October 6

Chapte4 ORION

LO 4.2 aspcted of light

A laser emits a pulse of light containing 2.59 x 10^{-15} J of energy at a frequency of 7.94 x 10^{14} Hz. How many photons are present in the pulse?

$E = h\nu = 6.63\times10^{-34}\,J\,s \times 7.94\times10^{14}\,\frac{1}{s} = 5.3\times10^{-19}\,\frac{J}{photon}$

$\frac{2.59\times10^{-15}\,J}{pulse}\;\frac{photon}{5.3\times10^{-19}\,J} = 4927\,\frac{photons}{pulse}$

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

2280 photons $\nu = 4.058\times10^{9}\,\frac{1}{s}$

$E = h\nu = 6.63\times10^{-34}\,J\,s \times 4.058\times10^{9}\,\frac{1}{s} = 2.7\times10^{-24}\,\frac{J}{photon}$

$2280\,photons \times 2.7\times10^{-24}\,\frac{J}{ph} = 6.1\times10^{-21}\,J$

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

$NO(g) \rightarrow\rightarrow N(g) + O(g)$

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

$607\,\frac{kJ}{mol}\;\frac{1\,mole}{6.02\times10^{23}}\;\frac{10^{3}\,J}{kJ} = 1.0\times10^{-18}\,J$

$E = h\nu = h\frac{c}{\lambda} = \frac{6.63\times10^{-34}\,J\,s \times 3\times10^{8}\,m/s}{\lambda}$

$1.0\times10^{-18}\,J = \frac{6.63\times10^{-34}\,J \times 3\times10^{8}\,m}{\lambda}$

$\lambda = \frac{6.63\times10^{-34} \times 3\times10^{8}}{1.0\times10^{-18}}\,m = 1.97\times10^{-7}\,m$

197 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 = 1.602×10^{-19} J)

$5.01\,eV \times \frac{1.602\times10^{-19}\,J}{eV} = 8.03\times10^{-19}\,J = \frac{hc}{\lambda}$

$8.03\times10^{-19}\,J = \frac{6.63\times10^{-34}\,J\,s \times 3\times10^{8}\,m/s}{\lambda}$

$\lambda = 248\,nm$

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.

8

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

$n = 4$ and $m_l = +2$

4 d + f

2 2

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

$n = 3$ and $l = 1$ 3 x m_l 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.

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

4d electrons = 10