Ans Ranges + ANS key

Name STURMAN key

Period _____ Date _____

LIGHT PROBLEMS

1. Calculate the smallest increment of energy that an object can absorb from yellow light, wavelength 589nm. (2-5x10^{-19} J)

$\lambda = 589\text{nm} = 589\times10^{-9}\text{m}$ $C = f\lambda$ $E = hf$

$E = ?$ $3.00\times10^{8} = f(589\times10^{-9})$ $= 6.62\times10^{-34}\text{J}\cdot\text{s}(5.09\times10^{14}\text{s}^{-1})$

$f = 5.09\times10^{14}\text{s}^{-1}$ $= 3.37\times10^{-19}\text{J}$

2. A laser, used to weld detached retinas, produces radiation with a frequency of 4.69 x 10^{14} s^{-1}. What is the energy of this radiation? (2-4x10^{-19} J)

$f = 4.69\times10^{14}\text{s}^{-1}$ $E = hf$

$E = ?$ $= 6.62\times10^{-34}\text{J}\cdot\text{s}(4.69\times10^{14}\text{s}^{-1})$

$= 3.11\times10^{-19}\text{J}$

3. The orange light given off by a sodium vapor, used for street lamps, has a wavelength of 625nm. How much energy does it give off? (2-4 x10^{-19} J)

$\lambda = 625\text{nm} = 625\times10^{-9}\text{m}$ $C = f\lambda$ $E = hf$

$3.00\times10^{8} = f(625\times10^{-9})$ $= 6.62\times10^{-34}\text{J}\cdot\text{s}(4.80\times10^{14}\text{s}^{-1})$

$f = 4.80\times10^{14}\text{s}^{-1}$ $= 3.18\times10^{-19}\text{J}$

4. A laser that emits light energy in pulses of short duration has a frequency of 4.69 x 10^{14} s^{-1}. It deposits 1.30 x 10^{-2} J of energy during each pulse. How many quanta of energy does each pulse deposit? (1-2 x10^{-2} J)

1.30x10^{-2} J of energy for each pulse

5. What is the wavelength, in nanometers, of a photon that gives off 1.88 x 10^{-18} J of energy? (90-110nm)

$E = 1.88\times10^{-18}\text{J}$ $E = hf$ $f = 2.84\times10^{15}\text{s}^{-1}$

$\lambda = ?\text{nm}$ $1.88\times10^{-18} = 6.62\times10^{-34}f$ $C = f\lambda$

$3.00\times10^{8} = 2.84\times10^{15}\lambda \Rightarrow \lambda = 1.06\times10^{-7}\text{m}$

$= 106\text{nm}$

6. What color light gives off 4.417 x 10^{-19} J of energy? ($\lambda \rightarrow$ 300-500nm)

$E = 4.417\times10^{-19}\text{J}$ $E = hf$ $C = f\lambda$

$\lambda = ?$ $4.417\times10^{-19} = 6.62\times10^{-34}f$ $3.00\times10^{8} = 6.67\times10^{14}\lambda$

$f = 6.67\times10^{14}\text{s}^{-1}$ $\lambda = 4.50\times10^{-7} = 450\text{nm} \rightarrow \text{BLUE}$

7. How much energy does an AM radio wave emit if its frequency is 1.00 x 10^{6} s^{-1}? (5-7 x10^{-28} J)

$f = 1.00\times10^{6}\text{s}^{-1}$ $E = hf \Rightarrow$

$E = ?$ $= 6.62\times10^{-34}(1.00\times10^{6}) = 6.63\times10^{-28}\text{J}$