Name: ______________________ **Card #**: ____________

Clear your desk of everything excepts pens, pencils and erasers. **Show all your work.**
If you have a question raise your hand and I will come to you.

1. Sketch the graph of $f(x) = x - \sin(-x)$ on the interval $[-2\pi, 2\pi]$ by following the below steps.

   (a) (1 point) Determine if there are any asymptotes or if f is even/odd.

   Solution: f is odd, since $f(-x) = -x - \sin(x) = -x + \sin(-x) = -f(x)$.

   (b) (2 points) Determine where f is increasing, decreasing, and where any local extrema are.

   Solution: Use the first derivative test:

   $$f'(x) = 1 + \cos(-x)$$

   Never undefined. So find when 0 to locate crit. pts.

   $$\begin{aligned} 0 &= 1 + \cos(-x) \\ -1 &= \cos(-x) \\ x &= \{-\pi, \pi\} \qquad \text{(On the interval } [-2\pi, 2\pi]) \end{aligned}$$

   Now we plot and take test points to see:

f'	-2π		$-\pi$		π		2π
	•	$(+)$	•	$(+)$	•	$(+)$	•

   f is increasing on $[-2\pi, 2\pi]$, never decreasing, and has no local extrema.

   (c) (2 points) Determine where f is concave up, concave down, and where any inflection points are.

   Solution: Lets look at the second derivative:

   $$f''(x) = \sin(-x)$$

   Never undefined. So find when 0 to locate potential inflection pts.

   $$\begin{aligned} 0 &= \sin(-x) \\ x &= \{-2\pi, -\pi, 0, \pi, 2\pi\} \qquad \text{(On the interval } [-2\pi, 2\pi]) \end{aligned}$$

   Now we plot and take test points to see:

f''	-2π		$-\pi$		0		π		2π
	•	$(-)$	•	$(+)$	•	$(-)$	•	$(+)$	•

   f is concave down on $(-2\pi, -\pi) \cup (0, \pi)$ and is concave up on $(-\pi, 0) \cup (\pi, 2\pi)$. Giving inflection points at $x = \{-\pi, 0, \pi\}$.

Continue on to back side

(d) (2 points) Sketch f on the graph below. Mark all local extrema and inflection points, if any.

Solution: