

Name: \_\_\_\_\_

### Unit 6 – Practice AP Problems

1) Explain each of the following experimental observations:

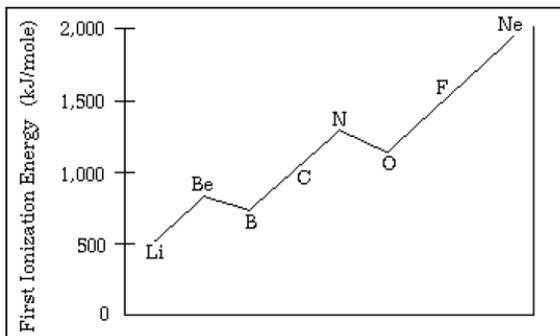
a) Within a family such as the alkali metals, the atomic radius increases as the atomic number increases.

b) The radius of the chlorine atom is smaller than the radius of the chloride ion,  $\text{Cl}^-$ . (Radii: Cl atom =  $0.99\text{\AA}$ ;  $\text{Cl}^-$  ion =  $1.81\text{\AA}$ )

c) The first ionization energy of aluminum is lower than the first ionization energy of magnesium. (First ionization energies:  $^{12}\text{Mg} = 7.6\text{ eV}$ ;  $^{13}\text{Al} = 6.0\text{ eV}$ )

d) For magnesium, the difference between the second and third ionization energies is much larger than the difference between the first and second ionization energies. (Ionization energies for Mg:  $1^{\text{st}} = 7.6\text{ eV}$ ;  $2^{\text{nd}} = 14\text{ eV}$ ;  $3^{\text{rd}} = 80\text{ eV}$ )

2) 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.

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

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

i) Calculate the frequency, in  $\text{s}^{-1}$ , of the light.

3ai) \_\_\_\_\_

ii) Calculate the energy, in J, of a photon of the light.

3aii) \_\_\_\_\_

iii) Calculate the minimum energy, in  $\text{kJ mol}^{-1}$ , of the Cl-Cl bond.

3aiii) \_\_\_\_\_

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 ( $n = 2$ ).

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

ii) If the amount of energy absorbed or emitted was determined to be  $4.84 \times 10^{-19} \text{ J}$ , calculate the wavelength, in nm, of the radiation associated with the spectral line.

3bii) \_\_\_\_\_

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