AP Chemistry Fall Benchmark #1 Review

1.

First Ionization Second Ionization Third Ionization

Energy (kJ mol-1) Energy (kJ mol-1) Energy (kJ mol-1)

Element 1 1251 2300 3820

Element 2 496 4560 6910

Element 3 738 1450 7730

Element 4 1000 2250 3360

The table above shows the first three ionization energies for atoms of four elements from the third period of the periodic table. The elements are numbered randomly. Use the information in the table to answer the following questions.

(a) Which element is most metallic in character? Explain your reasoning. Element 2; highest 2nd IE meaning it is an alkali metal

(b) Identify element 3. Explain your reasoning. Magnesium. The large increase in IE from 2nd to 3rd indicates it is an alkaline earth metal and is therefore, Mg.

(c) Write the complete electron configuration for an atom of element 3. 1s22s22p63s2

(d) What is the expected oxidation state for the most common ion of element 2? 1+

(e) What is the chemical symbol for element 2? Na

(f) A neutral atom of which of the four elements has the smallest radius? Element 1; it has the highest 1st IE.

2. Answer the following problems about gases.

1. The average atomic mass of naturally occurring neon is 20.18 amu. There are two common isotopes of naturally occurring neon as indicated in the table below.

|  |  |
| --- | --- |
| Isotope | Mass (amu) |
| Ne-20 | 19.99 |
| Ne-22 | 21.99 |

1. Using the information above, calculate the percent abundance of each isotope.

19.99x + (100-x)21.99/100 = 20.18

X = 90.5 Ne-20 has a 90.5% abundance and Ne-22 has a 9.5% abundance.

(ii) Calculate the number of Ne-22 atoms in a 12.55 g sample of naturally occurring neon.

12.55 g x (1 mole/20.18) x (6.022 x 1023 atoms/1 mole) x (9.5 atoms of Ne-22/100 atoms of Ne) = 3.558 x 1022 atoms

1. A major line in the emission spectrum of neon corresponds to a frequency of 4.34 x 1014 s-1. Calculate the wavelength, in nanometers, of light that corresponds to this line.

3.00x108 = x(4.34x1014 ) x= 6.91 x10-7 m = 691 nm

1. In the upper atmosphere, ozone molecules decompose as they absorb ultraviolet (UV) radiation, as shown by the equation below. Ozone serves to block harmful ultraviolet radiation that comes from the Sun.

O3(g)  O2(g) + O(g)

A molecule of O3(g) absorbs a photon with a frequency of 1.00 x 1015 s-1.

1. How much energy, in joules, does the O3(g) molecule absorb per photon?

E = 6.626x10-34(1.00x1015) = 6.626x10-19 J

(ii) The minimum energy needed to break an oxygen-oxygen bond in ozone is 387 kJ mol-1.

Does a photon with a frequency of 1.00 x 1015 s-1 have enough energy to break this bond?

Support your answer with a calculation.

6.626x10-19 / 1000 x (6.022x1023) = 399 kJ/mol Yes

3. Suppose that a stable element with atomic number 120, symbol Q, has been discovered.

1. Write the noble gas ground state electron configuration for Q, showing only the valence electrons. [Rn] 8s2
2. Would Q be a metal or a nonmetal? Explain in terms of **electron configuration**. Metal-fewer than 4 electrons in the outer level
3. List four properties you would expect Q to exhibit. (At least one must be a chemical property).

Lustrous, conductor, malleable, reactive with acid

1. On the basis of periodic trends, would Q have the largest atomic radius of the group or would it have the smallest? Explain in terms of **electronic structure**. Largest; atoms consist of 8 energy levels meaning its electrons would be further from the nucleus and the shielding effect would lessen the nuclear attraction for the valence electrons resulting in an atom with a larger radius.
2. What would be the most likely charge of the Q ion? 1+

4. A chemistry student was trying to measure the volume of a metal cylinder using both the volume

formula and water displacement. After measuring the cylinder, he found the radius to be

1.51 + 0.05 cm and the height 4.22 +0.05 cm. The mass of the cylinder was 81.30 + 0.02 g. He then

placed 30.00 + 0.02 mL of water in a graduated cylinder. After sliding the metal cylinder into the

water, the level rose to 60.55 + 0.02 mL. Determine and compare the density of the sample, with

appropriate error limts, using both methods for measuring volume. Which method resulted in the

more precise measurement?

Measurement: Vmax = 3.14(1.56)2(4.27) = 32.6 cm3 Vmin= 3.14(1.46)2(4.17) = 27.9 cm3

Mmax = 81.32 g Mmin= 81.28 g

Dmax = 81.32/27.9 = 2.91 Dmin = 81.28/32.6 = 2.49

D=2.70 +/- 0.21 g/cm3

Water Displacement: Vmax = 60.57-29.98 = 30.59 mL Vmin= 60.53-30.02 = 30.51 mL

Dmax=81.32/30.51 = 2.665 Dmin = 81.28/30.59 = 2.657

D=2.661 +/- 0.04 g/mL Water Displacement is more precise