TEST 2 (of 3)

Show all of your work. Students should make use of the conversion factor method throughout, use significant figures and express their answers in scientific notation.

1. (a) In 1909 _____ used alpha particles to investigate the atom.

   (b) Why were alpha particles used and not beta or gamma rays?

   (c) The gold foil experiment produced two major insights:

   (i) Most of the particles passed through the foil undeflected, suggesting that the atom is mostly empty space.

   (ii) A small fraction of alpha particles bounced almost straight back, suggesting a very dense, positive "nucleus."

   These results were surprising, since the model of the atom believed at that time was a jelly-like sphere containing a uniform distribution of positive and negative charges, with the gold being a tight arrangement of these semi-solid spheres. What were the expected observations?

2. (a) Write down the atomic symbol for carbon in the form below:

$$ {}^{A}_{Z}X $$

   (b) Calculate the number of atoms of carbon in 24.02 g.
   (Avogadro's number = 6.022×10^{23} atoms/mole).

3. (a) Draw Bohr diagrams for a chlorine atom and a chloride ion.

   (b) Does an atom of chlorine gain or lose electrons when forming an ion?

   (c) When chlorine forms an ion, the ion is isoelectric to which of the noble gases?

   (d) Write down the Lewis dot structure for the chloride ion.

4. Magnesium has three naturally occurring isotopes, ^{24}Mg (isotopic mass 23.98504 amu, abundance 78.70 %), ^{25}Mg (isotopic mass 24.98584 amu, abundance 10.13 %) and ^{25}Mg (isotopic mass 25.98259 amu, abundance 11.17 %. Calculate the atomic mass of magnesium.

   (SHOW ALL YOUR WORK)

5. The compound 'aluminum carbonate' consists of a cation and an anion.

   (a) What are the names, formulas and electric charges of these ions?

   (b) What is the molar mass of this compound?

6. Complete the following table:

Isotope	^{57}Fe	^{40}X	^{36}S
No. protons			
No. neutrons			
No. electrons			

7. Correct the name to match the formula of the following compounds:

(a) iron (I) nitrite, $Fe(NO_3)$ (b) magnesium (IV) oxide, MnO_2,

(c) monohydrogen nitrate acid, $HNO_{3(aq)}$ (d) krypton sulfite, K_2SO_4

8. Give the name and formula for the acid derived from each of the following anions:

(a) NO_3^-, (b) Cl^-,

(c) sulfate, (d) phosphate (PO_4^{3-})

9. Give the names for the formulas or the formulas for the names:

(a) Lead (III) sulfate, (b) NH_4NO_3,

(c) Mn_2O_3, (d) nickel (II) nitrate hexahydrate

10. Determine the oxidation number of copper in the following species:

(a) CuO (b) Elemental Copper

(c) Copper sulfate (d) K_3CuF_6 (potassium hexafluorocuprate)

BONUS:

Nitrous oxide (dinitrogen monoxide) is a potent greenhouse gas. It enters the atmosphere from fertilizer breakdown, car exhausts, and many other sources. Some studies have shown that the isotope ratios of ^{15}N to ^{14}N and of ^{18}O to ^{16}O in nitrous oxide depend on the source. Thus, measuring the relative abundance of molecular masses in a sample of the gas can help determine the source.

(a) What different molecular masses are possible for nitrous oxide?

(b) The percent abundance of ^{14}N is 99.6 %, and that of ^{16}O is 99.8 %. Which molecular mass of nitrous oxide is least common, and which is most common?