

## 2 • Atoms and Elements

### Study Questions and Problems

*“The one quality which sets one man apart from another — the key which lifts one to every aspiration while others are caught up in the mire of mediocrity — is not talent, formal education, nor brightness — it is self-discipline. With self-discipline, all things are possible. Without it, even the simplest goal can seem like the impossible dream.”*

*Theodore Roosevelt (1858-1919)*

- Explain, at an atomic or molecular level, what happens when
  - water freezes to form ice
  - copper and tin combine to form bronze
  - rainwater evaporates from the pavement
- Which of the following atoms are isotopes of the same element? Identify the elements of these isotopes and describe the number of protons and neutrons in the nucleus of them all.
 
$${}^15_7\text{X} \quad {}^{12}_6\text{X} \quad {}^{13}_7\text{X} \quad {}^{18}_8\text{X} \quad {}^{14}_7\text{X} \quad {}^{14}_6\text{X} \quad {}^{16}_8\text{X} \quad {}^{13}_6\text{X} \quad {}^{17}_8\text{X}$$
- There are three naturally occurring isotopes of neon:
 

neon-20	mass 19.9924 amu	abundance 90.84%
neon-21	mass 20.9940 amu	abundance 0.260%
neon-22	mass 21.9914 amu	abundance 8.90%

  - Without calculation, what is the approximate atomic mass of neon?
  - Calculate the actual atomic mass.
- Uranium has an atomic mass equal to 238.0289. It consists of two isotopes: uranium-235 with an isotopic mass of 235.044 amu and uranium-238 with an isotopic mass of 238.051. Calculate the % abundance of the uranium-235 isotope.
- From amongst the elements sodium, chlorine, nickel, argon, calcium, uranium, and oxygen, select the alkali metal, the alkaline earth metal, the transition metal, the actinide, the halogen, the noble gas, and the chalcogen (Group 6A).
- To illustrate Robert Millikan’s determination of the charge on an electron, suppose that you were given the task of determining the mass of a single jelly bean given the following experimental data:

Various scoops of jelly beans were weighed and the following masses determined. The number of jelly beans in each scoop was not known.

Masses (in grams) of ten different scoops:

4.96	8.68	13.64	7.44	21.08	16.12	9.92	19.84	6.20	12.40
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8. Reorder this list to match the name of the scientist with his or her contribution to our understanding of the nature of matter:

J.J. Thompson	_____	developed the idea of the atomic nature of matter
James Chadwick	_____	established the law of conservation of matter
Robert Millikan	_____	characterized positive and negative electrical charges
Henry Moseley	_____	suggested that atoms could disintegrate
Michael Faraday	_____	experimented with electrolysis
Dmitri Mendeleev	_____	proved the existence of the electron
John Dalton	_____	developed the idea of a nuclear atom
Henri Becquerel	_____	discovered the neutron
Democritus	_____	developed the first periodic table of elements
Joseph Proust	_____	showed that periodicity depended upon atomic number
Antoine Lavoisier	_____	formulated the laws of constant composition
Ernest Rutherford	_____	determined the charge on a single electron
Marie Curie	_____	revived the atomic theory
Benjamin Franklin	_____	discovered radioactivity

9. Identify the following elements:

- a. The most abundant metal in the earth's crust
- b. Combined with chlorine, it produces a compound essential to life.
- c. A metal that occurs in vast limestone deposits and combines with oxygen to form an oxide with a formula MO.
- d. The transition element at the center of hemoglobin.
- e. Used in smoke detectors and named for the United States.
- f. A component of washing powder mined in Death Valley.
- g. The basis for the compounds that make up all living things.
- h. Primary constituent of pencil lead.
- i. The last element in the Periodic Table that is not radioactive.
- j. Exists as X<sub>4</sub> molecules.
- k. The element named after the sun, where it was first detected.