CHM 111 Key 2 Fall 2023

Multiple Choice: (4 points each. Put answers in left margin as capital letters.)

1. Which of the following is a transition metal?

   A) cerium B) cobalt C) lead D) sodium E) uranium

2. One-millimeter equals 10^x meters. What is x?

   A) -3 B) -2 C) 2 D) 3 E) 6

3. How many significant figures are in the answer to the problem: 455 + (827 x 1130)?

   A) 1 B) 2 C) 3 D) 4 E) 5

4. An unknown sample has a mass of 0.00442 kg. Determine the density of the sample if the object has a volume of 2.73×10^{-6} m^3. Select the closest value.

   A) 1.21×10^{-8} g/mL
   B) 0.00162 g/mL
   C) 1.21 g/mL
   D) 1.62 g/mL
   E) 4.87 g/mL

5. Which of the following chemical equations best describes the statement, "magnesium metal is heated in the presence of gaseous oxygen to produce solid magnesium oxide"?

   A) $2\ Mg_{(s)} + O_{2\ (g)} \rightarrow 2\ MgO_{(s)} + \text{heat}$
   B) $2\ MgO_{\ (s)} + \text{heat} \rightarrow 2\ Mg_{\ (s)} + O_{2\ (g)}$
   C) $2\ Mg_{(s)} + O_{2\ (g)} + \text{heat} \rightarrow 2\ MgO_{(s)}$
   D) $2\ MgO_{(s)} + O_{2\ (g)} \rightarrow 2\ Mg_{\ (s)} + \text{heat}$

6. How many of the following statements represent potential energy?

   i) two magnets separated by a few inches
   ii) water flowing in a waterfall
   iii) a car racing down a hill
   iv) He atoms bouncing around in a balloon

   A) 0 B) 1 C) 2 D) 3 E) 4

7. Which of the following particles would have the strongest attraction to the Ca^{2+} ion?

   A) Al^{3+} B) Br^- C) Na^+ D) O^{2-} E) S^{2-}

8. The correct number of protons, neutrons, and electrons in S^+ (S-32) is:

   A) 15p, 16n, 14e
   B) 15p, 16n, 16e
   C) 16p, 16n, 15e
   D) 16p, 15n, 16e
   E) 16p, 32n, 17e

9. If two atoms are isotopes of the same element, which part(s) of the symbol below would never be the same? Select all correct answers.

   ${}_b^aX^c$

   A) a B) b C) c D) X

10. What is the charge on chromium in $Cr(SO_4)_3$?

    A) 0 B) +2 C) +3 D) +4 E) +6

11. How many of the following exist either as a diatomic molecule or a polyatomic molecule?

i) hydrogen ii) sulfur iii) magnesium iv) nitrogen

A) 0 B) 1 C) 2 D) 3 E) 4

12. Identify the phosphide ion:

A) PO_3^{3-} B) PO_4^{2-} C) P^{3+} D) PO_4^{3+} E) P^{3-}

Discussion Questions:

1. Define: (4 points each)

specific heat – the energy required to raise the temperature of one gram of the substance by one degree Celsius

kinetic energy –the energy of motion

isotopes – atoms of the same element with different numbers of neutrons

Fill-in-the-blanks (4 points each)

1. The joule is the principal unit of energy in chemistry.
2. List two, unrelated physical properties: From the list: color, melting or boiling temperatures, hardness (of a solid), viscosity (flow rate), conductivity (of heat/electricity), etc.
3. Cl_2O_5 dichlorine pentoxide, SO_3 sulfur trioxide
4. $FeBr_3$ iron(III) bromide, KNO_3 potassium nitrate
5. O_3 ozone, $HClO_4$ perchloric acid
6. Distance and charge size are the two factors that influence the magnitude of interaction between two ions.
7. State three (3) postulates of Dalton's Atomic Theory.
   i) All elements are composed of extremely small particles called atoms.
   ii) All atoms of a particular element are identical and differ from all atoms of other elements. Atoms of an element have identical properties, which differ from those of other elements.
   iii) Atoms cannot be created, destroyed, or interconverted [by chemical reactions].
   iv) Compounds are formed from atoms of different elements in fixed, whole number ratios.
   v) Chemical reactions are the rearrangement of atoms in compounds and molecules.

Show your work problems (4 points each)

1. Naturally occurring antimony (Sb) has an average atomic mass of 121.760 amu. It has two stable isotopes ^{121}Sb (120.904 amu) and ^{123}Sb (122.904 amu). What percentage of the same is Sb-121?
   Let x be the percentage of ^{121}Sb in the sample, then
   x(120.904 amu) + (1-x)(122.904 amu) = 121.760 amu

1.144 amu = (2.000 amu)x
x = 0.572
The sample is 57.2% ^{121}Sb and (100% - 57.2%) = 42.8% $_{123}$Sb.

2. Calculate the temperature change that results when 12,500 J of heat are applied to 0.0345 kg of iron. The specific heat of iron is 0.442 J/g·ºC.

$$\Delta T = \left(\frac{g \cdot ^{o}C}{0.442\ J}\right)\left(\frac{1}{0.0345\ kg}\right)\left(\frac{1\ kg}{1000\ g}\right)(12{,}500\ J) = 819\ ^{o}C$$