

Quantum Chemistry Ranking Tasks

Electromagnetic Spectrum V

Rank the following types of light from greatest to lowest energy.

- A. 632nm λ B. 2.8×10^{14} Hz ν C. 5.5×10^{-19} J E
D. 423×10^9 m λ E. 2.1×10^{-19} J J F. 6.0×10^{14} Hz ν

Greatest 1 C 2 F 3 A 4 E 5 B 6 D Least

Explain your reasoning below.

I first determine by the units what quantity each value is. Length $\rightarrow \lambda$, Hz $\rightarrow \nu$, J $\rightarrow E$

If E, then no conversion is necessary.

If ν , then use $E = h\nu$ to get E

If λ , then we use $\lambda\nu = c$ to get $\nu = \frac{c}{\lambda}$

and substitute for ν to get $E = \frac{hc}{\lambda}$

Note: $h = 6.626 \times 10^{-34}$ J.s

$c = 2.998 \times 10^8$ m/s

\rightarrow so λ must be in m!

Circle the response that best describes your confidence in your answer above.

(Basically Guessed) 1 2 3 4 5 (Positive you get it)

$$A) \lambda = 632 \text{ nm}$$

$$E = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.998 \times 10^8 \text{ m/s})}{632 \text{ nm}} \times \frac{10^9 \text{ nm}}{1 \text{ m}} = \underline{3.14 \times 10^{-19} \text{ J}}$$

$$B) \nu = 2.8 \times 10^{14} \text{ Hz}$$

$$E = (6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.8 \times 10^{14} / \text{s}) = \underline{1.9 \times 10^{-19} \text{ J}}$$

$$C) E = 5.5 \times 10^{-19} \text{ J}$$

$$D) \lambda = 423 \times 10^9 \text{ m}$$

$$E = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.998 \times 10^8 \text{ m/s})}{(423 \times 10^9 \text{ m})} = \underline{4.70 \times 10^{-37} \text{ J}}$$

$$E) E = 2.1 \times 10^{-19} \text{ J}$$

$$F) \nu = 6.0 \times 10^{14} \text{ Hz}$$

$$E = (6.626 \times 10^{-34} \text{ J}\cdot\text{s})(6.0 \times 10^{14} / \text{s}) = \underline{4.0 \times 10^{-19} \text{ J}}$$