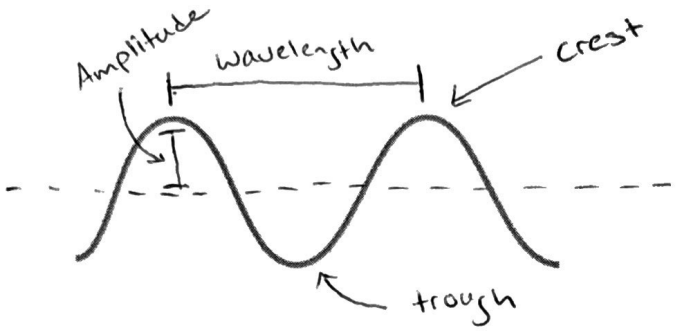
Answer Key

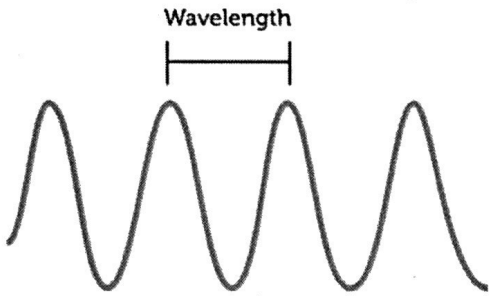
Chapter 6: Electronic Structure of Atoms

Label the following diagrams:

Long λ
low V
low E

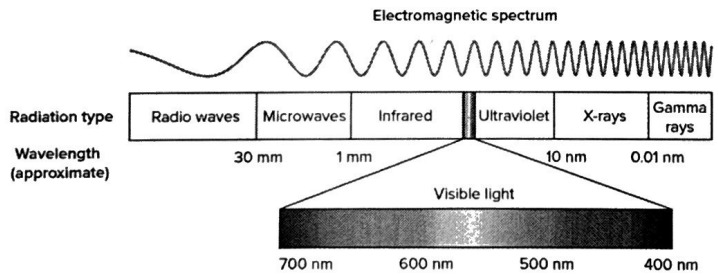


λ = wavelength
V = frequency
E = energy



short λ
high V
high E

Red = long λ



Red orange yellow green blue

Blue = short λ

long λ

short λ

$\frac{1}{s} = s^{-1}$

What is the equation for the speed of light? c = speed of light 3.00×10^8 m/s

$c = \lambda \nu$

λ = wavelength

ν = frequency

Calculate the frequency given a wavelength of 640.0 nm.

$\frac{c = \lambda \nu}{\lambda \quad \lambda}$ $\quad \nu = \frac{c}{\lambda}$

$\nu = \frac{3.00 \times 10^8 \text{ m/s}}{6.4 \times 10^{-7} \text{ m}}$

$= 4.688 \times 10^{14} \text{ s}^{-1}$

$c = 3.00 \times 10^8$ m/s

$\lambda = 640.0$ nm $\longrightarrow$ $\frac{640.0 \text{ nm} \mid 1 \text{ m}}{\quad \mid 10^9 \text{ nm}} = 6.4 \times 10^{-7}$ m

What is the formula for energy?

$E = h\nu$ or $E = \frac{hc}{\lambda}$

E = energy

h = planck's constant 6.626×10^{-34} J/s

Calculate the energy for a light that has a frequency of 4.69×10^{14} s^{-1}.

$E = ?$

$\nu = 4.69 \times 10^{14} \text{ s}^{-1}$

$h = 6.626 \times 10^{-34}$ J/s

$E = h\nu$

$E = (6.626 \times 10^{-34} \text{ J/s})(4.69 \times 10^{14} \text{ s}^{-1})$

$= 3.11 \times 10^{-19}$ J

Calculate the energy of yellow light that has a wavelength of 589nm.

$E = \frac{hc}{\lambda}$

$E = ?$

$h = 6.626 \times 10^{-34}$ J/s

$c = 3.00 \times 10^8$ m/s

$\lambda = 589 \text{ nm} \sim 5.89 \times 10^{-7}$ m

$E = \frac{(6.626 \times 10^{-34} \text{ J/s})(3.00 \times 10^8 \text{ m/s})}{5.89 \times 10^{-7} \text{ m}}$

$= 3.37 \times 10^{-19}$ J

What is the emission spectrum?

Emission of light from electronically excited gas atoms

Is the fingerprint for elements

What are the three rules for assigning electron configuration?

Pauli Exclusion = Arrows can't go in the same direction ↑↑ ← NO

Aufbau = e^- fill lower atomic orbitals first ↑ 1s ↑ 2s ← wrong

Hund's = 1 e^- in each orbital before e^- pairing occurs

→ $1s^1$ ← # of e^- in the orbital

↑ orbital

Period #

↑↓ 1s ↑↓ 2s ↑↓ | | 2p ← wrong

Identify what groups are in each orbital?

s: alkali metals + alkaline earth metals

d: transition metals

p: everything right of group 2B

f: lanthanide + actinide series

What is the electron configuration for the following elements?

Na $1s^2 2s^2 2p^6 3s^1$

↑↓ 1s ↑↓ 2s ↑↓ ↑↓ ↑↓ 2p ↑ 3s

B $1s^2 2s^2 2p^1$

↑↓ 1s ↑↓ 2s ↑ | | 2p

Na^+ $1s^2 2s^2 2p^6$

↑ lose e^-

↑↓ 1s ↑↓ 2s ↑↓ ↑↓ ↑↓ 2p

O^{2-} $1s^2 2s^2 2p^6$

↑ gain 2 e^-

↑↓ 1s ↑↓ 2s ↑↓ ↑↓ ↑↓ 2p

Write the following elements in condensed electron configuration:

Mg $[Ne]\ 3s^2$

Ti $[Ar]\ 4s^2 3d^2$

P^{3-} $[Ne]\ 3s^2 3p^6$

Bi $[Xe]\ 6s^2 4f^{14} 5d^{10} 6p^3$

*know silver as well. Follows same rules as Cu ↓ *

What are the exceptions to the electron configuration rules?

Cr: $1s^2 2s^2 2p^6 3s^2 3p^6 \boxed{4s^2 3d^4}$ → $4s^1 3d^5$

Cu: $1s^2 2s^2 2p^6 3s^2 3p^6 \boxed{4s^2 3d^9}$ → $4s^1 3d^{10}$

★ $[Ar]\ 4s^1 3d^5$

★ $[Ar]\ 4s^1 3d^{10}$

What shape are s orbitals? What shape are p orbitals?

s orbitals = spheres ○

p orbitals = dumbell / hourglass 8 ∞

If n = 1, then l can only be 0

n = period #
l = block (orbital)
m_l = e⁻
m_s = e⁻ spin
~~n ≠ l~~
l = m_l

If n = 3, and l = 2, then m_l can be -2, -1, 0, 1, 2

-2 → 2

What would be the quantum numbers for n, l, and m_l, and m_s if you are given chlorine?

$1s^2 2s^2 2p^6 3s^2 3p^5$

n = 3 l = 1 m_l = ∅ $m_s = -1/2$

s = ∅
p = 1
d = 2
f = 3
↑ l