

### Exercise 1: Atoms

Complete the table. You may need the periodic tables and the following information. **Assume all atoms are neutral in electrical charge.**

• 1 proton = 1 neutron = 1 amu

• Atomic Number (AN) = P = E

• Electric Charge of Nucleus (ECN) = + P

• 1 electron = 0 amu

• Atomic Mass = P + N

• Electric Charge of Electron Shells (ECE) = - E

| #  | Name | Atomic Symbol | Atomic Number (AN) | Atomic Mass (AM, amu) | Number of   |              |               | Electric Charge of     |                                |
|----|------|---------------|--------------------|-----------------------|-------------|--------------|---------------|------------------------|--------------------------------|
|    |      |               |                    |                       | Protons (P) | Neutrons (N) | Electrons (E) | Nucleus (ECN, + units) | Electron Shells (ECE, - units) |
| 1  |      |               | 6                  |                       |             | 6            |               |                        |                                |
| 2  |      |               |                    | 14                    | 7           |              |               |                        |                                |
| 3  |      |               |                    |                       |             | 8            | 8             |                        |                                |
| 4  |      |               | 10                 | 20                    |             |              |               |                        |                                |
| 5  |      |               |                    |                       | 11          | 12           |               |                        |                                |
| 6  |      |               |                    |                       |             | 14           | 13            |                        |                                |
| 7  |      |               |                    | 40                    |             | 22           |               |                        |                                |
| 8  |      |               |                    | 39                    | 19          |              |               |                        |                                |
| 9  |      |               |                    |                       |             | 20           | 20            |                        |                                |
| 10 |      |               |                    |                       |             | 18           |               | +17                    |                                |
| 11 |      |               | 26                 |                       |             | 30           |               |                        |                                |
| 12 |      |               |                    | 64                    | 29          |              |               |                        |                                |
| 13 |      |               |                    |                       |             | 35           | 30            |                        |                                |
| 14 |      |               |                    |                       |             | 61           |               |                        | -47                            |
| 15 |      |               |                    | 197                   | 79          |              |               |                        |                                |
| 16 |      |               |                    | 127                   |             |              | 53            |                        |                                |
| 17 |      |               | 80                 |                       |             | 121          |               |                        |                                |
| 18 |      |               |                    | 207                   | 82          |              |               |                        |                                |
| 19 |      |               |                    |                       |             | 146          | 92            |                        |                                |
| 20 |      |               |                    | 1                     |             | 0            |               |                        |                                |

**Exercise 2: Molecules**

**2.1.** Complete the following table. The atom counts are written in the exact order they appear in the chemical formula.

| #  | Chemical Formula                              | Name of Substance            | Number of Atoms of Each Element |
|----|-----------------------------------------------|------------------------------|---------------------------------|
| 1  | H <sub>2</sub> O                              | Water                        |                                 |
| 2  |                                               | Carbon Dioxide               | C:1, O:2                        |
| 3  | NaCl                                          | Sodium Chloride (Table Salt) |                                 |
| 4  |                                               | Ammonia                      | N:1, H:3                        |
| 5  | CaCO <sub>3</sub>                             | Calcium Carbonate            |                                 |
| 6  |                                               | Methane                      | C:1, H:4                        |
| 7  | H <sub>2</sub> SO <sub>4</sub>                | Sulfuric Acid                |                                 |
| 8  |                                               | Sodium Hydroxide             | Na:1, O:1, H:1                  |
| 9  | K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> | Potassium Dichromate         |                                 |
| 10 |                                               | Glucose                      | C:6, H:12, O:6                  |

