4. [12 points] Katya and Miles are sailing in the ocean, which is represented by the $xy$-plane. Katya’s position, $t$ hours after 12:00pm, is given by

$$x = 3t, \quad y = \sin\left(\frac{\pi t}{2}\right),$$

while Miles’ position, $t$ hours after 12:00pm, is given by

$$x = t^2 + 2, \quad y = \cos(\pi t) - 1.$$

In this problem, $x$ and $y$ have units in kilometers. All above equations are valid for $0 \leq t \leq 6$.

a. [2 points] What is Miles’ position at 3:00pm?

$$x = \quad \quad \quad y = \quad \quad$$

b. [4 points] Will Katya and Miles ever collide during their journey? If so, at what time(s) will this occur? Justify your answer.

The time(s) is/are ____________

c. [3 points] What is the slope of the tangent line to Katya’s path at $t = 4$?

The slope is ____________

d. [3 points] Write an expression involving one or more integrals that gives the distance, in kilometers, Miles traveled between 1:00pm and 4:00pm. Do not evaluate your integral(s).

The distance is ____________________________