

9. [11 points] A group of marine biologists are studying life in the Challenger Deep, the deepest known point in the world's ocean. They use a special submarine to take samples of sea water for their study. Let $S(t)$ be the depth of the submarine (in miles) t minutes after it started collecting sea water samples. In this problem, depth will always be a positive number.
- a. [5 points] Find a formula for $S(t)$ assuming that:
- $S(t)$ is a sinusoidal function.
 - The submarine rises in 4 hours from a maximum depth of 6 miles to half a mile below the sea level (the closest point it gets to the surface).
 - The submarine reaches its maximum depth 30 minutes after it starts taking sea water samples.

Answer: $S(t) =$ _____

- b. [6 points] During a second expedition, the depth of the submarine (in miles) is given by the function

$$D(t) = 3 + 2.5 \cos\left(\frac{\pi}{90}t\right)$$

where t represents the time in minutes after the submarine started collecting samples. Once the submarine reaches a depth of 4 miles for the first time, how much time passes before it is at a depth of 4 miles for the second time? Your answer must be in exact form. Show all your work and include units.

Answer: _____