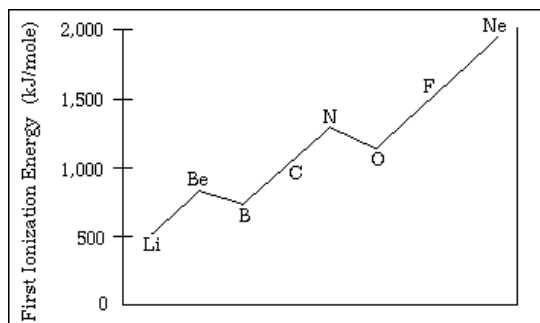


Free Response



1) The diagram shows the first ionization energies for the elements from Li to Ne. Briefly (in one to three sentences) explain each of the following in terms of atomic structure.

(a) In general, there is an increase in the first ionization energy from Li to Ne.

(b) The first ionization energy of B is lower than that of Be.

(c) The first ionization energy of O is lower than that of N.

(d) Predict how the first ionization energy of Na compares to those of Li and of Ne. Explain.

2) Account for each of the following in terms of principles of atomic structure, including the number, properties, and arrangements of subatomic particles.

(a) The second ionization energy of sodium is about three times greater than the second ionization energy of magnesium.

(b) The difference between the atomic radii of Na and K is relatively large compared to the difference between the atomic radii of Rb and Cs.

(c) A sample of solid nickel chloride is attracted into a magnetic field, whereas a sample of solid zinc chloride is not.

(d) The Ca^{2+} and Cl^- ions are isoelectronic, but their radii are not the same. Which ion has the larger radius? Explain.

3. Answer the following questions regarding light and its interactions with molecules, ions and atoms.

(a) The longest wavelength of light with enough energy to break a Cl-Cl bond in $\text{Cl}_2(\text{g})$ is 495nm.

1. Calculate the frequency, in s^{-1} , of the light.

2. Calculate the energy, in J, of a photon of the light.

3. Calculate the minimum energy, in kJ mol^{-1} , of the Cl-Cl bond.

(b) A certain line in the spectrum of atomic hydrogen is associated with the electronic transition in the H atom from the sixth energy level ($n=6$) to the second energy level ($n=2$).

1. Indicate whether the H atom emits energy or whether it absorbs energy during the transition. Justify your answer.

2. Calculate the wavelength, in nm, of the radiation associated with the spectral line.

3. Account for the observation that the amount of energy associated with the same electronic transition ($n=6$ to $n=2$) in the He^+ ion is greater than that associated with the corresponding transition in the H atom.

4) Write the net ionic equations for the following reactions. All reactions will occur:

(a) Cesium metal is placed in water.

(b) Sodium metal is reacted with oxygen.

(c) Fluorine gas is bubbled through a solution of magnesium iodide.

(d) Carbon dioxide is bubbled through water.

(e) Calcium metal is reacted with nitrogen.