Combustion 1
Bond Energy

Avi Mehra

February 7, 2021

1 Atomic Radii

We often treat individual atoms as spherical entities, where the border roughly represents the electron cloud. While it isn't strictly true, this simplification provides motivation for studying chemical reactions using the notion of distance.

Recall that a sphere is uniquely defined by the length of its radius, the line segment from its center to any point on its boundary (see Figure 1).

Definition 1.1. When we treat an atom as a sphere, its *atomic radius* is the radius of that sphere.

We already know that certain atoms have different "sizes." The concept of atomic radii makes this precise: different elements—and even different atoms of the same element—have different atomic radii.

2 Bond Length

Consider two atoms bonded together. By virtue of being bonded, their spheres are right next to each other (*adjacent*) in physical space. Then, as in Figure 2, the distance between the centers of these two atoms is just the sum of the atomic radii.[1]

References

[Mar] MarinaVladivostok. File:sphere and ball.png.

[1] This is another simplification. It is entirely reasonable for the spheres to overlap; this happens as a result of, for example, shared electron pairs due to covalent bonding. It also may be the case that there is a small gap between the spheres. Regardless, we should expect that the distance between the spheres is relatively close to the sum of the atomic radii.

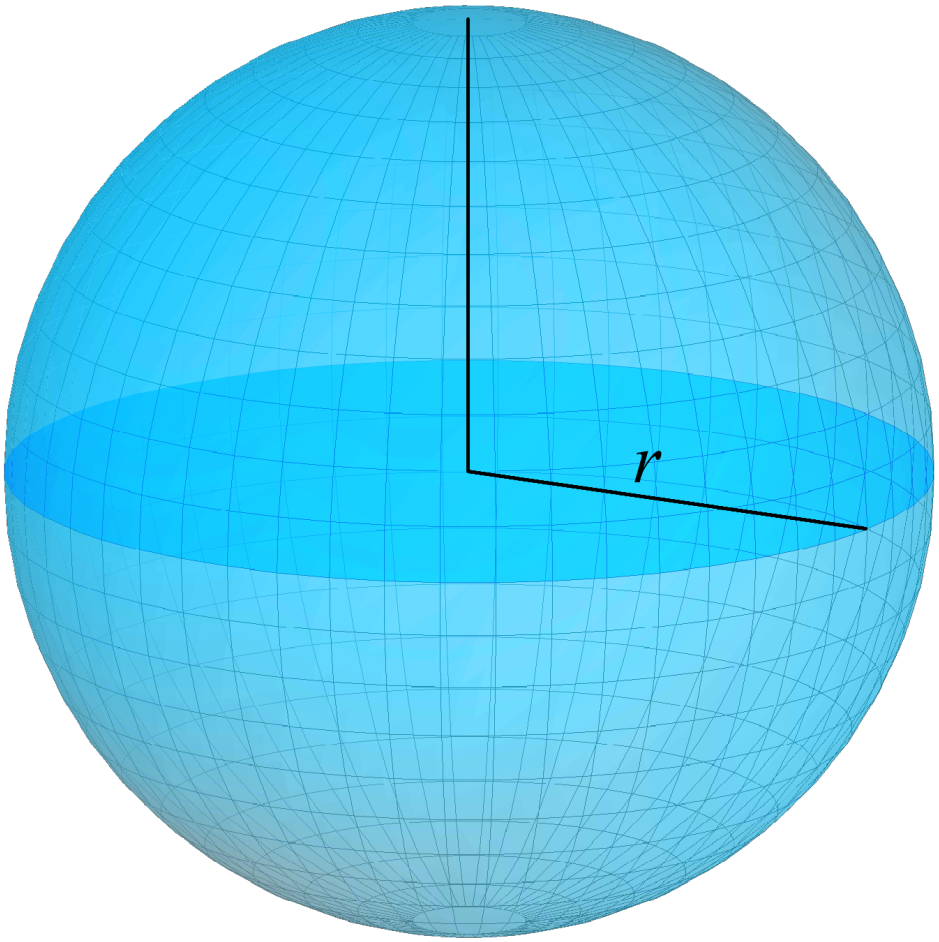

Figure 1: Two radii of a sphere are shown. Note that they have the same length. [Mar]

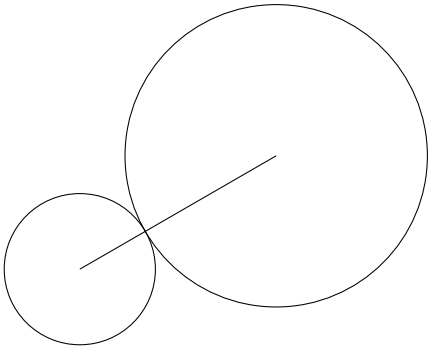

Figure 2: Two adjacent spheres. The distance between the centers is the sum of the individual radii.