax=4) for t in sxrange(-1, 7, 0.3)]
animation = animate(traveling_wave)
animation.show(delay=10)
```

And then finally to:

```
traveling_wave = [plot((1.6*e^(-0.75*(x+t)^2) + e^(-0.5*(x-t)^2)), (-3, 10), ymin=0, ymax=4) for t in sxrange(-1, 7, 0.3)]
animation = animate(traveling_wave)
animation.show(delay=10)
```

Calculations: All calculations were performed in SageMathCell through the process of trial and error with my lab partners and with the help of Dr. Harrison, no paper calculations exist.

Results:

Part 1	Part 2	Part 3
successful	successful	successful

Analysis: The process of using software to recreate wave motion can be a challenging one but with the given equation, starter codes, and guidance all parts of the lab were completed successfully. SageMathCell does require meticulous data entry. One minor oversight can produce inaccuracies in the wave you are trying to create or not create anything at all. The error codes given can help but can also hinder. For instance, I was getting an error about one particular line I entered. I only focused on that one line and couldn't figure out what was wrong. It turned out the error was on a different line and was then easily fixed. As I get more familiar with the program, the easier it will be for me to pick up on mistakes.

Comments: I found the lab to be difficult based on my lack of experience inputting code and with SageMathCell. I am hopeful the more practice I get with this software, the better I'll be at using it.