## Part 1: The Structure of Atoms

**Democritus**, a famous Greek teacher proposed the idea of the atom. Democritus said that all matter was made of tiny, indivisible particles. Called these particles atoms.

**Aristotle** believed that there was no empty space, therefore atoms could not move through empty space. He also believed that matter is made of earth, fire, air and water.

**Dalton Atomic Theory**

- Matter is composed of extremely small particles called atoms.
- Atoms are indivisible and indestructible.
- Atoms of a given element are identical in size, mass, and chemical properties.
- Atoms of a specific element are different from those of another element.
- Different atoms combine in simple whole-number ratios to form compounds.
- In a chemical reaction, atoms are separated, combined, or rearranged.
- When an electric charge is applied, a ray of radiation travels from the cathode to the anode, called a cathode ray.
- Cathode rays are a stream of particles carrying a negative charge. The particles carrying a negative charge are known as *electrons.*

**Robert Millikan** used the oil-drop experiment to determine the charge of an electron.

**Ernest Rutherford** studied how positively charged alpha particles interacted with the solid matter by aiming the particles at a thin sheet of gold foil.

- Although most of the alpha particles went through the gold foil, a few of them bounced back, some at large angles
- Almost all of the atom's positive charge and almost all of its mass are contained in a dense region in the center of the atom called the *nucleus*
- The repulsive force between the positively charged nucleus and positive alpha particles caused the deflections.
- Positively charged particles in the nucleus called *protons.*
- Neutrons, neutral particles in the nucleus.

The number of protons in the nucleus is the *atomic number*

- The sum numbers of protons and neutrons is called the atomic mass number
- Atoms are electrically neutral because they have equal numbers of protons (positively charged) and electrons (negatively charged). If an atom gains or loses one or more electrons.
- Atoms with the same number of protons but different numbers of neutrons are called *isotopes*
- One atomic mass unit (*amu*) is defined as 1/12th the mass of a carbon-12 atom.
- One amu is nearly, but not exactly, equal to one proton and one neutron.

scientists noticed some substances spontaneously emitted radiation, a process they called *radioactivity*.

- The rays and particles emitted are called radiation.
- A reaction that involves a change in an atom's nucleus is called a *nuclear reaction*. Nuclear reactions can change one element into another element.
- Unstable nuclei lose energy by emitting radiation in a spontaneous process called *radioactive decay*
- There are three types of radiation: alpha, beta, and gamma
- *Alpha radiation* is made up of positively charged particles called *alpha particles.* Each *alpha particle* contains two protons and two neutrons and has a 2+ charge
- *Beta radiation* is radiation that has a negative charge and emits beta particles, each beta particle is an electron with a (1-)charge.
- During *Beta decay*, a neutron is converted to a proton and an electron.

*Gamma rays* are high-energy radiation with no mass and are neutral. They usually accompany alpha and beta radiation.

**Q1** **First to propose the idea of atoms...**
CH 3
**A** Aristotle **B** Democritus
**C** Dalton **D** Bohr
Democritus said that all matter was made of tiny, indivisible particles • Called these particles atoms. →B

**Q2** **Believed that all matter is continuous and composed of varying amounts of air, earth, fire and water**
CH 3
**A** Aristotle **B** Democritus
**C** Dalton **D** Bohr
Aristotle believed that matter is made of earth, fire, air and water. →A

**Q3** **from Dalton's atomic theory: matter is composed of ….**
CH 3
**A** Electrons **B** Protons
**C** Neutrons **D** Atoms
John Dalton revived the idea of the atom in the early 1800s based on numerous chemical reactions. →D

**Q4** **The smallest particle of an element that retains the properties of the element …**
CH 3
**A** Electrons **B** Protons
**C** Neutrons **D** Atoms
The smallest particle of an element that Retaining the properties of the element is called an atom. →D

**Q5** **Negatively charged particles that orbit the nucleus…**
CH 3
**A** Electrons **B** Protons
**C** Neutrons **D** photon
The particles carrying a negative charge are known as electrons. →A

**Q6** **Cathode ray was a stream of …**
CH 3
**A** Positive charge
**B** Negative charge
**C** Photons
**D** Neutral particles
Cathode rays are a stream of particles carrying a negative charge. →B

**Q7** **Who discovered the electron**
CH 3
**A** Dalton **B** Thomson
**C** Henry **D** Lewis
Thomson identified the first subatomic particle—the electron →B

