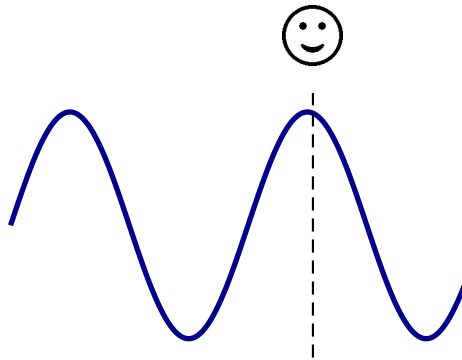# Question 1

A person observes water waves passing one particular point. He counts the number of crests that pass in 10 minutes.


The waves are produced by someone dipping her foot in and out of the water repeatedly. At one point the rate at which she dips her foot in and out triples. Which of the following is true?

1. The frequency stays constant and the number of crests passing (in $10\,\mathrm{min}$) stays constant.

2. The frequency triples and the number of crests passing stays constant.

3. The frequency stays constant and the number of crests passing triples.

4. The frequency triples and the number of crests passing triples.

Question 2

Two pulses approach each other on a string. At an initial instant the string is as illustrated and the pulses travel with speed 1 unit per second.
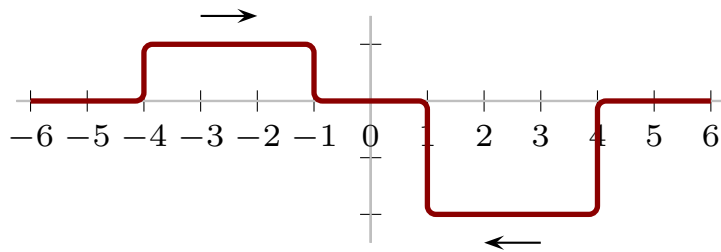
Which of the following depicts the entire string at an instant 2 seconds later?

Case 1

Case 2

Case 3
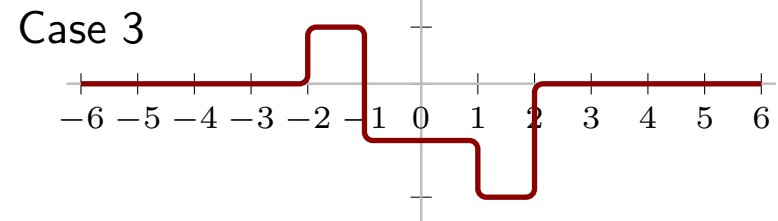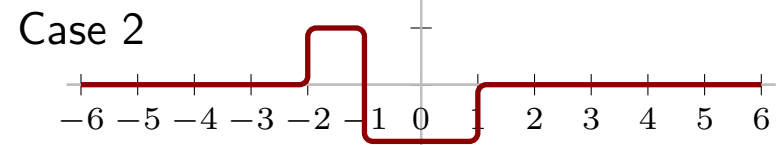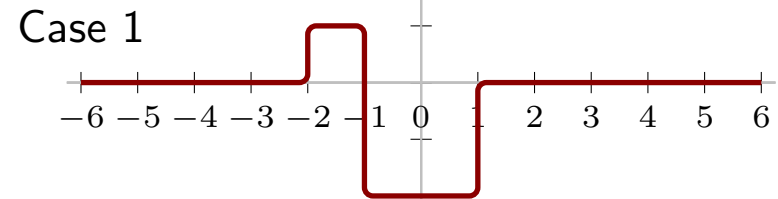
Question 3

Light is incident on a double slit arrangement. The probability distribution for arrival of photons when both slits are open is indicated by the solid line. The probability distribution for arrival of photons when *the left slit is open and the right slit is closed* is illustrated by the dashed line.
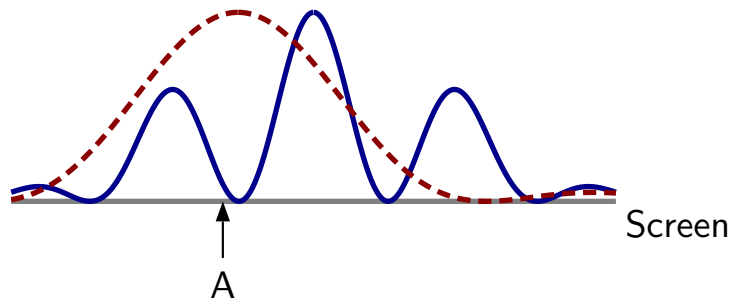
The experiment is initially done with just the left slit open. Subsequently the right slit is opened (the left slit stays open). Which of the following is true?

1. Opening the right slit does not change the number of photons that arrive at A.

2. Opening the right slit decreases the number of photons that arrive at A.

3. Opening the right slit increases the number of photons that arrive at A.

Screen

A

Question 4

A hydrogen atom (one proton and one electron) and a helium atom (two protons, two neutrons, two electrons) each move at the same speed.

Which of the following is true?

1. Neither has any wavelength.

2. Hydrogen wavelength larger than helium wavelength.

3. Hydrogen wavelength smaller than helium wavelength.

4. Same wavelengths.

Question 5

A particular type of matter has the illustrated partial energy level diagram. The energies are in units of 10^{-19} J.

$$E_3 = 9.0 \; \rule{2em}{1.2pt}$$

$$E_2 = 5.0 \; \rule{1.5em}{1.2pt}$$

$$E_1 = 2.0 \; \rule{2em}{1.2pt}$$

Electromagnetic radiation consisting of photons, each with energy 3.0 (in units of 10^{-19} J) is incident on the matter. Which of the following is true?

1. This radiation cannot be absorbed.

2. This radiation can be absorbed. The energy of the matter afterwards is 3.0.

3. This radiation can be absorbed. The energy of the matter afterwards is 5.0.

4. This radiation can be absorbed. The energy of the matter afterwards is 9.0.