Atomic Structure

- Atomic Number: The number of protons in an element
  - Determines spot on the periodic table
- Mass Number: The number of protons and neutrons in an element
- If an atom has a neutral charge, it must have the same # of protons and electrons
- Isotope: An element that has the same number of protons, but different number of neutrons
  - Same atomic number, different mass number

1. The mass of an atom is contained mainly in its protons and neutrons.
2. The identity of an element is determined by its number of protons.
3. Isotopes are atoms with the same number of protons and different number of neutrons.
4. The charge of an atom or ion is determined by its number of electrons.
5. B Particle X contains 9 protons, 10 neutrons, and 9 electrons. Particle Y contains 9 protons, 10 neutrons, and 10 electrons. What is the relationship between particles X and Y?
   A. Particles X and Y are isotopes of the same element.
   B. Particle X is an atom, and particle Y is an ion of the same element.
   C. Particle X and Y are atoms of different elements.
   D. There is no significant difference between particles X and Y.

The table below contains information about several ions. Use the information given to fill in the blanks.

Element Name	Ion Symbol	Atomic Number	Mass Number	# of Protons	# of Neutrons	# of Electrons
6. Chlorine	Cl^-	17	35	17	18	18
7. Silver	Ag^+	47	107	47	60	46
8. Oxygen	O^{2-}	8	16	8	8	10
9. Aluminum	Al^{3+}	13	27	13	14	10

The table below contains information about several isotopes. Use the information given to fill in the blanks. Assume all atoms are neutral.

Isotope Name	Nuclear Symbol	Atomic Number	Mass Number	# of Protons	# of Neutrons	# of Electrons
10. Calcium-40	$^{40}_{20}Ca$	20	40	20	20	20
11. Calcium-42	$^{42}_{20}Ca$	20	42	20	22	20
12. Iron-56	$^{56}_{26}Fe$	26	56	26	30	26
13. Oxygen-18	$^{18}_{8}O$	8	18	8	10	8
14. Gold-197	$^{197}_{79}Au$	79	197	79	118	79

15. Calculate the average atomic mass for neon if its abundance in nature is 90.5% neon-20, 0.3% neon-21, and 9.2% neon-22.

Step ① Convert % to decimal
② Multiply decimal by each mass
③ Add each mass together

$(0.905 \times 20\text{ amu}) + (0.003 \times 21\text{ amu}) + (0.092 \times 22\text{ amu})$

$= \boxed{20.19\text{ amu}}$

16. Calculate the average atomic mass of silver if 13 out of 25 atoms are silver-107 and 12 out of 25 atoms are silver-109.

$13/25 = 0.52 = 52\%$

$12/25 = 0.48 = 48\%$

$(0.52 \times 107\text{ amu}) + (0.48 \times 109\text{ amu})$

$= \boxed{107.96\text{ amu}}$

17. Please use the following table to calculate the average atomic mass of chlorine.

Isotope	% Abundance	Mass (amu)
^{35}Cl	75.78%	34.969
^{37}Cl	24.22%	36.966

$(0.7578 \times 34.969\text{ amu}) + (0.2422 \times 36.966\text{ amu})$

$= \boxed{35.453\text{ amu}}$

18. Raiderium (Cv) has three naturally occurring isotopes. Raiderium is 74.655% ^{44}Cv, which has an atomic mass of 43.064 amu, 24.958% ^{46}Cv, which has a mass of 46.125 amu, and 0.387% ^{48}Cv, which has an atomic mass of 47.982 amu. Please calculate the average atomic mass of Raiderium.

$(0.74655 \times 43.064\text{ amu}) + (0.24958 \times 46.125\text{ amu}) + (0.00387 \times 47.982\text{ amu})$

$= \boxed{43.857\text{ amu}}$

19. Naturally occurring silicon consists of three stable isotopes (see table). The average atomic weight is 28.09 AMU.

What is the atomic mass of ^{30}Si?

Isotope	% Abundance	Mass (amu)
^{28}Si	92.21%	27.977
^{29}Si	4.70%	28.976
^{30}Si	3.09%	?

$(0.9221 \times 27.977\text{ amu}) + (0.0470 \times 28.976\text{ amu}) + (0.0309 \cdot x) = 28.09\text{ amu}$

$25.80\text{ amu} + 1.36\text{ amu} + 0.0309 \cdot x = 28.09\text{ amu}$ ← solve for x

$27.16\text{ amu} + 0.0309x = 28.09\text{ amu}$

$0.0309x = 0.93\text{ amu}$

$x = \boxed{30.11\text{ amu}}$

15) 20.19 amu 16) 107.96 amu 17) 35.453 amu 18)43.847 amu 19) 30.11 amu