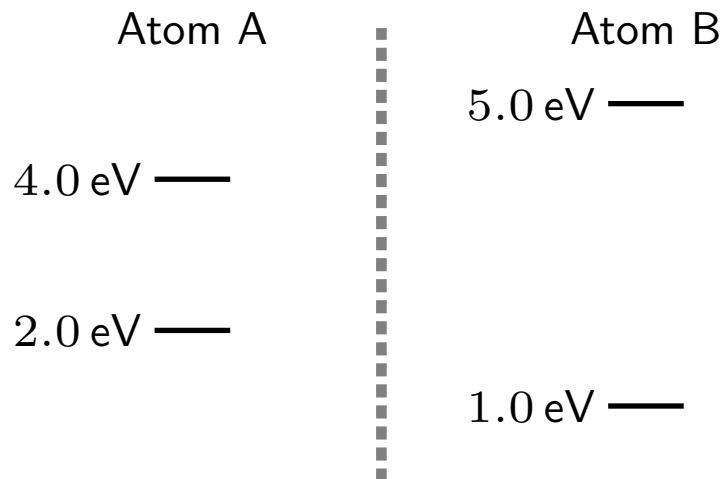# Question 1

Certain manufactured "artificial atoms" have exactly two energy levels. The artificial atoms are initially in the lowest energy state in each case.

Atom A

Atom B

$5.0\,\text{eV}$ ——

$4.0\,\text{eV}$ ——

$2.0\,\text{eV}$ ——

$1.0\,\text{eV}$ ——

Light is incident upon the artificial atoms. Which of the following is true regarding the wavelengths of light required to excite the atoms from the lower to higher energy states?

1. Wavelength for A equals wavelength for B.

2. Wavelength for A is larger than wavelength for B.

3. Wavelength for A is smaller than wavelength for B.

Question 2

The Balmer series (visible spectrum of hydrogen) lines satisfy

$$\lambda = \frac{91.1 \text{ nm}}{\left(\dfrac{1}{2^2} - \dfrac{1}{n^2}\right)}.$$

The red line in the hydrogen spectrum has a longer wavelength than the blue line. Which of the following must be true?

1. The value of n for red is the same as that for blue.

2. The value of n for red is larger than that for blue.

3. The value of n for red is smaller than that for blue.

Question 3

An electron orbits a proton in a circle as illustrated.
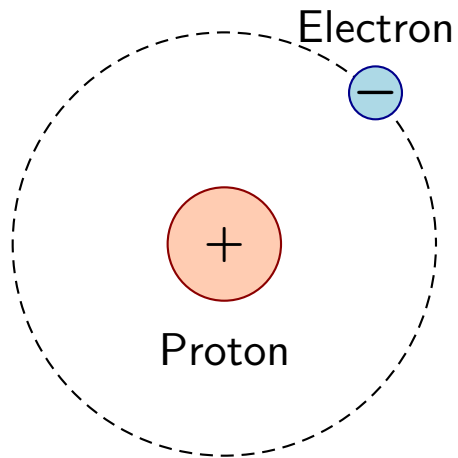
Classical electromagnetism predicts that any accelerating charge emits electromagnetic waves.

Which of the following is true according to this model?

1. The electron will never emit electromagnetic waves.

2. The electron will emit electromagnetic waves only if its speed increases.

3. The electron will emit electromagnetic waves even if its speed is constant.