

October 6

Chapte4 ORION

LO 4.2 aspcted of light

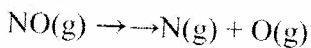
A laser emits a pulse of light containing  $2.59 \times 10^{-5} \text{ J}$  of energy at a frequency of  $7.94 \times 10^{14} \text{ Hz}$ . How many photons are present in the pulse?

$$E = h\nu = 6.63 \times 10^{-34} \text{ J} \cdot \text{s} \times 7.94 \times 10^{14} \frac{1}{\text{s}} = 5.3 \times 10^{-19} \text{ J} \text{ photon}$$
$$\frac{2.59 \times 10^{-5} \text{ J}}{\text{pulse}} \frac{\text{photon}}{5.3 \times 10^{-19} \text{ J}} = 4927 \frac{\text{photons}}{\text{pulse}}$$

An instrument can detect 2280 photons of light of frequency  $4.058 \times 10^9 \text{ Hz}$ . What is the minimum amount of energy in J to which the instrument is sensitive?

$$2280 \text{ photons} \quad \nu = 4.058 \times 10^9 \frac{1}{\text{s}}$$
$$E = h\nu = 6.63 \times 10^{-34} \text{ J} \cdot \text{s} \times 4.058 \times 10^9 \frac{1}{\text{s}} = 2.7 \times 10^{-24} \text{ J} \text{ photon}$$
$$2280 \text{ photons} \times 2.7 \times 10^{-24} \frac{\text{J}}{\text{ph}} = \boxed{6.1 \times 10^{-21} \text{ J}}$$

The energy required to split apart nitrogen monoxide according to the equation shown below is 607 kJ/mol.



Calculate the wavelength in nanometers of the photon that can break the nitrogen-oxygen bond.

$$\frac{607 \text{ kJ}}{\text{mol}} \frac{1 \text{ mole}}{6.02 \times 10^{23}} = \frac{10^{23} \text{ J}}{\text{kJ}} = 1.0 \times 10^{-18} \text{ J}$$

$$E = h\nu = \frac{hc}{\lambda} = 6.63 \times 10^{-34} \text{ J} \cdot \text{s} \times 3 \times 10^8 \frac{\text{m}}{\text{s}}$$
$$1.0 \times 10^{-18} \text{ J} = \frac{6.63 \times 10^{-34} \text{ J} \cdot \text{s} \times 3 \times 10^8 \text{ m}}{\lambda}$$
$$\lambda = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{1.0 \times 10^{-18}} \text{ m} = 1.97 \times 10^{-7} \text{ m}$$
$$197 \text{ nm}$$

A wave with an energy of 5.01 eV is required to remove an electron from the surface of nickel metal. What is the longest wavelength of light that could remove an electron from a nickel atom? (1 eV =  $1.602 \times 10^{-19}$  J)

$$5.01 \text{ eV} \times 1.602 \times 10^{-19} \text{ J/eV} = 8.03 \times 10^{-19} \text{ J} = h \frac{c}{\lambda}$$
$$8.03 \times 10^{-19} \text{ J} = \frac{6.63 \times 10^{-34} \text{ J} \cdot \text{s} \times 3 \times 10^8 \text{ m/s}}{\lambda}$$
$$\lambda = 248 \text{ nm}$$

LO 4.5 values of Q#

Which type of subshell consists of three separate orbitals of equal energy?

- A s
- B d
- C f

An neutral element has two electrons in the n=1 shell, eight electrons in the n=2 shell, eight electrons in the n=3 shell, and two electrons in the n=4 shell. How many electrons are found in s-subshells? Assume the atom is in its ground state.

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What is the maximum number of electrons that are allowed to have the following set of quantum numbers in one atom?

$$n = 4 \text{ and } m_l = +2$$

$$\begin{array}{cc} 4 & d + f \\ 2 & 2 \end{array}$$

What is the maximum number of electrons that are allowed to have the following set of quantum numbers in one atom?

$$n = 3 \text{ and } l = 1$$

$$3 \times m_l \quad \textcircled{6}$$

The quantum numbers given represent an electron in the last occupied subshell of an atom. Which of the elements listed could have the following quantum numbers for the electron in the last occupied subshell? Select all that apply.

$$n = 4, l = 2, m_l = -1, m_s = +1/2$$

$$\underline{4d \text{ electrons}} = \underline{\underline{10}}$$