Atomic Particles, Atoms, Isotopes, and Bonding Worksheet

Atomic Particles (amu = atomic mass unit)

<table>
<thead>
<tr>
<th>Name</th>
<th>Symbol</th>
<th>Charge</th>
<th>Mass</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electron</td>
<td>e-</td>
<td>-1</td>
<td>0</td>
<td>Energy shells surrounding nucleus</td>
</tr>
<tr>
<td>Proton</td>
<td>p+</td>
<td>+1</td>
<td>1 amu</td>
<td>Nucleus</td>
</tr>
<tr>
<td>Neutron</td>
<td>n</td>
<td>0</td>
<td>1 amu</td>
<td>Nucleus</td>
</tr>
</tbody>
</table>

Atomic mass = total mass of atom = # of protons + # of neutrons

Atomic number = # of protons = designation for element

Energy shells: electrons reside in energy shells surrounding the nucleus of an atom.
- Shell 1 maximum = 2 electrons (no more allowed)
- Shell 2, 3, 4, 5… maximum = 8 electrons (no more allowed)
- Therefore, the first two electrons go into shell 1, the next eight into shell 2, and so on.

Octet rule: All atoms want to completely fill their outermost energy shell: 2 electrons maximum in the first shell and 8 maximum in all other shells.

Valence electrons = the number of electrons residing in the outermost unfilled energy shell

Bonding = Atoms attempt to fill their outermost energy shell by removing, adding, or sharing electrons.
- Ionic bonding = Atom A gives up electrons to Atom B, so that both can achieve the octet rule.
  The result: two ions with equal and opposite charges that now attract each other.
- Covalent bonding = Atoms A and B both share one of their electrons with each other, thereby effectively gaining one. In such cases, the electrons orbit both nuclei, gluing them together most strongly.
- Hydrogen bonding = Hydrogen atoms bonded to oxygen (like in water) act as weak positive ions that can then weakly attract negative ions. This is how water dissolves ions so easily, by surrounding and attacking ionic bonds, pulling the positive and negative ions apart. Hydrogen bonds are weak bonds, and so it take a number of water molecules to pull apart one salt molecule, for example.

Isotopes = atoms with same atomic number (same # protons), but different # of neutrons. Therefore, they are the same element, but with different masses.

Atomic weight = the average atomic mass of a given sample of an element (averaging in all its naturally occurring isotopes).
Complete these diagrams with all the missing information

- **Top Diagram**
  - \# p+ =
  - \# n =
  - Atomic # =
  - Element =
  - Atomic mass = 36
  - \# valence e- =
  - Change in e- desired?

- **Bottom Diagram**
  - \# p+ =
  - \# n =
  - Atomic # =
  - Element =
  - Atomic mass = 28
  - \# valence e- =
  - Change in e- desired?
# p+ =
# n =
atomic # =
element =
atomic mass = 23

# valence e- =
Change in e-desired?

# p+ =
# n =
atomic # =
element =
atomic mass = 1

# valence e- =
Change in e-desired?
# p+ =
# n =
atomic # =
element =
atomic mass = 16

# valence e- =
Change in e-desired?

# p+ =
# n =
atomic # =
element =
atomic mass = 18

# valence e- =
Change in e-desired?
# p⁺ = 11
# n = 12
atomic # = 11
element = Sodium
atomic mass = 23
# valence e-
before bond:
after bond:
Net charge:

Ionic Bonding
NaCl

# p⁺ = 17
# n = 18
atomic # = 17
element = Chlorine
atomic mass = 35
# valence e-
before bond:
after bond:
Net charge:

# p⁺ = 7    # n = 7
atomic # = 7
element = Nitrogen
atomic mass = 14
# valence e-
before bond:
# e- shared
with other?
# e- gained
from other?
# valence e-
after bond:

Covalent Bonding
N2 (gas)
Covalent Bonding -- $\text{SiO}_4$

4 ATOMS Each:
- $\# \ p^+ = 8$  \  $\# \ n = 8$
- atomic # = 8
- element = Oxygen
- atomic mass = 16
- $\#$ valence e-
  before bond:
- $\#$ e- shared
  with other?
- $\#$ e- gained
  from other?
- $\#$ valence e-
  after bond:

CENTER ATOM:
- $\# \ p^+ = 14$  \  $\# \ n = 14$
- atomic # = 14
- element = Silicon
- atomic mass = 28
- $\#$ valence e-
  before bond:
- $\#$ e- shared
  with other?
- $\#$ e- gained
  from other?
- $\#$ valence e-
  after bond:

Covalent Bonding -- $\text{H}_2\text{O}$

2 ATOMS Each:
- $\# \ p^+ = 1$  \  $\# \ n = 0$
- atomic # = 1
- element = Hydrogen
- atomic mass = 1
- $\#$ valence e-
  before bond:
- $\#$ e- shared
  with other?
- $\#$ e- gained
  from other?
- $\#$ valence e-
  after bond:

CENTER ATOM:
- $\# \ p^+ = 8$  \  $\# \ n = 8$
- atomic # = 8
- element = Oxygen
- atomic mass = 16
- $\#$ valence e-
  before bond:
- $\#$ e- shared
  with other?
- $\#$ e- gained
  from other?
- $\#$ valence e-
  after bond: