Photon Energy Comparisons

New Regents original practice • Name: _____ Date: _____
Show your work for written answers.

Use $E = hf$, where $h = 6.626 \times 10^{-34}$ J·s. For electromagnetic waves in vacuum, use $c = f\lambda$ with $c = 3.00 \times 10^{8}$ m/s.

1 If frequency triples, how does the energy of one photon change?

(1) It becomes one-third as large.

(2) It stays the same.

(3) It triples.

(4) It becomes nine times as large.

2 Calculate the energy of one photon with frequency 5.00×10^{14} Hz. Round to three significant figures. [1]

Answer and work

_____

_____

3 Which photon has the greater energy, a 500 nm photon or a 1,000 nm photon?

(1) The 500 nm photon

(2) The 1,000 nm photon

(3) Both have equal energy.

(4) Wavelength gives no information about energy.

4 Two beams have the same photon frequency. One delivers twice as many photons per second to a detector. Compare their energy per photon and total energy delivered per second. [1]

Answer and work

_____

_____

Sources for a Photon Detector

Use the information below to answer the questions.

A model detector responds to single photons only when their energy is at least 4.00×10^{-19} J. Three sources supply photons of the listed frequencies.

Source	**Frequency (Hz)**
P	4.00×10^{14}
Q	5.50×10^{14}
R	7.00×10^{14}

5 Which source provides photons that meet the detector’s energy requirement?

(1) P only

(2) Q only

(3) R only

(4) P and Q

6 Calculate the minimum frequency that reaches the detector’s energy requirement. [1]

Answer and work

7 Which source’s photons have the longest wavelength in vacuum?

(1) P

(2) Q

(3) R

(4) All three have the same wavelength.

8 Suppose source Q emits more photons per second at the same frequency. Explain whether each photon now meets the threshold. [1]

Answer and work