

## Free Response KEY

31. Explain the following statements using your understanding of atomic structure. (Consider PEA)

(a) The first ionization energy of sodium is less than that of magnesium.

Magnesium has 12 protons in its nucleus whereas sodium only has 11 protons. Both atoms have three energy levels that are occupied by electrons. The nucleus of sodium has a weaker attraction for its valence electrons due to the smaller positive charge of the nucleus. Because of the weaker attractions, it requires less energy to remove a valence electron in sodium, and therefore, it has a smaller first ionization energy.

### Rubric

+1 The most important atomic evidence is discussed and specific numbers of subatomic particles of both atoms are presented.

+1 The key attractions/repulsions within each atom are discussed and the relative magnitude of each is discussed. The two particles that are being attracted or repulsed are clearly identified.

+1 The implication of those attractions and repulsions are tied back to the question and the impact is explained.

+1 Chemical Grammar:

**Chemical terminology is used correctly in context.**

Example of incorrect use: *Magnesium is more attracted to its nucleus.*

**Chemical terminology used throughout the unit is spelled correctly.**

Example: *The nucleus of sodium has a weaker attraction for its atom due to the smaller positive charge of the nucleus.*

Grammar, organization of the paragraph, and clarity of writing are suitable for a 10<sup>th</sup> grade L2k student. Bullet point style writing is not evident.

(b) The atomic radius of chlorine is smaller than that of sulfur.

How would you grade this response?

*While both chlorine and sulfur have valence electrons in the third energy level, chlorine has more protons in its nucleus than sulfur. The greater nuclear charge of chlorine causes it to be more attracted to the nucleus and therefore chlorine is smaller.*

#### Free Response Rubric

+1 The most important atomic evidence is discussed and specific numbers of subatomic particles of all atoms are presented.

+1 The key attractions/repulsions within each atom are discussed and the relative magnitude of each is discussed. The two particles that are being attracted or repulsed are clearly identified.

+1 The implication of those attractions and repulsions are tied back to the question and the impact is explained.

+1 Chemical Grammar:

Chemical terminology is used correctly in context.

Chemical terminology used throughout the unit is spelled correctly.

Grammar, organization of the paragraph, and clarity of writing are suitable for a 10<sup>th</sup> grade L2k student. Bullet point style writing is not evident.