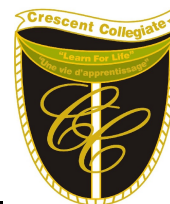
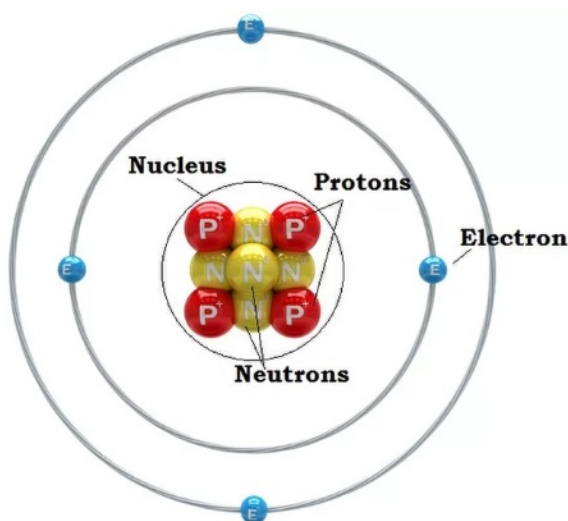


Physics 2204
Unit 3: Work, Power and Energy
Worksheet 11 : Nuclear Structure and Properties



Student Name: _____

Atom refers to the smallest unit of any chemical element. It is the building block of matter.



PROTON (+)	NEUTRON	ELECTRON (-)
Positively charged particles	Neutral particles; have no electric charge	Negatively charged particles
Help make up the nucleus of the atom	Help make up the nucleus of the atom	Found outside the nucleus of the atom, in the electron
Help identify the atom (could be considered an atom's DNA)	Contribute to the atomic mass	Move so rapidly around the nucleus that they create an electron cloud
Equal to the atomic number of the atom	$m_n = 1.67493 \times 10^{-27} \text{ kg}$	Mass is insignificant when compared to protons and neutrons
Contribute to the atomic mass		Equal to the number of protons
Equal to the number of electrons		Involved in the formation of chemical bonds
$m_p = 1.67262 \times 10^{-27} \text{ kg}$		$m_e = 9.1164 \times 10^{-31} \text{ kg}$

Nucleons - particles which make up the nucleus, namely protons and neutrons.

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



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

$$\text{\#of Neutrons} = A - Z$$

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 - ${}^1_1\text{H}$ mass = 1.67353×10^{-27} kg
 deuterium - ${}^2_1\text{H}$ mass = 3.34449×10^{-27} kg
 tritium - ${}^3_1\text{H}$ mass = 5.00827×10^{-27} kg

Example 1:

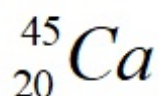
What is the atomic notation for the isotope of element X that has 30 electrons and 36 neutrons.

Example 2:

An atom has a mass number of 222 and an atomic number of 86. Find the name of the element, its symbol, the number of protons (or electrons), and the number of neutrons using a periodic table.

Example 3:

How many protons, neutrons, and nucleons are in the nucleus of:



Here are three ways to write the mass of an atomic particle:

In Kilograms	Unified Atomic Mass Unit (amu),	Mass Equivalence Unit
proton: 1.67262×10^{-27} kg neutron: 1.67493×10^{-27} kg electron: 9.1164×10^{-31} kg	One atomic mass unit (1u) is equal to one twelfth of the mass of the most abundant form of the carbon atom—Carbon 12 $1 \text{ u} = 1.661 \times 10^{-27} \text{ kg.}$	$1 \text{ u} = 931.5 \text{ MeV}/c^2$

Remember: $1 \text{ u} = 1.661 \times 10^{-27} \text{ kg} = 931.5 \text{ MeV}/c^2$

Example 4:

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

Example 5:

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

Example 6:

A particle has a mass of $106 \text{ MeV}/c^2$.

What is this mass in atomic mass units (u) and in kg?

PART A: MULTIPLE CHOICE

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided

1. What three sub-atomic particles make up an atom?
 - (A) Protons, electrons & neutrals
 - (B) Positives, negatives & neutrals
 - (C) Protons, electrons & neutrons
 - (D) Chocolate chips, nuts & raisins

2. Which of the following is the smallest?
 - (A) Proton
 - (B) Neutron
 - (C) Electron
 - (D) Atom

3. Which atomic particle carries a negative charge?
 - (A) Proton
 - (B) Nucleus
 - (C) Neutron
 - (D) Electron

4. Which statement is completely true?
 - (A) Neutrons and protons are about the same size and electrons are much smaller
 - (B) Protons are bigger than neutrons and electrons are much smaller
 - (C) Neutrons are much bigger than protons and electrons are about the same size
 - (D) Neutrons, protons, and electrons are all about the same size.

