

UNIT 1: TUTORIAL 8: PROTONS, NEUTRONS, ELECTRONS, ATOMS, AND IONS -2026

1. The approximate radius of a hydrogen atom is 0.0529 nm, and that of a proton is 1.5×10^{-15} m. Assuming both the hydrogen atom and the proton to be spherical, calculate the fraction of the space in an atom of hydrogen that is occupied by the nucleus. $V = \frac{4}{3}\pi \times r^3$ for a sphere.
2. The approximate radius of a neutron is 1.5×10^{-15} m, and the mass is 1.675×10^{-27} kg. Calculate the density of a neutron. $V = \frac{4}{3}\pi r^3$ for a sphere.
3. Define and illustrate the following terms clearly and concisely: (a) atomic number, (b) isotope, (c) mass number, (d) nuclear charge.
4. What is an isotope? How do atoms become isotopes? What is anion? How do atoms become cations and anions?

For the questions below determine if the particle that is described in an atom or an ion. In the space that says, “charge”, write either “positive”, “negative”, or “no charge”. Then indicate whether the particle is an “atom” or an “ion”.

5. A particle of oxygen that contains 8 protons and 8 electrons. Charge _____
Is this an atom or an ion? _____
6. A particle of fluorine that contains 9 protons and 10 electrons. Charge _____
Is this an atom or an ion? _____
7. A particle of calcium that contains 20 protons and 18 electrons. Charge _____
Is this an atom or an ion? _____
8. A particle of uranium that contains 92 protons and 88 electrons. Charge _____
Is this an atom or an ion? _____
9. What are nucleons and nuclides? _____
10. Arrange the following in order of increasing ratio of charge to mass: $^{12}\text{C}^+$, $^{12}\text{C}^{2+}$, $^{14}\text{N}^+$, $^{14}\text{N}^{2+}$
11. Estimate the percentage of the total mass of a $^{65}_{29}\text{Cu}$ that is due to (a) electrons, (b) protons, and (c) neutrons by *assuming* that the mass of the atom is simply the sum of the masses of the appropriate numbers of subatomic particles. ($m_e = 9.108 \times 10^{-31}$ kg, $m_p = 1.673 \times 10^{-27}$ kg, $m_n = 1.675 \times 10^{-27}$ kg)

12. Complete the following chart:

	Proton	Neutron	Electron
Relative Charge			
Relative Mass			
Location			
Significance	Identity, charge, mass	Mass	Charge

13. Fill in the following chart for the following nuclides:

	# protons	# neutrons	# electrons
${}_{7}^{15}\text{N}$			
Carbon -14			
Hydrogen -3			
${}_{15}^{31}\text{P}$			

14. Complete the following chart referring to a periodic table.

Chart A

Kind of Atom	Atomic Number	Mass Number	Isotope	Number of Protons	Number of Electrons	Number of Neutrons
			${}_{10}^{21}\text{Ne}$			
chlorine		35				
	28	58				
		40		18		

Chart B

Kind of Atom	Atomic Number	Mass Number	Isotope	Number of Protons	Number of Electrons	Number of Neutrons
selenium						40
			${}_{5}^{11}\text{B}$			
					35	46
		104			45	

15. Determine the number of protons, neutrons, and electrons in each of the following species:

- (a) ${}^{34}\text{S}^{2-}$; (b) ${}^{93}\text{Nb}$; (c) ${}^{91}\text{Zr}$; (d) ${}^{39}\text{K}^{+}$; (e) ${}^{65}\text{Zn}^{2+}$; (f) ${}^{108}\text{Ag}^{+}$.

16. What is the symbol of the species composed of each of the following sets of subatomic particles? (a) $24p, 27n, 24e$; (b) $20p, 20n, 18e$; (c) $34p, 44n, 34e$; (d) $53p, 74n, 54e$.
17. What is the symbol of the species composed of each of the following sets of subatomic particles? (a) $94p, 150n, 94e$; (b) $79p, 118n, 76e$; (c) $34p, 45n, 36e$; (d) $52p, 76n, 54e$.
18. The atomic weight of lithium is 6.941 amu. The only two naturally occurring isotopes of lithium have the following masses: ${}^6\text{Li}$, 6.01 amu; ${}^7\text{Li}$, 7.02 amu. Calculate the percent of ${}^6\text{Li}$ in naturally occurring lithium.
19. The atomic weight of rubidium is 85.47 amu. The two naturally occurring isotopes of rubidium have the following masses: ${}^{85}\text{Rb}$, 84.91 amu; ${}^{87}\text{Rb}$, 86.91 amu. Calculate the percent of ${}^{85}\text{Rb}$ in naturally occurring rubidium.
20. Bromine is composed of ${}^{79}\text{Br}$, 78.92 amu, and ${}^{81}\text{Br}$, 80.92 amu. The percent composition of a sample is 50.69% Br-79 and 49.31% Br-81. Based on this sample, calculate the atomic weight of bromine.
21. Assuming these are all pure elements (neutral atoms), complete the following table. You can refer to a periodic table.

Atomic Symbol	Name-#	Atomic Number	Atomic Mass	# protons	# neutrons	# electrons
${}^{222}_{86}\text{Rn}$						
	Cobalt – 60					
				80	117	
			90	38		
					21	19
		34	79			

22. Provide the symbol and charge (where appropriate) for each of the following. Indicate if the atom is neutral (N), an anion (A), of a cation (C). See example.

# protons, # electrons	Symbol	Neutral, Anion, or Cation
19 p, 18 e ⁻	K ⁺	
33 p, 36 e ⁻		

30 p, 30 e ⁻		
26 p, 23 e ⁻		
35 p, 36 e ⁻		
	Ca ⁺²	
	N ⁻³	
	Al	

22. Calculate the average atomic weight of Chlorine, which occurs in nature as 75.5% ³⁶Cl and the rest as ³⁵Cl.
23. Calculate the average atomic weight the following element if it has three naturally occurring isotopes: 50% of which have an atomic mass of 127 amu, 40% at 128 amu, and 10% at 129 amu.