Example from physics: For an alternating current (AC) circuit like those that provide electricity to our homes, the current and voltage obey equations that involve the trig functions sine and/or cosine.

For an AC circuit which operates at 60 cycles (periods) per second, if the maximum current is 20 amperes, and the current is at 0 amperes at time t=0, then the amount of electrical current in the circuit obeys the equation

$$i = 20\sin(120\pi t)$$

where i is the amount of current in amperes, and t is the time in seconds.
If the average voltage is 120 volts, then the voltage may obey the equation

$$v = 120\sqrt{2}\sin(120\pi t + 0.003)$$

Question 1:
At what times does the current reach 10 amperes in the first cycle?

We must translate the question into a trig equation: we want to know what is the time t when $i = 10$, so by substituting 10 for i, we need to solve

$$10 = 20\sin(120\pi t)$$

To solve this problem, we will proceed in steps.
Step 1: Simplify the equation by substituting $x = 120\pi t$ in the argument of the sine: Solve the simplified equation

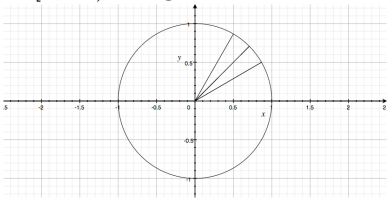
$$10 = 20\sin(x)$$

as we have already learned to do.
First solve that equation for $\sin(x)$:

Next, find all the solutions to

write your equation here

in $[0, 2\pi)$ using the unit circle:



write your solutions here

Step 2: Now substitute $x = 120\pi t$ in each of your solutions to step 1, and solve for t:

Question 2:
At what times does the voltage reach 0 volts in the first cycle? Remember that the voltage obeys the equation

$$v = 120\sqrt{2}\sin(120\pi t + 0.003)$$

We must translate the question into a trig equation: we want to know what is the time t when $v = 0$, so by substituting 0 for v, we need to solve

$$0 = 120\sqrt{2}\sin(120\pi t + 0.003)$$

To solve this problem, we will again proceed in steps.
Step 1: Simplify the equation by substituting $x = 120\pi t + 0.003$ in the argument of the sine: Solve the simplified equation

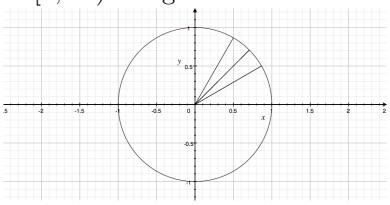
$$0 = 120\sqrt{2}\sin(x)$$

as we have already learned to do.
First solve that equation for $\sin(x)$:

Next, find all the solutions to

$$\underbrace{\qquad\qquad}_{\text{write your equation here}}$$

in $[0, 2\pi)$ using the unit circle:



$$\underbrace{\qquad\qquad}_{\text{write your solutions here}}$$

Step 2: Now substitute $x = 120\pi t + 0.003$ in each of your solutions to step 1, and solve for t:

Question 3: At what times does the current reach -10 amperes in the first cycle? Remember that the current obeys the equation

$$i = 20\sin(120\pi t)$$

This time you work it all out: (Fill in all the blanks as you go!)

Translate the question into a trig equation: we want to know what is the time t when $i =$ _____, so by substituting _____ for i, we need to solve

_____ = _____

To solve this problem, we will again proceed in steps.
Step 1: Simplify the equation by substituting substitute $x =$ _____: Solve the simplified equation

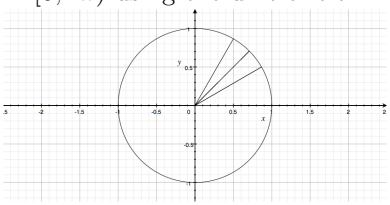
_____ = _____

as we have already learned to do.
First solve that equation for $\sin(x)$:

Next, find all the solutions to

_____
write your equation here

in $[0, 2\pi)$ using the unit circle:



_____
write your solutions here

Step 2: Now substitute $x =$ _____ in each of your solutions to step 1, and solve for t:

Question 4:

At what times does the voltage reach 120 volts in the first cycle? Remember that the voltage obeys the equation

$$v = 120\sqrt{2}\sin(120\pi t + 0.003)$$

This time you work it all out: (Fill in all the blanks as you go!)

Translate the question into a trig equation: we want to know what is the time t when $v =$ _____, so by substituting _____ for v, we need to solve

_____ = _____

To solve this problem, we will again proceed in steps.

Step 1: Simplify the equation by substituting substitute $x =$ _____: Solve the simplified equation

_____ = _____

as we have already learned to do.

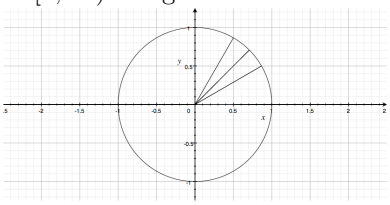
First solve that equation for $\sin(x)$:

Next, find all the solutions to

_____

write your equation here

in $[0, 2\pi)$ using the unit circle:



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write your solutions here

Step 2: Now substitute $x =$ _____ in each of your solutions to step 1, and solve for t: