1. Suppose a bug crawls halfway along outside of your coffee cup, which has a diameter of 4 inches (see diagram). According to the diagram how far (to the nearest 10\textsuperscript{th}) did the bug travel in inches?

![Coffee Cup Diagram]

2. a) Write a cosine function that will model your height above ground for the following Ferris wheel.

- It will have a diameter of 40 feet.
- Passengers will board from a platform 4 feet above ground.
- One Revolution will take 2 minutes.
- at \( t = 0 \) you are at the 6 o’clock position.
  (you might want to use the axis to get a visual sketch)

b) What will your height be, to the nearest tenth, after being on the ride for 45 seconds?

c) At what time, to the nearest tenth of a minute, will you first reach 40 feet?
  (Only an algebraic solution will be accepted!)

d) Write this equation as a sine function.
3. On the interval \(0 \leq x \leq 100\pi\), how many times will \(\sin(2x) = \cos x\)? Show or Explain.

4. What is the range of the function \(g(x) = 5 - 3\cos(2x)\)

5. Given \(f(x) = \sin x\) evaluate the limit and simplify down to a single trigonometric function of \(x\):
\[
\lim_{h \to \frac{\pi}{2}} f(x + h)
\]

6. A function is given by: \(f(x) = 2\sin(\pi x) - \sqrt{3}\)
   a) Find the exact value of \(f\left(\frac{7}{4}\right)\).
   b) Determine the exact values of \(f(x) = 0\) on the interval \(0 \leq x \leq 2\).
7. A power company serves two different cities, City A and City B. The power requirements of both cities vary in a periodic fashion over the course of a typical day as follows, expressed in KWh (kilowatt-hours) used $t$ hours past midnight:

[Hint: Use graphical methods to solve parts b), c), and d)]

City A: $A(t) = -30\sin\left(\frac{\pi}{12}t\right) + 80$

City B: Varies in power usage from a low of 35 KWh at midnight to a high of 95 KWh at noon.

a) Find an equation, $B(t)$, to model the power supply needed by City B in KWh used $t$ hours past midnight.

b) During a 24-hour period, list all the times (to the nearest tenth of an hour past midnight) that both cities require the same amount of power output from the power supply company. Show or explain.

c) If this power company supplies both of these cities simultaneously throughout the day, at what time of the day would the power company have to put out the most power to accommodate both of the cities? Show or explain.

d) To the nearest tenth of a KWh, what is this maximum amount of power that the company will need to supply in a given 24-hour period in order to supply both cities?