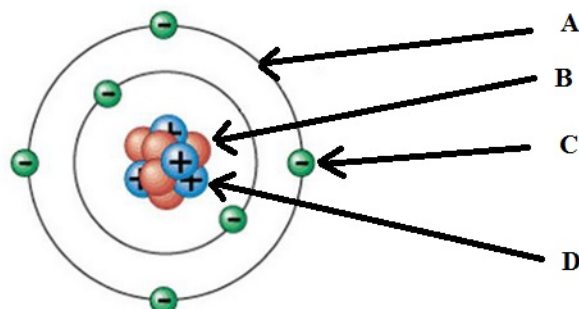
5. Which of the following correctly matches the parts of an atom with their charge?

	Proton	Neutron	Electron
(A)	Positive	Negative	Neutral
(B)	Negative	Neutral	Positive
(C)	Positive	Neutral	Negative
(D)	Neutral	Positive	Negative

Use the picture below to answer questions 6 to 8

6. Which of the following is an electron?

- (A) A
- (B) B
- (C) C
- (D) D



7. Which of the following has no charge?

- (A) A
- (B) C
- (C) B
- (D) D

8. Which of the following is found in the nucleus?

- (A) A
- (B) B
- (C) B and D
- (D) C and D

9. An element with an atomic mass number of 15 and an atomic number of 7 has how many neutrons?

- (A) 7
- (B) 8
- (C) 15
- (D) 22

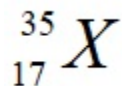
10. How many electrons are in the atom ${}^7_3\text{Li}$?

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

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

- (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 12-14



12. What is the atomic number of this element?
- (A) 17
(B) 18
(C) 35
(C) 52
13. How many neutrons are found in the nucleus of this atom?
- (A) 17
(B) 18
(C) 35
(C) 52
14. How many electrons does this element have?
- (A) 17
(B) 18
(C) 35
(C) 52
15. How many protons, neutrons, and nucleons are in the ${}_{20}^{45}\text{Ca}$ 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

16. How many protons, neutrons, and nucleons are in ${}_{41}^{93}\text{Nb}$ 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

17. Which of the following phrases describes the isotopes of an element?
- (A) Atoms with the same number of protons, but different numbers of neutrons
(B) Atoms with the same number of protons, and the same number of neutrons
(C) Atoms with a different number of protons, and a different number of neutrons
(D) Atoms with a different number of protons, and the same number of neutrons

18. For an isotope of argon ($Z = 18$), the mass number is 40. What is the number of neutrons in this isotope?
- (A) 18
 (B) 22
 (C) 40
 (D) 58
19. Which of the following is true for neutral atoms of all of the isotopes of the same element?
- (A) Different numbers of protons.
 (B) Equal numbers of neutrons.
 (C) The same mass numbers.
 (D) The same number of electrons.
20. Which pair of atoms constitutes a pair of isotopes of the same element?
- (A) ${}^{14}_6\text{X}$ ${}^{14}_7\text{X}$
 (B) ${}^{14}_7\text{X}$ ${}^{12}_7\text{X}$
 (C) ${}^{17}_9\text{X}$ ${}^{17}_8\text{X}$
 (D) ${}^{19}_{10}\text{X}$ ${}^{19}_9\text{X}$
21. What is the mass of a proton?
- (A) 1.602×10^{-19} kg
 (B) 1.67262×10^{-27} kg
 (C) 1.67493×10^{-27} kg
 (D) 9.1164×10^{-31} kg
22. Which of the following is the definition of the unified atomic mass unit?
- (A) The mass of a proton
 (B) The mass of a neutron
 (C) The mass of a hydrogen nucleus
 (D) One-twelfth the mass of a carbon-12 atom
23. A sodium atom has an atomic mass of 22.989 u? What is this in kilograms?
- (A) 1.661×10^{-27} kg
 (B) 3.818×10^{-26} kg
 (C) 22.989 kg
 (D) 1.384×10^{28} kg
24. What is the mass equivalent for 0.0034 u?
- (A) $0.0034 \text{ MeV}/c^2$
 (B) $3.2 \text{ MeV}/c^2$
 (C) $931.5 \text{ MeV}/c^2$
 (D) $2.7 \times 10^5 \text{ MeV}/c^2$