2. [12 points] In the video game *Super Maria 64*, sisters Maria and Luisa travel through the Lilypad Kingdom to collect magical Rainbow Crystals. In the Sandland Desert, represented by the xy-plane, the sisters run around collecting all the Rainbow Crystals they see.

All distances in this problem are measured in kilometers. For $t \geq 0$, the sisters' positions t hours after they start running are given by the following parametric equations:

$$\text{Maria:} \begin{cases} x(t) = t^2 + t - 6 \\ y(t) = 2\sin(\pi t) \end{cases} \qquad \text{Luisa:} \begin{cases} x(t) = 2t^2 - 4t \\ y(t) = \cos(\frac{\pi}{2}t) \end{cases}$$

a. [2 points] Find **Maria's position** 1 hour after the sisters start running.

Answer: $x = $ _____ $y = $ _____

b. [3 points] Find **Maria's speed,** in kilometers per hour, 1 hour after the sisters start running.

Answer: _____

c. [3 points] Find **all** times $t \geq 0$ at which **Luisa** travels **directly north** (that is, not in any northwest or northeast direction). If there is no such time, write "NONE." Show your work to justify your answer.

Answer: $t = $ _____

d. [4 points] Find **all** times $t \geq 0$ at which Maria and Luisa are at the same position. If there is no such time, write "NONE." Show your work to justify your answer.

Answer: $t = $ _____