4. [11 points] Dahlia is running an experiment. A weight bobs up and down on the end of a spring that is attached to the ceiling. The distance, in inches, between the spring and the ceiling t seconds after Dahlia begins recording is given by

$$h(t) = 3\sin\left(\frac{4\pi}{3}t\right) + 8$$

a. [3 points] Find the period of $h(t)$, and interpret your answer in the context of the problem.

Answer: Period: _____ $3/2$ _____

Interpretation:

> *Solution:* From one time the weight reaches its maximum distance to the next, 1.5 seconds pass.

b. [2 points] Which of the following best describes the spring's motion at the moment Dahlia begins recording? Choose the **one** best answer.

When Dahlia begins recording...

  i. the spring is at its average distance from the ceiling, and is moving away from the ceiling.

  ii. the spring is at its average distance from the ceiling, and is moving toward the ceiling.

  iii. the spring is at its farthest point from the ceiling.

  iv. the spring is at its closest point to the ceiling.

  v. none of these

c. [6 points] Find the first **two** times the spring is exactly 9 inches from the ceiling. Show all of your work, and give your answers in exact form or correct to at least two decimal places. Include units.

> *Solution:* We find one solution by solving using arcsin:
>
> $$3\sin(\frac{4\pi}{3}t) + 8 = 9$$
> $$3\sin(\frac{4\pi}{3}t) = 1$$
> $$\sin(\frac{4\pi}{3}t) = 1/3$$
> $$\frac{4\pi}{3}t = \arcsin(1/3)$$
> $$t = \frac{3}{4\pi}\arcsin(1/3)$$
>
> Since the period is 3/2, the second solution is $3/4 - \frac{3}{4\pi}\arcsin(1/3)$