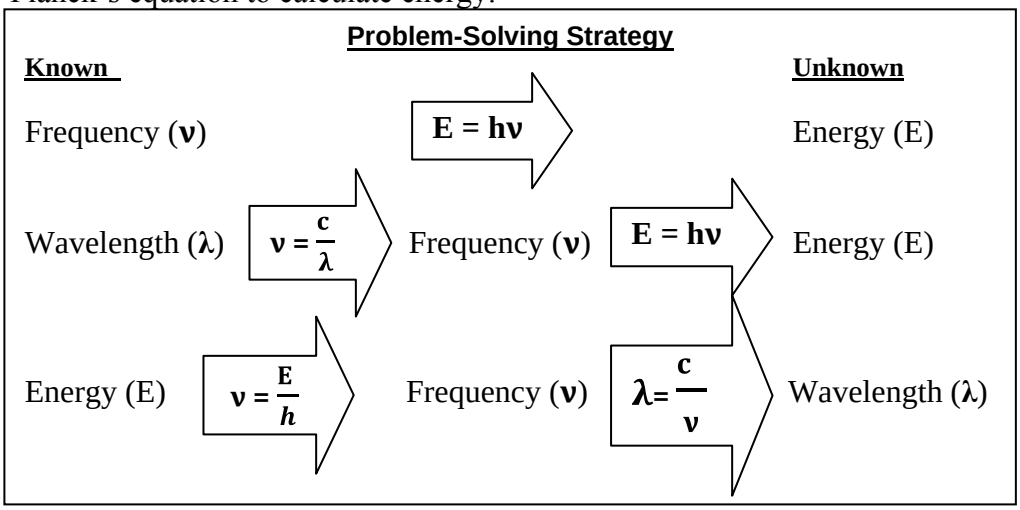
Planck's Constant Worksheet Name _____Date_____Period_____

Max Planck explained that energy was transferred in chunks known as **quanta**, equal to $h\nu$. The variable h is Planck's constant equal to 6.6262×10^{-34} J·s and the variable ν represents the frequency in 1/s, s^{-1}, or Hz (Hertz). This equation allows the calculation of the energy of photons, given their frequency. If the wavelength is given, the energy can be determined by first using the light equation ($c = \nu\lambda$) to find the frequency, then using Planck's equation to calculate energy.

Problem-Solving Strategy



useful equations

$c = \nu\lambda$

$c = 3.00 \times 10^{8}$ m/s

$E = h\nu$

$h = 6.63 \times 10^{-34}$ J·s

1 nm = 1×10^{-9} m

1 kJ = 1000 J

Example: Light with a wavelength of 525 nm is green. Calculate the energy in joules for a green light photon.

- ***First*** find the frequency: $\nu = \frac{c}{\lambda}$ $= \frac{3.00 \times 10^{8}\ \cancel{m}/s}{525\ \cancel{nm}\ \frac{1 \times 10^{-9}\ \cancel{m}}{1\ \cancel{nm}}} = \nu = 5.71 \times 10^{14}\ s^{-1} =$ 5.71 x 10^{14} Hz

- **Second** find the energy $E = h\nu$ $E = (6.6262 \times 10^{-34}\ J \cdot s)(5.71 \times 10^{14} s^{-1}) = E = 3.78 \times 10^{-19}\ J$ / *photon*

Use the equations above to answer the following questions.

1. Ultraviolet radiation has a frequency of 6.8×10^{15} Hz. Calculate the energy, in joules, of the photon.
2. Find the energy, in joules per photon, of microwave radiation with a frequency of 7.91×10^{10} Hz.
3. A sodium vapor lamp emits light photons with a wavelength of 5.89×10^{-7} m. What is the energy of these photons?
4. One of the electron transitions in a hydrogen atom produces infrared light with a wavelength of 746.4 nm. What amount of energy causes this transition?
5. Find the energy in kJ for an x-ray photon with a frequency of 2.4×10^{18} s^{-1}.
6. A ruby laser produces red light that has a wavelength of 500 nm. Calculate its energy in joules.
7. What is the frequency of UV light that has an energy of 2.39×10^{-18} J?
8. What is the wavelength and frequency of photons with an energy of 1.4×10^{-21} J?
9. What is the energy of a light that has 434 nm?
10. What is the wavelength of a light that has a frequency of 3.42 x 10^{11} Hz?