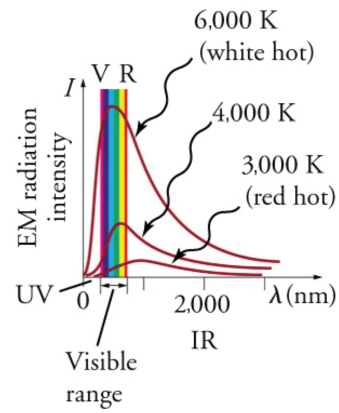
Physics 12-04 Quantum Nature of Light **Name: _____________**



- Black absorbs _________ light
  - It also _________ that light
- Blackbody
  - Absorbs _________light
  - Re-emits _________that light
- The color that a hot object (___________) emits depends on its __________________.

- As the temperature _________, the total amount of _________increases
- While _________the wavelengths are emitted, there is one _________wavelength
- As the temperature _________, the peak wavelength gets _________
  - The increased temperature atoms move _________and the ___________of the light increases.
  - By $v = f\lambda$, the wavelength _________
- This graph does not match _________physics which is based on ___________energy
- Planck invented the idea that the frequencies emitted are based on __________________
- Energy is _________
  - Only exists in _________amounts
  - Like the number of electrons in something must be a _________number
  - $E = nhf = n\frac{hc}{\lambda}$
    - n = 0, 1, 2, 3, … (# of _________)
    - $h = 6.626\times10^{-34}$ J·s
    - f = frequency of light
  - Low frequency (long λ) light is _________energy
  - High frequency (short λ) light is _________energy
- Low temperature has low _________so more low ___________light
- High temperature has higher _________so more higher ___________light

- Other things that are quantized
  - _________and _________
  - _________
  - _________

How many photons per second does a typical 10W LED lightbulb produce if 80% of the electrical energy is turned into useable light with an average wavelength of 520 nm?

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Compare the energy of one photon of UV light (λ = 250 nm) with IR light (λ = 890 nm).

Practice Work

1. Give an example of a physical entity that is quantized. State specifically what the entity is and what the limits are on its values.
2. Give an example of a physical entity that is not quantized, in that it is continuous and may have a continuous range of values.
3. An AM radio station broadcasts at a frequency of 1,530 kHz . What is the energy in Joules of a photon emitted from this station? (HSP PP21.1)
4. A photon travels with energy of 1.0 eV. What type of EM radiation is this photon? (HSP PP21.2) **Infrared**
5. Why do we not notice quantization of photons in everyday experience? (HSP PP21.6)
6. Two flames are observed on a stove. One is red while the other is blue. Which flame is hotter? How do you know? (HSP PP21.7) **Blue**
7. Your pupils dilate when visible light intensity is reduced. Does wearing sunglasses that lack UV blockers increase or decrease the UV hazard to your eyes? Explain. (HSP PP21.8) **Increase**
8. The temperature of a blackbody radiator is increased. What will happen to the most intense wavelength of light emitted as this increase occurs? (HSP PP21.9)
9. How many X-ray photons per second are created by an X-ray tube that produces a flux of X-rays having a power of 1.00 W? Assume the average energy per photon is 75.0 keV. (HSP 21.22)
10. What is the frequency of a photon produced in a CRT using a 25.0-kV accelerating potential? This is similar to the layout as in older color television sets. (HSP 21.23)
11. Find the energy in joules of photons of radio waves that leave an FM station that has a 90.0-MHz broadcast frequency. (HSP 21.31)
12. Which region of the electromagnetic spectrum will provide photons of the least energy? Explain. (HSP 21.32)
13. What is the efficiency of a 100-W, 550-nm lightbulb if a photometer finds that 1×10^{20} photons are emitted each second? (HSP 21.51)