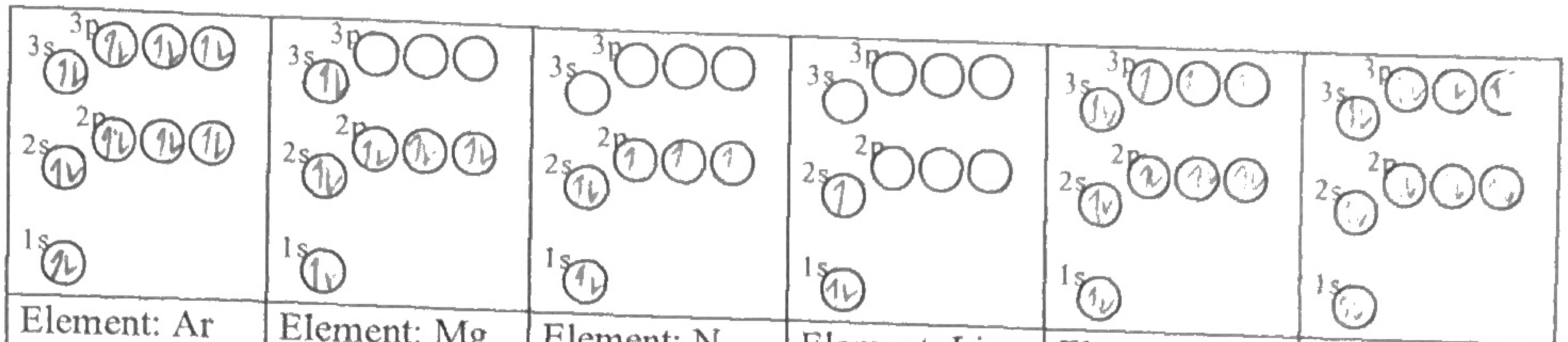
Electron Configurations & Periodicity

WRITING ELECTRON CONFIGURATIONS

For each given element, fill in the orbital diagram and then write the electron configuration for the element.



Element: Ar	Element: Mg	Element: N	Element: Li	Element: P	Element: Cl
# of e⁻'s: 18	# of e⁻'s: 12	# of e⁻'s: 7	# of e⁻'s: 3	# of e⁻'s: 15	# of e⁻'s: 17

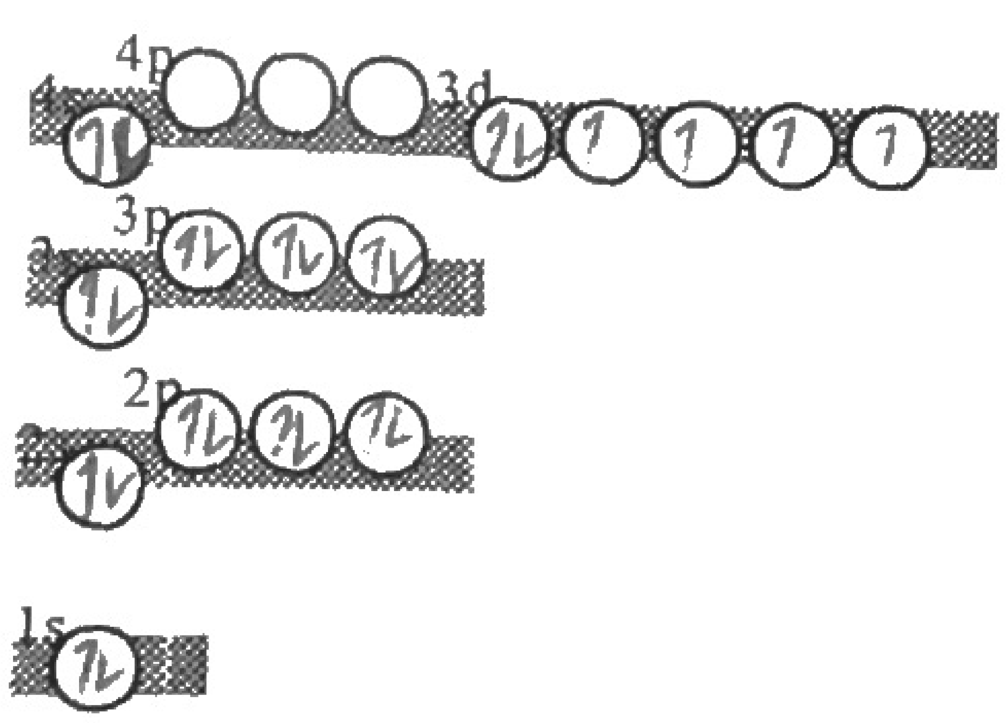
Write the electron configurations of each of these in **long form** and **short form**:

1. Ar $1s^2 2s^2 2p^6 3s^2 3p^6$
   Ar [Ne] $3s^2 3p^6$ = [Ar]

2. Ni $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$
   Ni [Ar] $4s^2 3d^8$

3. In $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^1$
   In [Kr] $5s^2 4d^{10} 5p^1$

4. I $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^5$
   I [Kr] $5s^2 4d^{10} 5p^5$



5. Fill in the orbital diagram for the element, Fe, and write the electron configuration of Fe in the long and short form.