**Q8** **Atom is a uniform, positively charged sphere containing electrons…**
CH 3
**A** Bohr's model **B** Rutherford's model
**C** Thomson's model **D** Dalton's model
Thomson's plum pudding model of the atom states that the atom is a uniform, positively charged sphere containing electrons →C

**Q9** **Millikan calculated the charge of …**
CH 3
**A** Proton **B** Neutron
**C** Photon **D** Electron
Robert Millikan used the oil-drop apparatus shown below to determine the charge of an electron →D

**Q10** **What does the deflection of a few alpha particles back to the source when Rutherford focused the radiation toward the gold sheet indicates ...**
CH 3
**A** Atom carries a positive charge
**B** Atoms mostly consist of empty space
**C** The presence of a dense mass in the nucleus
**D** The presence of negative electrons
The repulsive force between the positively charged nucleus and positive alpha particles caused the deflections. →A

**Q11** **Which of the following is wrong according to the atom…**
CH 3
**A** Atom has no empty space
**B** Different elements consist of different atoms
**C** The smallest particle retains the element properties
**D** Its mass is concentrated in a small condensed place
Atoms are mostly empty space. →A

**Q12** **Atom is electrically neutral because ...**
CH 3
**A** Protons no. = Neutrons no.
**B** Atomic no. = Mass no.
**C** Protons no. = Electrons no.
**D** Electrons no. = Mass no.
Atoms are electrically neutral because they have equal numbers of protons (positively charged) and electrons (negatively charged). →C

**Q13** **Particles that are in an atom's nucleus and represent most of the atom's mass…**
CH 3
**A** Electrons and protons
**B** Electrons and neutrons
**C** Protons only
**D** Protons and neutrons
The sum numbers of protons and neutrons is called the atomic mass number →D

**Q14** **The mass number is the number of …**
CH 3
**A** Protons
**B** Electrons
**C** Protons and photons
**D** Protons and neutrons
The sum numbers of protons and neutrons are called the atomic mass number →D

**Q15** **In nitrogen atom ( $^{14}_{7}N$ ), there are**
CH 3
**A** 14 protons
**B** 7 protons and 7 neutrons
**C** 14 neutrons
**D** 14 protons and 7 electrons
The sum numbers of protons and neutrons are called the atomic mass number →B

**16** **In element ( $^{23}_{11}Na$ ) the protons number is …**
CH 3
**A** 23 **B** 12 **C** 11 **D** 13
Number of protons = atomic number →C

**17** **Neutrons number in element ( $^{132}_{55}Cs$ ) is ….**
CH 3
**A** 55 **B** 77 **C** 132 **D** 187
The number of neutrons = mass no.-protons no. →B

**18** **Isotopes of an element are different in…**
CH 3
**A** Atomic no. **B** Electrons no.
**C** Neutrons no. **D** Avogadro's no.
Atoms with the same number of protons but different numbers of neutrons are called isotopes →C

**19** **Isotopes are equal in...**
CH 3
**A** Proton no. **B** atoms no.
**C** Neutrons no. **D** Atomic size
Atoms with the same number of protons but different numbers of neutrons are called isotopes →A

**20** **A reaction that involves a change in an atom's nucleus and changes an element into a new element…**
CH 3
**A** Synthesis reaction. **B** Decomposition reaction
**C** Nuclear reaction. **D** Electrolysis reaction
A reaction that involves a change in an atom's nucleus is called a nuclear reaction that can change one element into another element. →C

**21** **Unstable nuclei lose energy by emitting radiations in a spontaneous process called …. decay.**
CH 3
**A** Photic/photodegrading. **B** Nuclear
**C** Natural **D** Radioactive
Unstable nuclei lose energy by emitting radiation in a spontaneous process called radioactive decay. →D

**22** **Particles that contain two protons and two neutrons are…**
CH 3
**A** Alpha **B** Positive Beta
**C** Negative Beta **D** Gamma
Each alpha particle contains two protons and two neutrons and has a (2+) charge →A

**23** **A particle with a 1- charge …**
CH 3
**A** Alpha **B** Beta **C** Neutron **D** Gamma
Beta radiation is radiation that has a negative charge and emits beta particles, each beta particle is an electron with a 1– charge. →B

**24** **High-energy radiation…**
CH 3
**A** Alpha **B** Beta **C** Neutron **D** Gamma
Gamma rays are high-energy radiation with no mass and are neutral. →D