| #  | Chemical Formula                | Name of Substance        | Number of Atoms of Each Element |
|----|---------------------------------|--------------------------|---------------------------------|
| 11 | Al <sub>2</sub> O <sub>3</sub>  | Aluminum Oxide           |                                 |
| 12 |                                 | Phosphoric Acid          | H:3, P:1, O:4                   |
| 13 | HNO <sub>3</sub>                | Nitric Acid              |                                 |
| 14 |                                 | Ethanol (Simple Alcohol) | C:2, H:6, O:1                   |
| 15 | Fe(OH) <sub>3</sub>             | Iron (III) Hydroxide     |                                 |
| 16 |                                 | Potassium Permanganate   | K:1, Mn:1, O:4                  |
| 17 | CuSO <sub>4</sub>               | Copper (II) Sulfate      |                                 |
| 18 |                                 | Hydrochloric Acid        | H:1, Cl:1                       |
| 19 | Na <sub>2</sub> CO <sub>3</sub> | Sodium Carbonate         |                                 |
| 20 |                                 | Magnesium Chloride       | Mg:1, Cl:2                      |

**2.2.** Calculate the **total number of atoms** present in the specified quantity of molecules.

| # | Chemical Formula                              | Name of Substance | Number of Molecules | Number of Atoms of Each Element |
|---|-----------------------------------------------|-------------------|---------------------|---------------------------------|
| 1 | O <sub>2</sub>                                | Oxygen Gas        | 8                   |                                 |
| 2 | HCl                                           | Hydrogen Chloride | 10                  |                                 |
| 3 | CH <sub>4</sub>                               | Methane           | 7                   |                                 |
| 4 | C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> | Glucose           | 2                   |                                 |

|    |                                                 |                         |    |  |
|----|-------------------------------------------------|-------------------------|----|--|
| 5  | H <sub>3</sub> PO <sub>4</sub>                  | Phosphoric Acid         | 4  |  |
| 6  | K <sub>2</sub> CO <sub>3</sub>                  | Potassium Carbonate     | 5  |  |
| 7  | C <sub>12</sub> H <sub>22</sub> O <sub>11</sub> | Sucrose (Sugar)         | 3  |  |
| 8  | Fe <sub>2</sub> O <sub>3</sub>                  | Iron (III) Oxide (Rust) | 6  |  |
| 9  | LiNO <sub>3</sub>                               | Lithium Nitrate         | 9  |  |
| 10 | SO <sub>2</sub>                                 | Sulfur Dioxide          | 11 |  |

### Exercise 3: Elementary Substances and Compounds

Determine if the substance is an **Elementary Substance** (*made of only one type of atom*) or a **Compound** (*made of two or more types of atoms*).

| #  | Chemical Formula               | Name of Substance                | Type of Substance |
|----|--------------------------------|----------------------------------|-------------------|
| 1  | O <sub>3</sub>                 | Ozone                            |                   |
| 2  | H <sub>2</sub> O <sub>2</sub>  | Hydrogen Peroxide                |                   |
| 3  | S <sub>8</sub>                 | Sulfur                           |                   |
| 4  | CaCO <sub>3</sub>              | Calcium Carbonate<br>(Limestone) |                   |
| 5  | N <sub>2</sub>                 | Nitrogen Gas                     |                   |
| 6  | Fe                             | Iron                             |                   |
| 7  | C <sub>10</sub> H <sub>8</sub> | Naphthalene                      |                   |
| 8  | P <sub>4</sub>                 | White Phosphorus                 |                   |
| 9  | KCl                            | Potassium Chloride               |                   |
| 10 | Au                             | Gold                             |                   |

| #  | Chemical Formula               | Name of Substance  | Type of Substance |
|----|--------------------------------|--------------------|-------------------|
| 11 | Mg                             | Magnesium          |                   |
| 12 | CO                             | Carbon Monoxide    |                   |
| 13 | H <sub>2</sub> SO <sub>4</sub> | Sulfuric Acid      |                   |
| 14 | Br <sub>2</sub>                | Bromine            |                   |
| 15 | C                              | Carbon (Graphite)  |                   |
| 16 | Ne                             | Neon Gas           |                   |
| 17 | NH <sub>3</sub>                | Ammonia            |                   |
| 18 | C <sub>2</sub> H <sub>2</sub>  | Ethyne (Acetylene) |                   |
| 19 | Ag                             | Silver             |                   |
| 20 | NO <sub>2</sub>                | Nitrogen Dioxide   |                   |