Fe $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

Fe [Ar] $4s^2 3d^6$

8. Write the orbital occupied by the last electron of each of the following elements:

As	W	Li	U	O	Rn	V
4p	5d	2s	5f	2p	6p	3d

Name Key

Period ___ Date __/__/__

Atomic Structure

CALCULATION PRACTICE — 1

Formulas and Constants

$c = \lambda \nu$	$\nu = \frac{c}{\lambda}$	$\lambda = \frac{c}{\nu}$	$E = h\nu$	$E = \frac{hc}{\lambda}$
$c = 2.998 \times 10^8$ m/s		$h = 6.626 \times 10^{-34}$ J·s		

1. An FM radio station has a frequency of 88.9 MHz (1 MHz = 10^6 Hz, or cycles per second). What is the wavelength of this radiation in meters?

$88.9\ \text{MHz} \times \frac{10^6\ \text{Hz}}{1\ \text{MHz}} = 8.89 \times 10^7\ \text{Hz}$ $\quad c = \lambda\nu \quad \lambda = \frac{3.00\times10^8\ \frac{m}{s}}{8.89\times10^7\ \frac{1}{s}} = 3.37\ m$

2. The U.S. Navy has a system for communicating with submerged submarines. The system uses radio waves with a frequency of 76 s^{-1}. What is the wavelength of this radiation in meters?

$c = \lambda\nu \quad \lambda = \frac{c}{\nu} = \frac{3.00\times10^8\ \frac{m}{s}}{76\ \frac{1}{s}} = 3.9\times10^6\ m$

3. Violet light has a wavelength of about 410 nm. What is its frequency? Calculate the energy ~~of one photon of~~ violet light.

$410\ \text{nm} \times \frac{1\ m}{10^9\ \text{nm}} = 4.1\times10^{-7}\ m \quad c = \lambda\nu \quad \nu = \frac{3.00\times10^8\ \frac{m}{s}}{4.1\times10^{-7}\ m}$

$\nu = 7.3\times10^{14}\ \frac{1}{s}$

$E = h\nu = 6.626\times10^{-34}\ J\cdot s \cdot 7.3\times10^{14}\ \frac{1}{s}$ $\quad E = 4.8\times10^{-19}\ J$

4. The energy of a photon of red light from a laser is 2.907×10^{-19} J. ~~Calculate the energy of one photon of red light~~. What is the wavelength of red light in meters? In nm?

$E = h\nu \quad \nu = \frac{E}{h} = \frac{2.907\times10^{-19}\ J}{6.626\times10^{-34}\ J\cdot s} = 4.387\times10^{14}\ \frac{1}{s}$

$c = \lambda\nu \quad \lambda = \frac{c}{\nu} = \frac{3.00\times10^8\ \frac{m}{s}}{4.387\times10^{14}\ \frac{1}{s}} = 6.838\times10^{-7}\ m \times \frac{10^9\ nm}{1\ m} = 683.8\ nm$

5. The most prominent line in the spectrum of neon is found at 865.438 nm. Other lines are found at 837.761 nm, 878.062 nm, 878.438 nm, and 1885.387 nm.
   (a) Which of these lines represents the most energetic light? 837.761 nm
   (b) What is the frequency of the most prominent line? What is the energy of one photon of this wavelength? $865.438\ nm \times \frac{1\ m}{10^9\ nm} = 8.65438\times10^{-7}\ m$

high energy = high frequency = low wavelength

$c = \lambda\nu \quad \nu = \frac{c}{\lambda} = \frac{3.00\times10^8\ \frac{m}{s}}{8.65438\times10^{-7}\ m} = 3.46645\times10^{14}\ \frac{1}{s}$

$E = h\nu = 6.626\times10^{-34}\ J\cdot s \cdot 3.46645\times10^{14}\ \frac{1}{s} = 2.29687\times10^{-19}\ J$

6. A certain atom has two energy levels with the following energies: $E_1 = 6.8 \times 10^{-20}$ J and $E_3 = 1.5 \times 10^{-19}$ J. Determine the wavelength and frequency of the radiation emitted when the electron falls from the n = 3 energy level to the n = 1 energy level.

$1.5\times10^{-19}\ J - 6.8\times10^{-20}\ J = 8.2\times10^{-20}\ J$

$E = h\nu \quad \nu = \frac{E}{h} = \frac{8.2\times10^{-20}\ J}{6.626\times10^{-34}\ J\cdot s} = 1.2\times10^{14}\ \frac{1}{s} = Hz$

$c = \lambda\nu \quad \lambda = \frac{c}{\nu} = \frac{3.00\times10^8\ \frac{m}{s}}{1.2\times10^{14}\ \frac{1}{s}} = 2.4\times10^{-6}\ m$