**25** **If alpha (γ) decay happens to a nucleus then…**
CH 3
**A** Mass number increase
**B** Neither mass nor atomic number changes
**C** Atomic number increase
**D** Atomic Number increases but mass number decreases
If alpha (γ) decay happens to a nucleus then Atomic number decrease →A

**26** **Which of the following radiations is not affected by the electric field?**
CH 3
**A** Alpha **B** Beta
**C** Gamma **D** Cathode ray
Gamma rays are high-energy radiation with no mass and are neutral →C

**27** **If beta (β) radiation is emitted from an atom, then the mass number of the atom…**
CH 3
**A** Decreases by 2 **B** Increases by 1
**C** Decreases by 4 **D** Does not change
Beta radiation is radiation that has a negative charge and emits beta particles, each beta particle is an electron with a 1– charge. →B

**28** **If alpha particle decay happens to an element's The nucleus then mass number A and atomic Number Z becomes...**
CH 3
**A** A+4, Z+2
**B** A+4, Z-2
**C** A-4, Z+2
**D** A-4, Z-2
If alpha (γ) decay happens to a nucleus then Atomic number and mass number decrease →D

**29** **If a … radiation is emitted from an atom, then its atomic number decreases by 2 ...**
CH 3
**A** Alpha **B** Positive Beta
**C** Gamma **D** Negative Beta
Each alpha particle contains two protons and two neutrons and has a (2+) charge →A

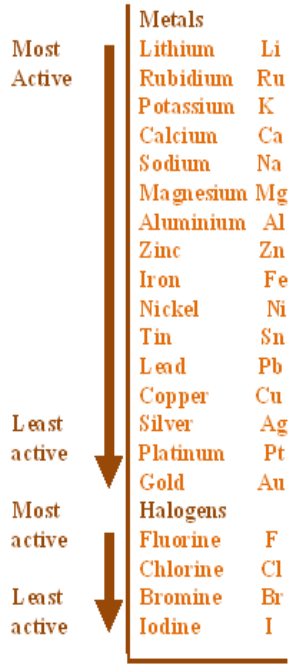
**30** **Radiation accounts for most of the energy lost during a radioactive decay**
CH 3
**A** Alpha **B** Gamma
**C** Negative Beta **D** Positive Beta
Gamma rays are high-energy radiation with no mass and are neutral →B

## Part 2: Chemical Reactions

The process by which one or more substances are rearranged to form different substances is called a ***chemical reaction***.
Evidence that a chemical reaction may have occurred: - Change in temperature
- Change in color - Odor - Gas bubbles - Appearance of a solid
Chemists use statements called ***equations*** to represent chemical reactions.
***Reactants*** are the starting substances.
***Products*** are the substances formed in the reaction. A ***chemical equation*** is a statement that uses chemical formulas to show the identities and relative amounts of the substances involved in a chemical reaction.

**Types of Chemical Reactions**:

- ***Synthesis reaction (Combination)***: A + B → AB
Reaction in which two or more substances react to produce a single product.
- ***Decomposition reaction***: AB → A + B
One in which a single compound breaks down into two or more elements or new compounds.
***Combustion reaction***: Oxygen combines with a substance and releases energy in the form of heat and light.
Ex: - $4Na + O_2 \rightarrow 2Na_2O$ - $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
- ***Single replacement reaction***: A + BX → AX + B
A reaction in which the atoms of one element replace the atoms of another element in a compound.
Metal will not always replace metal in a compound dissolved in water because of differing reactivities.
An activity series can be used to predict if reactions will occur.
***Double replacement reactions*** AY + BX → AX + BY
occur when ions exchange between two compounds. All double replacement reactions produce either liquid water, liquid, precipitate, or a gas.




**Q31** **Rearranging the atoms of two or more elements to form different substances is called…**
CH 3
**A** A chemical reaction
**B** A chemical equation
**C** Chemical equilibrium
**D** Rate of chemical reaction
The process by which one or more substances are Rearranged to form different substances is called a chemical reaction. →A

**Q32** **In combustion: a substance reacts with…**
CH 3
**A** Hydrogen **B** Oxygen **C** Chlorine **D** Nitrogen
Oxygen combines with a substance and releases energy in the form of heat and light. →B

**Q33** **Reaction with a single reactant is…**
CH 3
**A** Decomposition **B** Replacement
**C** Combustion **D** synthesis
Decomposition reaction: One in which a single compound breaks down into two or more elements or new compounds. →A

