Modeling with Sine and Cosine Curves

Mth 111 Mathematics as a Human Pursuit Lab

Name _____

Follow instructions

Execute the following two commands (Place cursor anywhere on the command and press Enter.)

```
> restart
> with(plots) :
```

Note that π is an irrational number and is equal to the area of a circle with radius one. To see its value to 100 decimal places, execute the following command:

```
> evalf(π, 100)
```

1. Plot the standard sine curve y = sin(x) by executing the Maple command below.

This curve has a period = _____, amplitude = _____, and frequency = _____.

We plot the sine curve below for the range 0 to 4 π:

```
> p1 := plot(sin(x), x = 0..4 π, color = green); p1
```

2. Replace the WHAT below the appropriate value for A define a sine curve with amplitude 2:

```
> A := WHAT; p2 := plot(A sin(x), x = 0..4 π, color = plum); p2
```

3. Display the this curve with the standard sine curve:

```
> display({p1, p2})
```

Below is a plot of the function $\sin(2x)$

What is the amplitude, period and frequency of $\sin(2x)$?

Amplitude = _____ Period = _____ Frequency = _____

```
> plot(sin(2 x), x = 0..4·π)
```

4. Below we plot the cosine curve:

> $p3 := plot(\cos(x), x = 0..4\,\pi, color = coral); p3$

5. Display both curves together ($\sin(x)$ and cos(x)):

> $display(\{p1, p3\})$

6. Below we plot the curve y = sin(x + C) with C = π/2. How does $\sin\left(x + \frac{\pi}{2}\right)$ differ from the standard sine curve?

Answer: _____

> $p4 := plot\left(\sin\left(x + \frac{\pi}{2}\right), x = 0..4\,\pi, color = sienna, linestyle = dash\right); p4$

7. Display $\cos(x)$, $\sin\left(x + \frac{\pi}{2}\right)$ together:

> $display(\{p3, p4\})$

8. Here we display a standard cosine curve along with a sine curve with parameters A, B, C, E -- Try different values for A, B, C and E in the command below to see how the graph changes. Explain what you see.

Answer:

