## CHEMISTRY 11
## Atomic Number and Atomic Mass

The _atomic_ _number_ of an atom is the number of protons in its nucleus.

The _atomic_ _mass_ of an atom is the number of protons and neutrons in the nucleus of an atom

For a NEUTRAL atom, the number of _protons_ equals the number of _electrons_.

The charge on a proton is _+_
The charge on a neutron is _$n^0$_
The charge on an electron is _−_

An _ion_ is formed when you either add or remove **electrons** from/to a neutral atom.

If you **add** electrons the ion will have a _negative_ charge.
If you **remove** electrons the ion will have a _positive_ charge

Exercises 13-17:

13. How many protons are in the nucleus of each of the following?
    (a) Be          (b) U          (c) Mn

14. How many electrons are there in a neutral atom of each of the following?
    (a) C           (b) Fe         (c) Ar

15. How many electrons are there on each of the following?
    (a) $Na^+$          (c) $V^{3+}$          (e) $Cl^-$          (g) $Sb^{3-}$          (i) $H^-$
    (b) $Mg^{2+}$       (d) $O^{2-}$          (f) $Al^{3+}$       (h) $Fe^{2+}$          (j) $As^{3-}$

16. What is the ion produced when
    (a) two electrons are added to S?              (f) two electrons are removed from $Mn^{2+}$?
    (b) two electrons are removed from Ca?         (g) an electron is removed from $V^{4+}$?
    (c) an electron is added to Cl?                (h) two electrons are added to $Sb^-$?
    (d) three electrons are removed from Al?       (i) an electron is removed from $O^{2-}$?
    (e) an electron is added to $Cr^{3+}$?

17. What is the charge on the nucleus of each of the following?
    (a) Mg          (b) Ne          (c) $K^+$          (d) $S^{2-}$

Isotopes are atoms of an element that have the same number of protons but different numbers of neutrons. Therefore, they have the same atomic number but different atomic mass.

Excercise 22: Complete the table. Show the atomic number and atomic mass in the "Symbol" column.

|  | Symbol | Atomic Mass | Atomic Number | Number of protons | Number of neutrons | Number of electrons |
|---|---|---|---|---|---|---|
| (a) |  | 84 | 36 |  |  | 36 |
| (b) |  |  |  | 35 | 45 | 35 |
| (c) |  | 127 | 53 |  |  | 54 |
| (d) |  |  | 27 |  | 32 | 27 |
| (e) | Zn |  |  |  | 36 |  |
| (f) | $Cd^{2+}$ | 112 |  |  |  |  |
| (g) |  |  |  | 38 | 50 | 36 |
| (h) | $X^{2-} =$ |  |  |  | 75 | 54 |
| (i) | $X^{3+} =$ | 103 |  |  |  | 42 |
| (j) | $X^{3-} =$ |  | 33 |  | 42 |  |

## Calculating atomic masses using a mix of isotope percentages:

The atomic mass of Chlorine is said to be 35.5 grams...we know that it is impossible to have ½ a proton or neutron, so 35.5 grams must represent an **AVERAGE** value for a **MIXTURE** of isotopes.
**Example:** The atomic mass of 35.5 grams is calculated based on the relative abundance of the following chlorine isotopes
$$^{35}Cl = 75.77\ \%,\ ^{37}Cl = 24.23\ \%$$
$$(35 \times 0.7577) + (37 \times 0.2423) = 35.453 = 35.5\ g$$
(note: atomic mass is always rounded to the first decimal place)

Exercise 23:

(a) $^{10}B = 18.8\%$, $^{11}B = 81.2\%$

(b) $^{69}Ga = 60.0\%$, $^{71}Ga = 40.0\%$

(c) $^{107}Ag = 51.8\%$, $^{109}Ag = 48.2\%$

(d) $^{70}Ge = 20.5\%$, $^{72}Ge = 27.4\%$, $^{73}Ge = 7.8\%$, $^{74}Ge = 36.5\%$, $^{76}Ge = 7.8\%$

(e) $^{64}Zn = 48.9\%$, $^{66}Zn = 27.8\%$, $^{67}Zn = 4.1\%$, $^{68}Zn = 18.6\%$, $^{70}Zn = 0.6\%$

(f) $^{90}Zr = 51.5\%$, $^{91}Zr = 11.2\%$, $^{92}Zr = 17.1\%$, $^{94}Zr = 17.4\%$, $^{96}Zr = 2.8\%$

(g) $^{92}Mo = 15.8\%$, $^{94}Mo = 9.0\%$, $^{95}Mo = 15.7\%$, $^{96}Mo = 16.5\%$, $^{97}Mo = 9.5\%$, $^{98}Mo = 23.8\%$, $^{100}Mo = 9.6\%$

13. (a) 4        (b) 92        (c) 25

14. (a) 6        (b) 26        (c) 18

15. (a) 10       (c) 20       (e) 18       (g) 54       (i) 2
    (b) 10       (d) 10       (f) 10       (h) 24       (j) 36

16. (a) $S^{2-}$        (c) $Cl^-$        (e) $Cr^{2+}$        (g) $V^{5+}$        (i) $O^-$
    (b) $Ca^{2+}$       (d) $Al^{3+}$       (f) $Mn^{4+}$       (h) $Sb^{3-}$

17. (a) +12       (b) +10       (c) +19       (d) +16

18. ~~Proton $_1^1 p$, neutron $_0^1 n$, electron = $_{-1}^0 e$~~

22.

| Symbol | Atomic Mass | Atomic Number | Number of protons | Number of neutrons | Number of electrons |
|---|---|---|---|---|---|
| (a) $_{36}^{84}Kr$ | 84 | 36 | **36** | **48** | 36 |
| (b) $_{35}^{80}Br$ | **80** | **35** | 35 | 45 | 35 |
| (c) $_{53}^{127}I^-$ | 127 | 53 | **53** | **74** | 54 |
| (d) $_{27}^{59}Co$ | **59** | 27 | **27** | 32 | 27 |
| (e) $_{30}^{66}Zn$ | **66** | **30** | **30** | 36 | **30** |
| (f) $_{48}^{112}Cd^{2+}$ | 112 | **48** | 48 | **64** | **46** |
| (g) $_{38}^{88}Sr^{2+}$ | **88** | **38** | 38 | 50 | 36 |
| (h) $X^{2-} = _{52}^{127}Te^{2-}$ | **127** | **52** | **52** | 75 | 54 |
| (i) $X^{3+} = _{45}^{103}Rh^{3+}$ | 103 | **45** | **45** | **58** | 42 |
| (j) $X^{3-} = _{33}^{75}As^{3-}$ | **75** | 33 | **33** | 42 | **36** |

23. a 10.8 g     b. 69.0 g     c. 108.0 g     d. 72.7 g
    e. 65.4 g    f. 91.3 g              g. 95.9 g