4. [12 points] Chump is on his yacht, enjoying his annual vacation. After finishing a bottle of Martinelli's sparkling apple cider, he tosses the empty bottle into the ocean. The trajectory of the bottle is a parabola. When the bottle is a horizontal distance of x meters away from Chump, it is $H(x)$ meters above the level of the yacht deck, where $H(x) = -x^2 + \frac{\pi}{2}x + \frac{1}{2}$.

a. [5 points] Use the method of completing the square to put $H(x)$ in vertex form. **Your answer must be exact**, and you must *show all your work, step-by-step*, to get full credit.

$H(x) =$ _____

b. [2 points] What was the maximum height of the bottle? Give your answer in exact form.

The maximum height was _____ above the level of the yacht deck.

c. [5 points] Suppose the deck of the yacht is 1 meter above the surface of the ocean. What is the horizontal distance between Chump and the bottle when it hits the ocean? Leave your answer in exact form.

The bottle was a horizontal distance of _____ away from Chump.