Which (A,B,C, or E) represents the

Amplitude _____

Horizontal Shift _____

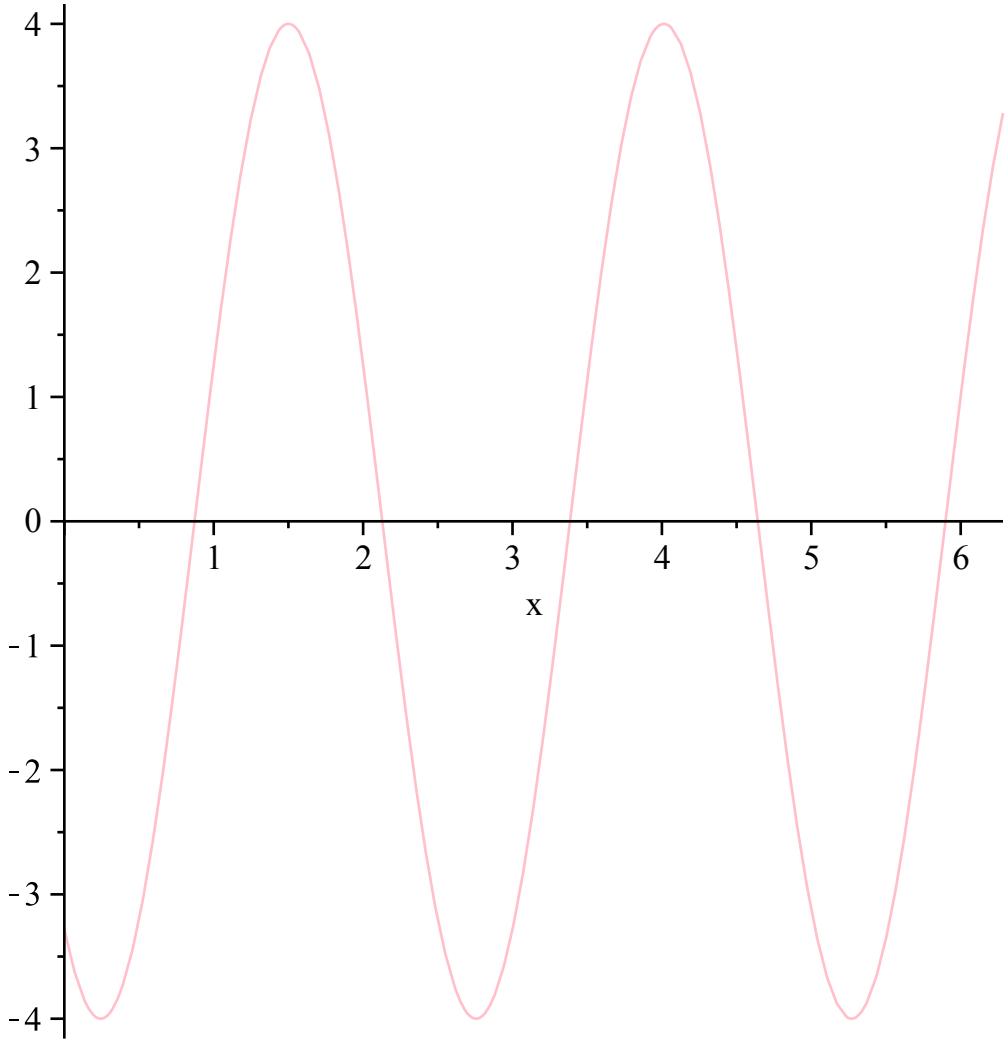
Vertical Shift _____

Angular Frequency -- Calculated as $\frac{2\,\pi}{Period}$ _____

> $A := 1; B := 1; C := \frac{\pi}{2}; E := 1;$
$plot([\cos(x), A\sin(B\cdot(x - C)) + E], x = 0..4\,\pi, color = [red, blue])$

>

9. The pink graph below represents a cosine curve -- Answer the questions below for this curve



10. For the pink cosine curve above:

a) What is its amplitude?

b) What is its period?

c) What is its frequency?

d) What is its angular frequency?

e) What is its horizontal shift?

f) What is its vertical shift?

12. Enter below the correct values for A, B, C, E to model the curve above -- compare your plot to make sure it is correct.

A = _____ B = _____ C = _____ E = _____

```
> A := WHAT; B := WHAT; C := WHAT; E := WHAT;
  plot(A cos(B (x - C)) + E, x = 0..2 π, color = blue)
```

13. For the equivalent sine curve you only have to change **one** of the above parameters:

(Which one is it? A, B, C, or E _____; What do you change it to ?_____

```
> A := WHAT; B := WHAT; C := WHAT; E := WHAT;
> plot(A (sin(B (x - C))) + E, x = 0..2 π, color = blue)
```

14. (Optional **Extra Credit) Beats:** When two sound waves combine the resulting sound wave curve is the alegbraic sum of the two individual curves. Consider two sound waves represented by the functions:

$5\sin(3x)$ (plotted in red) and $5\sin(2x)$ (plotted in green)

and their algebraic sum

$5\sin(3x) + 5\sin(2x)$ (plotted in blue).

What is the frequency of the red curve? _____

What is the frequency of the green curve? _____

```
> plot([5 sin(3 x), 4 sin(2 x + 1), 5 sin(3 x) + 4 sin(2 x + 1)], x = 0..12 π, color = [red,
      green, blue])
```

Plotting the algebraic sum by itself, we can definitely see the "beats". This curve is periodic with period = _____ and frequency = _____. Its maximum amplitude is _____.

Check to see that your results support the mathematical fact that the frequency of the beat curve (blue) should be the difference in the frequency of the two individual curves (red frequency - green frequency) .

```
> plot(5 sin(3 x) + 4 sin(2 x + 1), x = 0..12 π, color = blue)
```