**Q34** **The type of reaction that produces one product is…**
CH 3
**A** Decomposition **B** Replacement
**C** Combustion **D** Synthesis
Synthesis reaction (Combination): Reaction in which two or more substances react to produce a single product. →D →

**Q35** **The type of reaction** $2Na + Cl_2 \rightarrow 2NaCl$ **is …**

CH 3

**A** Decomposition **B** Replacement
**C** Combustion **D** Synthesis

Synthesis reaction (Combination): Reaction in which two or more substances react to produce a single product. →D

**Q36** **Which of the following reaction a decomposition reaction**

CH 3

**A** $N_2 + 3H_2 \rightarrow 2NH_3$
**B** $2KClO_3 \rightarrow 2KCl + 3O_2$
**C** $Cd(NO_3)_2 + H_2S \rightarrow CdS + 2HNO_3$
**D** $C_2H_6 + O_2 \rightarrow 2CO_2 + 3H_2$

Decomposition reaction: One in which a single compound breaks down into two or more elements or new compounds. →B

**Q37** **Which of the following reaction a decomposition reaction**

CH 3

**A** $H_2 + O_2 \rightarrow H_2O$
**B** $Na + H_2O \rightarrow NaOH + H_2$
**C** $NaHCO_3 \rightarrow NaOH + H_2O + CO_2$
**D** $C_4H_8 + O_2 \rightarrow CO_2 + H_2O$

Decomposition reaction: One in which a single compound breaks down into two or more elements or new compounds. →C

**Q38** **Which of the following reaction is a single replacement reaction**

CH 3

**A** $2Fe + 3Br_2 \rightarrow 2FeBr_3$
**B** $K(s) + NaCl(aq) \rightarrow KCl(aq) + Na(s)$
**C** $N_2 + 3H_2 \rightarrow 2NH_3$
**D** $NaCl(aq) + AgNO3(aq) \rightarrow NaNO3\ (aq) + AgCl(s)$

A reaction in which the atoms of one element replace the atoms of another element in a compound. →B

**Q39** **Which of the following reaction is a double replacement reaction**

CH 3

**A** $C_6H_{12} + 9\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$
**B** $O_3 \rightarrow O^{\cdot} + O_2$
**C** $CaCO_3 \rightarrow CaO + CO_2$
**D** $Na_3PO_4(aq) + 3(KOH)_3(aq) \rightarrow NaOH(aq) + K_3PO_4\ (s)$

A reaction in which the atoms of one element replace the atoms of another element in a compound. →D

**Q40** **Which of the following reaction is a combustion reaction?**

CH 3

**A** $C_6H_{12} + 9\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$
**B** $2H_2O \rightarrow 2H_2^{\cdot} + O_2$
**C** $CaCO_3 \rightarrow CaO + CO_2$
**D** $Na_3PO_4(aq) + 3(KOH)_3(aq) \rightarrow NaOH(aq) + K_3PO_4\ (s)$

Combustion reaction: Oxygen combines with a substance →A

**Q41** **The separation of the components of sodium chloride (NaCl) is …**

CH 3

**A** Decomposition **B** Replacement
**C** Combustion **D** Synthesis

Decomposition reaction: One in which a single compound breaks down into two or more elements or new compounds. →A

**Q42** **The type of reaction** $CaCO_3 \rightarrow CaO + CO_2$ **is …**

CH 3

**A** Decomposition **B** Replacement
**C** Combustion **D** Synthesis

Decomposition reaction: One in which a single compound breaks down into two or more elements or new compounds. →A

**Q43** **Which of the following reactions can occur?**

CH 3

**A** $Na + KCl \rightarrow$
**B** $K + NaCl \rightarrow$
**C** $Br_2 + NaCl \rightarrow$
**D** $I_2 + NaCl \rightarrow$

An activity series can be used to predict if reactions will occur. →B

**Q44** **Which of the following reactions cannot occur?**

CH 3

**A** $Li + KCl \rightarrow$
**B** $K + NaCl \rightarrow$
**C** $Na + CaCl_2 \rightarrow$
**D** $Li + NaCl \rightarrow$

An activity series can be used to predict if reactions will occur. →C

**Q45** **Which of the following reactions represent combustion and synthesis reactions at the same time?**

CH 3

**A** $2Fe + 3Br_2 \rightarrow 2FeBr_3$
**B** $2Ca + O_2 \rightarrow 2CaO$
**C** $CH_4 + O_2 \rightarrow CO_2 + H_2O$
**D** $Li + NaCl \rightarrow LiCl + Na$

