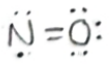
Exceptions to the Octet Rule

- B and Be are second row elements that may have fewer than 8 electrons around them.
- Second row elements never exceed the octet rule. Why?
  Electron configuration - $2s^2\,2p^6$
- Third row elements may exceed the octet rule. Why?
  Electron configuration - $3s^2\,3p^6 \ldots 3d^{10}$

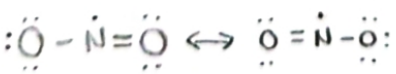
Examples

Odd number of electrons

NO



NO_2



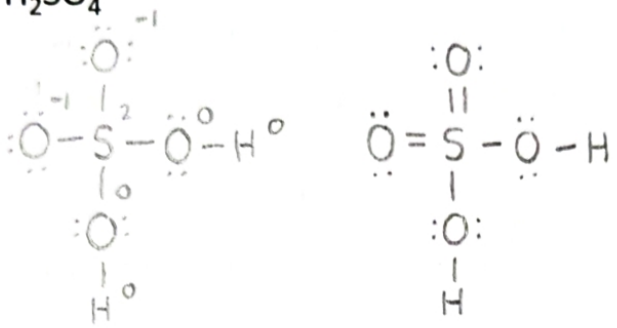
(Free) radicals

OH

Example

Expanded octet

H_2SO_4



Structure and Bonding in Metals

Physical Properties:

Conduct heat/electricity well
Malleable
Ductile

Spherical atoms packed together and bonded equally in all directions (nondirectional bonding). Closest packing of spheres minimizes the void volume.

Metallic bonding
Difficult to break bonds
Easy to change atom arrangement

Unit Cells without Closest Packing

Simple-cubic unit cell (sc)

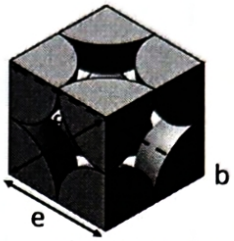
Each sphere has 6 nearest neighbors

1 atom/unit cell

e = edge length = $2r$

f = face diagonal

b = body diagonal



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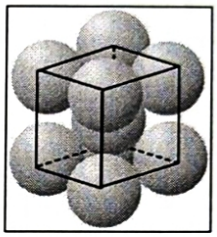
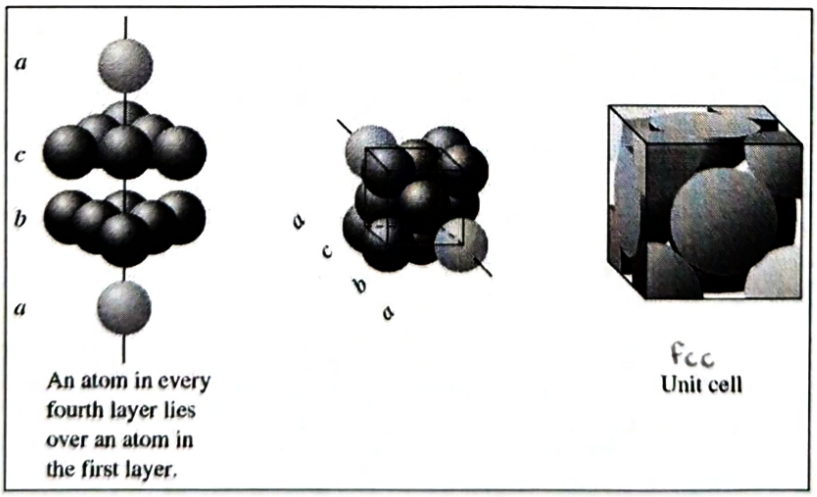
Body-centered cubic (bcc) unit cell

Each sphere has 8 nearest neighbors

2 atoms/unit cell

$b = 4r$



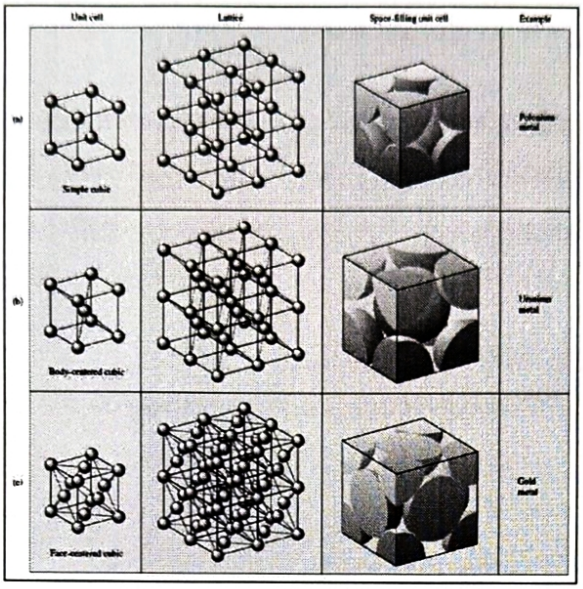


Face-centered cubic unit cell: cubic closest packing (ccp) structure

Each sphere has 12 nearest neighbors

4 atoms/unit cell

$f = 4r$



Unit Cell Characteristics

Unit Cell	% Void Volume	Atoms/Unit Cell	Edge length
Simple Cubic		1	$2r$
Body-Centered Cubic		2	
Face-Centered Cubic		4	

$V = e^3$

$V_{sphere} = \frac{4}{3}\pi r^3$

$Density = \frac{m}{V}$