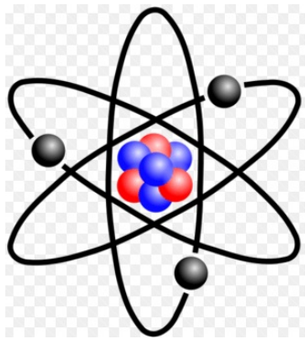
PHYSICS 3204

WORKSHEET #5 NUCLEAR STRUCTURE

Nucleus - positively charged core of atom, which contains most of the mass.
Nucleons - particles which make up the nucleus, namely protons and neutrons.
Protons - particles with +1 charge and $m_p = 1.673 \times 10^{-27}$ kg
Neutrons - particles with no charge and $m_n = 1.675 \times 10^{-27}$ kg
Electrons - particles which orbit nucleus. They have -1 charge and $m_e = 9.11 \times 10^{-31}$ kg

Atomic number (Z) - number of protons (or electrons in an atom)
Atomic mass number (A) - number of nucleons (protons + neutrons).



A chemical symbol is written as follows

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

In order to calculate the number of neutrons use the following formula:

#of Neutrons = A - Z

Isotopes - atoms of the same element (same Z) but having differing numbers of neutrons and thus differing atomic mass (differing A).

Hydrogen isotopes:
- normal hydrogen - ${}^{1}_{1}H$ mass = 1.67353×10^{-27} kg (1p,1e) **
- deuterium - ${}^{2}_{1}H$ mass = 3.34449×10^{-27} kg (1p,1n,1e)
- tritium - ${}^{3}_{1}H$ mass = 5.00827×10^{-27} kg (1p,2n,1e)

Unified atomic mass units (u): Nuclear masses are often written in terms of **u**.
The mass of ${}^{12}_{6}C$ (carbon-12) has been defined to be 12 u.

1 u = 1.661×10^{-27} kg = 931.5 MeV/c^2

Examples:
- ^{1}H = 1.007825 u
- ^{2}H = 2.014102 u (1p,1n,1e)
- ^{12}C = 12.000000 u (6p,6n,6e)
- ${}^{19}_{9}F$ 18.9984 u

PART A: MULTIPLE CHOICE

1. How many electrons are in the atom ${}^{7}_{3}Li$?

   (A) 3
   (B) 4
   (C) 7
   (D) 10

2. How many neutrons are in the nucleus of ${}^{205}_{82}Pb$?

   (A) 82
   (B) 123
   (C) 205
   (D) 246

The chemical symbol for an unknown element (X) is shown below. Use this chemical symbol to answer questions 3-6

$$^{35}_{17}X$$

3. What is the atomic number of this element?

(A) 17
(B) 18
(C) 35
(C) 52

4. How many neutrons are found in the nucleus of this atom?

(A) 17
(B) 18
(C) 35
(C) 52

5. How many electrons does this element have?

(A) 17
(B) 18
(C) 35
(C) 52

6. What element does X represent?

(A) Argon
(B) Bromine
(C) Chlorine
(D) Tellurium

7. How many protons, neutrons, and nucleons are in the $^{45}_{20}\text{Ca}$ nucleus?

	Number of protons	**Number of neutrons**	**Number of nucleons**
(A)	20	25	45
(B)	20	45	65
(C)	45	20	65
(D)	45	25	45

8. How many protons, neutrons, and electrons are in $^{93}_{41}Nb$ nucleus?

	Number of protons	**Number of neutrons**	**Number of nucleons**
(A)	41	52	93
(B)	41	52	41
(C)	93	52	41
(D)	93	41	52

9. For an isotope of argon (Z = 18), the mass number is 40. The number of neutrons in this isotope is:

(A) 18
(B) 40
(C) 22
(D) The same as in any other isotope of argon

10. The neutral atoms of all of the isotopes of the same element have

(A) Different numbers of protons.
(B) Equal numbers of neutrons.
(C) The same number of electrons.
(D) The same mass numbers.

11. Which pair of atoms constitutes a pair of isotopes of the same element?

(A) ${}^{14}_{6}X$ ${}^{14}_{7}X$

(B) ${}^{14}_{7}X$ ${}^{12}_{7}X$

(C) ${}^{17}_{9}X$ ${}^{17}_{8}X$

(D) ${}^{19}_{10}X$ ${}^{19}_{9}X$

12. If an element has atomic mass of 18.9984 u, what is its mass in kg?

13. An element has a mass of 6.647×10^{-27} kg. What is its mass in unified atomic mass units (u) ?

14. A particle has a mass of 106 MeV/c^2. What is this mass in atomic mass units (u) and in kg?