

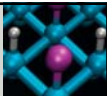
Chemistry
for Engineering Students 4th edition

Brown | Holme

Chapter 2

Atoms and Molecules

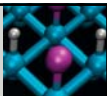
By Dr. Katugampola



Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

1

Polymers



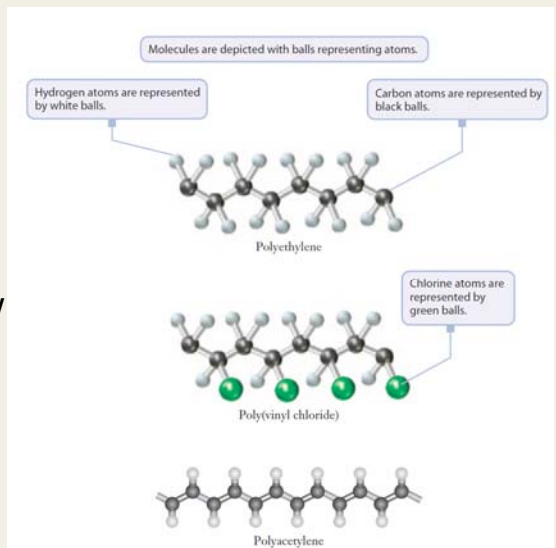
- Very large molecules made up of many smaller molecules, linked end to end
 - **Monomers**
 - Smaller molecules linked together in polymers
 - **Polymer backbone**
 - The long chain of bonded carbon atoms formed when monomers link together to form polymers

Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

2

Polymers (continued)

- Polymers used in everyday objects
 - Polyethylene
 - Poly(vinyl chloride), PVC
 - Polyacetylene
- Models showing how atoms are arranged in several polymers



Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

3

Polymer uses

- Polyethylene – As plastic bottles – milk, juice, or shampoo
- PVC – Plastic pipes
- Polyacetylene – First organic polymer **capable of electrical conductivity**

Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

4

(Q.1)



What element is most often found in a polymer backbone?

- Hydrogen
- Carbon
- Oxygen

Answer: Carbon

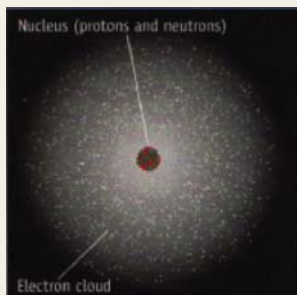
Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

5

Fundamental Concepts of the Atom



- Matter is composed of atoms
 - ✓ Atoms have a **nucleus**, which contains **protons** and **neutrons**
 - The nucleus is surrounded by a cloud of **electrons**
 - Protons are **positively** charged, electrons are **negatively** charged, and neutrons are **neutral**



Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

6

Atomic Number and Mass Number



- **Atomic number:** Number of protons in a particular atom
 - ✓ Identifies an element
- **Mass number:** Sum of the number of protons and number of neutrons in a nucleus
- 1 **atomic mass unit** or **amu** = 1.6605×10^{-24} g
- Protons and neutrons are nearly **2000 times more massive** than electrons

Particle	mass (amu)
Proton	1.007
Neutron	1.009
Electron	0.00055

Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

7

Isotopes



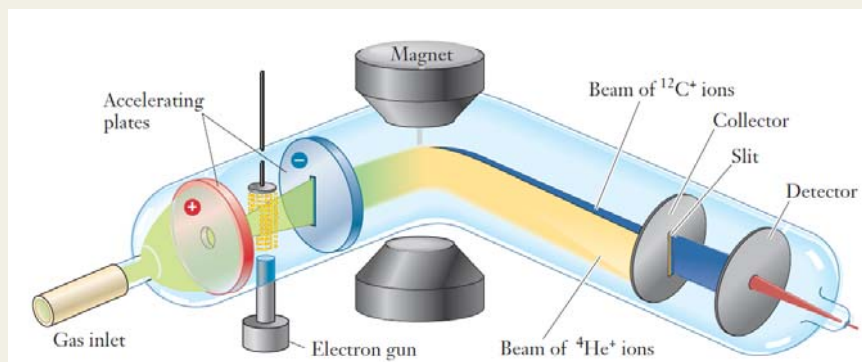
- Atoms of an element that differ in the **number of neutrons** in their nucleus
- **Isotopic abundances**
 - ✓ Relative amounts of each isotope as a percentage

Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

8

Mass Spectrometer

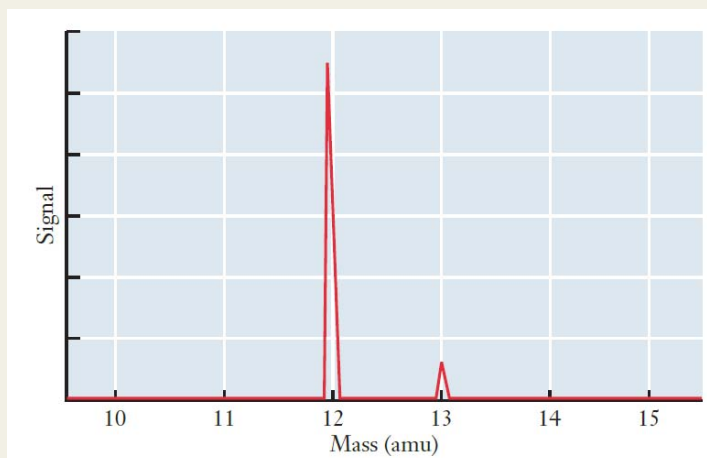
- Mass spectrometers can measure the **masses of atoms, isotopes, and molecules**
- Measures accurately the number of particles with a given mass



Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

9

Mass Spectrum of Elemental Carbon



Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

10

Atomic Symbols



- X is the **atomic symbol for element**
- Superscript A is the **mass number**
- Subscript Z is the **atomic number**

Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

11

Table 2.1: Atomic Symbols

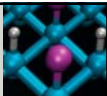


Names and symbols of some common elements whose symbols are not related to their English names

Name	Symbol (name origin)
Gold	Au (aurum)
Iron	Fe (ferrum)
Lead	Pb (plumbum)
Mercury	Hg (hydrargyrum)
Silver	Ag (argentum)
Sodium	Na (natrium)

Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

12



6

C

12.011

Atomic number

Symbol

Atomic weight

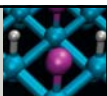
- **This is the entry for carbon on the periodic table**
 - $Z = 6$
 - Element symbol - C
 - Atomic weight = 12.011 (99 atoms of carbon-12 and a single atom of carbon-13)

$^{12}_6\text{C}$

Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

13

Atomic Masses



- Atomic weight of an element is **the average of the atomic masses of the naturally occurring isotopes of the element**
- **Atomic weight = atomic mass × fractional abundance**
 - Carbon-12 = $12.000000 \times 0.9893 = 11.87$
 - Carbon-13 = $13.003355 \times 0.0107 = 0.139$
 - Atomic weight of C = $11.87 + 0.139 = 12.01$

Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

14

(Q. 2)



- The chlorine present in PVC has two stable isotopes. ^{35}Cl with a mass of 34.97 amu makes up 75.77% of the natural chlorine found. The other isotope is ^{37}Cl , whose mass is 36.95 amu. What is the atomic weight of chlorine?

Answer:

$$^{35}\text{Cl} : 34.97 \times 0.7577 = 26.50$$

$$^{37}\text{Cl} : 36.95 \times 0.2423 = 8.953$$

$$\text{Weighted average mass} = 26.50 + 8.953 = 35.45$$

Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

15

(Q.4)



Which part of an atom is much less massive than the other parts?

- Electron
- Neutron
- Proton

Answer: Electron

Copyright ©2019 Cengage Learning. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

16

(Q.5)



Boron has two naturally occurring isotopes, ^{10}B and ^{11}B . Based on its atomic mass, which is more abundant?

- ^{10}B is more abundant
 - ^{11}B is more abundant
 - The abundance is roughly even
- (Atomic weight of Boron is 10.81)

Answer: ^{11}B is more abundant