

Light & Periodicity HOMEWORK

Lesson 1: Homework

1. Match the correct term, listed to EACH symbol below:

- a. 2.998×10^8
 b. wavelength
 c. frequency
 d. energy
 e. 2.998×10^{17}

- a. 6.626×10^{-34}
 b. frequency
 c. energy
 d. 2.998×10^8
 e. wavelength

2. Identify the units for EACH symbol below:

- a. c (m/s)
 b. λ (m)
 c. ν (sec⁻¹)

- a. meters (m)
 b. 1/photon
 c. sec⁻¹
 d. nanometers (nm)
 e. 1/m
 f. 1/m²

3. Convert 6.65×10^2 nanometers to meters.

$$6.65 \times 10^2 \text{ nm} \times (1000 \text{ nm} / 10^9 \text{ m}) = 6.65 \times 10^{-7} \text{ m}$$

4. As you orbit during orbit orbit around the sun, there is 1.49×10^8 meters from Earth.

a) If a signal, which uses light waves, is sent that distance (a wavelength of 1.49×10^8 meters), what is its frequency?

$$\begin{aligned} c &= \lambda \nu \\ (2.998 \times 10^8) &= (1.49 \times 10^8) \nu \\ \nu &= 2.01207986 \times 10^0 \text{ sec}^{-1} \end{aligned}$$

b) The units on the frequency is sec⁻¹. If this value is inverted, the units are inverted as well. How many seconds does it take to send this signal? Give your answer with units from part "a" in this calculation.

$$(1 / 2.01207986 \text{ sec}^{-1}) = 0.49701591 \text{ sec} \approx 0.50 \text{ sec}$$

5. Light can be used to excite the electrons in atoms. Certain frequencies of light work best for specific atoms. To excite an atom of Calcium, the ideal frequency of $5.2 \times 10^{14} \text{ s}^{-1}$ is needed. What is the wavelength (in nm) of this electromagnetic radiation? Give your answer in scientific notation and with units.

$$\begin{aligned} c &= \lambda \nu \\ (2.998 \times 10^8) &= (5.2 \times 10^{14}) \lambda \\ \lambda &= 5.7653846 \times 10^{-7} \end{aligned}$$

$$5.7653846 \times 10^{-7} \text{ sec} / \text{sec} = 5.7653846 \times 10^{-7} \text{ m} \approx 5.8 \times 10^{-7} \text{ m}$$

6. The energy required to dissociate the Cl_2 molecule into two separate Cl atoms requires a wavelength of 5.00×10^2 meters. What is the energy of this light in joules?

$$\begin{aligned} 5.000000 \times 10^2 \text{ m} &= (2.998 \times 10^8 \text{ m/sec}) / \nu \\ \nu &= 5.996000 \times 10^5 \text{ sec}^{-1} \\ E &= h \nu = (6.626 \times 10^{-34} \text{ J} \cdot \text{sec}) (5.996000 \times 10^5 \text{ sec}^{-1}) \\ E &= 3.973000 \times 10^{-28} \text{ J} \end{aligned}$$

7. Refrigerator coolant systems require compounds known as chlorofluorocarbons (CFCs). If not properly disposed, a refrigerator can leak this gas into the environment. Thus, ultraviolet radiation from the sun can destroy these CFCs, which can then destroy the ozone layer. How much energy do the CFCs receive from UV light that has a frequency of $6.62 \times 10^{14} \text{ s}^{-1}$. Give your answer in joules.

$$\begin{aligned} E &= h \nu = (6.626 \times 10^{-34} \text{ J} \cdot \text{sec}) (6.62 \times 10^{14} \text{ sec}^{-1}) \\ E &= 4.386012 \times 10^{-19} \text{ J} \end{aligned}$$

8. You want your lawn sprinklers to come on in the morning, at first light. So, you design a switch that will operate by the photoelectric effect when enough sunlight hits it. As sunlight hits on your switch, the metal inside the device absorbs energy and ejects electrons to create electricity that powers the sprinklers. If the switch requires $5.0 \times 10^{14} \text{ s}^{-1}$ (just off metal to remove an electron), will the switch react if the sunlight has a wavelength of 540nm?

$$\begin{aligned} \nu &= c / \lambda = (2.998 \times 10^8 \text{ m/sec}) / (540 \times 10^{-9} \text{ m}) \\ \nu &= 5.55185185 \times 10^{14} \text{ sec}^{-1} \end{aligned}$$

$$\begin{aligned} c &= \lambda \nu \\ (2.998 \times 10^8) &= (540 \times 10^{-9}) \nu \\ \nu &= 5.55185185 \times 10^{14} \text{ sec}^{-1} \end{aligned}$$

$$\begin{aligned} E &= h \nu = (6.626 \times 10^{-34} \text{ J} \cdot \text{sec}) (5.55185185 \times 10^{14} \text{ sec}^{-1}) \\ E &= 3.680000 \times 10^{-19} \text{ J} \end{aligned}$$

$$\begin{aligned} E &= h \nu = (6.626 \times 10^{-34} \text{ J} \cdot \text{sec}) (5.55185185 \times 10^{14} \text{ sec}^{-1}) \\ E &= 3.680000 \times 10^{-19} \text{ J} \end{aligned}$$

Periodicity Ap Chemistry Answers

Michael Hoelscher



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