6. [11 points] Fifi has decided to use one of Kiki's time machines to travel back in time to rescue Kiki. The electrical system of the time machine is not working properly. The voltage supplied to the machine in volts t minutes after she turns it on is given by

$$y = V(t) = -130\sin(\pi(t + 0.5)) + 110.$$

a. [3 points] Find the amplitude, period and midline of $V(t)$.

Amplitude: 130

Period: 2

Midline: $y = 110$

b. [3 points] To find Kiki, Fifi needs the machine to be supplied with exactly 200 volts when she travels back in time.

Find (any) one **exact** form solution to the equation

$$200 = -130\sin(\pi(t + 0.5)) + 110.$$

$t =$ $\frac{1}{\pi}\arcsin(-9/13) - 0.5$

Solution: Using basic algebra,

$$\frac{-90}{130} = \sin(\pi(t + 0.5)).$$

Using inverse sine and more algebra, we get

$$t = \frac{1}{\pi}\arcsin(-9/13) - 0.5.$$

c. [5 points] Using your answer from the previous part, find all times in the first three minutes after she turns on the machine when the machine is supplied with 200 volts. Show all your work and give your answers in **exact** form. No credit will be given for decimal approximations.

The times in the first three minutes when the machine is supplied with 200 volts are

$t =$ $\theta,\ \theta + 2,\ 2 - \theta$ minutes

Solution: If we call the solution from the previous part θ, then θ is one of the times we are looking for. There are two others (we can see this by graphing the line $y = 200$ and the graph of $V(t)$ for t-values from 0 to 3). One is a shift to the right by a period:

$$t = \theta + 2.$$

The other can be found using the symmetry of the graph of $V(t)$:

$$t = 2 - \theta \text{ or } \theta + 2(1 - \theta)$$

depending on how you view the symmetry.

