Chemistry 101 Name(s):

Exercise 3: Atoms and nomenclature

1. Given that the mass of the neutron is 1.674954×10^{-27} kg, the mass of a proton is $1.6726430 \times 10^{-27}$ kg and the mass of an electron is $9.1093897 \times 10^{-31}$ kg, what is the **mass** (in kg) of a single carbon-12 atom? **Pay attention to sig figs!**

2. Based on the definition of an amu, what is the **mass** (in amu) of a single carbon-12 atom?

3. 1 atomic mass unit has a mass of 1.66054×10^{-27} kg. Use this factor to convert your answer to question 2 into kg and **compare** it to the answer in question 1. Calculate the **difference** in mass.

4. This difference in mass is the amount of matter that is converted to energy which holds the nucleus together (**nuclear binding energy**). Convert this mass to energy (joules) using Einstein's famous equation (called the *mass-energy equivalence equation*) $E = mc^2$. One Joule = 1 kg m^2/s^2 and $c = 3.00 \times 10^8$ m/s.

5. Write the chemical **symbol** for an **isotope** which has 8 protons, 10 neutrons and 10 electrons. Hint: is this isotope also an **ion**?

6. Describe the **subatomic structure** of phosphorus-32, a commonly used "tracer" isotope, indicating the **number** and **placement** of subatomic particles.

7. Write the **electron configuration** for the ground state of phosphorus-32.

8. Write the **first excited state** electron configuration for phosphorus-32.

9. The following table shows various properties of chlorine and iodine molecules:

	Molecular formula	Boiling point (K)	Freezing point (K)
Chlorine	Cl_2	239	172
Bromine			
Iodine	I_2	457	386.5

Fill in the information for the missing line of bromine, given that bromine is between chlorine and iodine in group VIIA. **You do not have to look up these values in any reference.**

10. Unlike the text's treatment of electromagnetic (EM) radiation, there is a formula to calculate the number of joules of energy a **photon** of a particular **wavelength** of light contains. The formula is $E = hc/\lambda$, where E is the **energy** of the photon in Joules, h is Planck's constant = 6.626×10^{-34} Js (that is, joules times seconds), c is speed of light = 3.00×10^{8} m/s and λ (the Greek letter *lambda*) is the wavelength of the photon in meters.

The text mentions on page 73 that visible light frequencies range from 4.0×10^{-7} m (blue) to 7.0×10^{-7} m (red). **Calculate** the energy of one photon of **blue** light and one photon of **red** light and indicate which is the **more energetic** color.

Nomenclature

11. Write the **systematic name** for the following compounds. Don't forget Roman numerals and Greek prefixes where appropriate.

a. CaI_2

b. $FeBr_3$

c. $Fe(NO_3)_2$

d. ClF_5

e. $KHSO_3$

f. HCl

12. Write the **chemical formula** for the following compound names. Remember that the proper capitalization is important!

a. calcium fluoride

b. tin (II) nitrite

c. cobalt (III) carbonate

d. dinitrogen tetroxide

e. silicon tetrabromide

f. sodium sulfite heptahydrate

13. Write the **systematic name** for the following acids.

a. HBr (aq)

b. H_3PO_4 (aq)

c. HNO_3 (aq)

d. HNO_2 (aq)

14. Write the **chemical formula** for the following acid names. Don't forget to indicate the aqueous phase necessary to have an acid.

Note: BrO^- is the **hypobromite** ion; BrO_2^- is the **bromite** ion; BrO_3^- is the **bromate** ion; BrO_4^- is the **perbromate** ion.

a. perbromic acid

b. bromic acid

c. bromous acid

d. hypobromous acid

15. Write all of the chemical formulas possible when the $\mathbf{Mn^{2+}}$ and $\mathbf{Mn^{3+}}$ cations mix with the **nitrate** and **nitrite** anions. Underneath each of the formulas, write the systematic name of each of the compounds.