A Set of 3 ConcepTests dealing with the calculation of energy of a photon from a given wavelength in nm. Students need to use calculators for 2 of the questions in the set.

$E = h\nu$ and $c = \lambda\nu$. Give the equation for calculating the energy of a photon from its wavelength.

1. $E = hc$
2. $E = h\lambda$
3. $E = h\lambda/c$
4. $E = hc/\lambda$

Correct Answer: **4. $E = hc/\lambda$**

For the ruby laser (commonly used in laser pointers) beam, with a wavelength of 694.3 nm, what is the energy of its photon? Give the answer with the proper units and significant figures.
$h = 6.626 \times 10^{-34}$ J·s and
$c = 2.998 \times 10^{8}$ m/s

Part 1. The units for the answer above should be…

1. nm
2. $J \cdot m^2$
3. J·m/s
4. J

Correct Answer: **4. J**

Part 2. The final answer is…

1. 2.861×10^{-16} J
2. 2.861×10^{-19} J
3. 2.861×10^{-28} J
4. 2.861×10^{-35} J

Correct Answer: **2. 2.861×10^{-19} J**

Comment to Instructor:

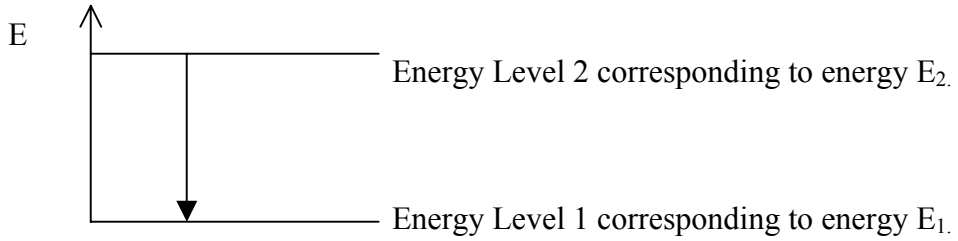
Choice 1 indicates students do not know how to enter exponents into their calculators. For example for c, instead of pressing 2.998 EXP 8, they have pressed 2.998 x 10 EXP 8, which corresponds to 2.998×10^{9} !

Choice 3 indicates that they forgot to change the wavelength from nm to m.

Choice 4 means they entered the numbers as $6.626x10^{-34}x2.998x10^{8}/6.943x10^{-9}$, which the calculator is interpreting as $\frac{6.626x10^{-34}x2.998x10^{8}}{6.943} \times 10^{-9}$.

Tell students to enter numbers as 6.626 EE –34 or use parenthesis: (6.626x10^–34)

ConcepTest relating the energy of a photon to the energy diagram.



A ruby laser (commonly used in laser pointer) emits a beam at a wavelength of 694.3 nm, which corresponds to 2.861 x 10^{-19} J. Which of the following statements is true?

1. E_1 is equal to 2.861 x 10^{-19} J.
2. E_2 is equal to 2.861 x 10^{-19} J.
3. $E_1 - E_2$ is equal to 2.861 x 10^{-19} J.
4. None of the above statements is true.

Correct Answer: ***4. None of the above statements is true. $E_2 - E_1$ is equal to 2.861 x 10^{-19} J.***

Comment to Instructor: It is common for students to think that the energy emitted corresponds to the energy of a particular energy level rather than to the energy released by the transition of an electron from one level to another.

ConcepTest concerning the relationship between wavelength, frequency and energy (no calculations required.)

Wave A Wave B

Which wave has photons of the higher energy?

1. Wave A
2. Wave B
3. They have the same energy.
4. Not enough information is given.

Correct Answer: **1. Wave A**

Comment to Instructor: Students may choose Choice 3 thinking that amplitude represents the amount of energy of the photon.

Wave A Wave B

Which wave has the higher frequency?

1. Wave A
2. Wave B
3. They have the same frequencies.
4. Not enough information is given.

Correct Answer: **1. Wave A**

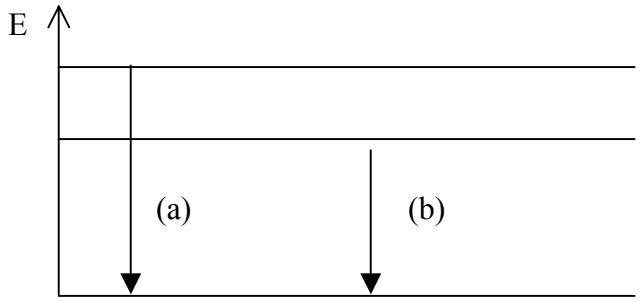
Wave A Wave B

Which wave has the longer wavelength?

1. Wave A
2. Wave B
3. They have the same wavelengths.
4. Not enough information is given.

Correct Answer: **2. Wave B**

ConcepTest Relating to the E diagram and Transitions between E Levels:



Which transition shown by the arrows above correspond to a longer wavelength?

1. Transition (a).
2. Transition (b).
3. They have the same wavelengths.
4. Not enough information is given.

Correct Answer: **2. Transition (b).**

Comment to Instructor: Students may select Choice 1 thinking that the longer arrow would mean a longer wavelength.

In leaves, chlorophyll *a*, is the pigment directly involved in the transformation of light energy to chemical energy. It absorbs at 670 nm (red) and at 440 nm (blue-violet). Leaves look green to us because light in the green region is not absorbed but reflected. Most plants also contain chlorophyll *b*, which absorbs at 480 nm (blue-green) and reflect red, yellow and orange. Normally chlorophyll *a* is far more abundant and the green it reflects masks the red, yellow and orange reflected by chlorophyll *b*. In the fall when the plant cells stop making chlorophyll *a*, the red, yellow and orange become dominant and give us our autumn colors.

List the three wavelengths (670 nm, 440 nm, and 480 nm) in order of increasing energy.

1. 440 nm, 480 nm, 670 nm
2. 670 nm, 480 nm, 440 nm
3. We need to know the value of Planck's constant (h).
4. We need to know the value for the speed of light (c).

Correct Answer: **2. 670 nm, 480 nm, 440 nm**