**Synthesis reaction (Combination)**: Reaction in which two or more substances react to produce a single product.
**Combustion reaction**: Oxygen combines with a substance →B

**Q46** **Predict the results of the following reaction**

$Na + AlCl_3 \rightarrow$

CH 3

**A** $NaCl + AlCl_2$
**B** $NaCl_2 + Al$
**C** $3NaCl + Al$
**D** $NaCl_3 + Al$

An activity series can be used to predict if reactions will occur. →C

**Q47** **Which of the following reaction is a double replacement reaction**

CH 3

**A** $Ca + O_2 \rightarrow CaO$
**B** $O + O_2 \rightarrow O_3$
**C** $CaO + CO_2 \rightarrow CaCO_3$
**D** $NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

A reaction in which the atoms of one Element replace the atoms of another element in a compound. →D

**1** The reaction $H_2CO_3 \rightarrow CO_2 + H_2O$ is

Do It?

**A** Combination **B** Decomposition
**C** Combustion **D** Replacement

## Part 3: The Mole

The **mole** is an SI base unit used to measure the amount of a substance. **Avogadro's number** is $N_A = 6.02 \times 10^{23}$

**The molar mass of a compound tells you the mass of 1 mole of that substance**.

To find the molar mass of a compound:

1. Use the chemical formula to determine the number of each type of atom present in the compound.
2. Multiply the atomic weight (from the periodic table) of each element by the number of atoms of that element present in the compound.
3. Add it all together and put units of grams/mole after the number.


**48** **How many atoms are there in 2 mol of Lithium (Li)?** ( $N_A = 6.02 \times 10^{23}$ )

CH 3

**A** $2 \times 10^{23}$ **B** $6.02 \times 10^{23}$

**C** $12.04 \times 10^{23}$ **D** $6.02 \times 10^{-23}$

Number of atoms = number of moles × $N_A$

Number of atoms = $12 \times 10^{23}$ atom → C

**49** **How many moles are there in** $12.04 \times 10^{23}$ atom **of Lithium (Li)?**

CH 3

**A** 1 mol **B** 2 mol

**C** 3 mol **D** 4 mol

$$\text{Number of mols} = \frac{\text{number of atoms}}{N_A}$$

$$= \frac{12.04 \times 10^{23} \text{ atom}}{6.02 \times 10^{23}}$$

= 2 mol →B

**50** **How many moles are there in** 21 g **of Lithium (Li)? (Molar mass of Li = 7 g/mol)**

CH 3

**A** 1 mol **B** 2 mol

**C** 3 mol **D** 4 mol

$$\text{Number of moles} = \frac{\text{Mass in grams}}{\text{Molarmass}}$$

$$= \frac{21 \text{ g}}{7 \text{ g/mol}} = 3 \text{ mol} \rightarrow C$$

**51** **How many grams are there in** 5 mol **of Sodium (Na)? (Molar mass of Na = 23 g/mol)**

CH 3

**A** 15 g **B** 215 g

**B** 23 g **D** 115 g

Mass in grams = Number of moles × Molar mass

= 5 mol × 23 g/mol

= 115 g →D

**52** **How many atoms are there in 14 g of Lithium (Li)?**

CH 3

**A** $2 \times 10^{23}$ **B** $6.02 \times 10^{23}$

**C** $12.04 \times 10^{23}$ **D** $6.02 \times 10^{-23}$

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molarmass}}$$

$$= \frac{14 \text{ g}}{7 \text{ g/mol}}$$

= 2 mol

Number of atoms = number of moles × $N_A$

Number of atoms = $2 \times 6 \times 10^{23}$

= $12 \times 10^{23}$ atom →C

**53** **How many grams are there in** $24.08 \times 10^{23}$ **of Silver (Ag)? (Molar mass of Ag = 108 g/mol)**

CH 3

**A** 108 g **B** 216 g

**C** 432 g **D** 648 g

$$\text{Number of moles} = \frac{\text{number of atoms}}{N_A}$$

$$= \frac{24.08 \times 10^{23}}{6.02 \times 10^{23}}$$

= 4 mol

Mass in gram = number of moles × Molar mass

= 4 mol × 108 g/mol

= 432 g →C

**54** **What is the molar mass of** $NaHCO_3$ **(Molar mass of Na = 23, H = 1, C = 12, O= 16 g/mol)**

CH 3

**A** 42 g /mol **B** 52 g/mol

**C** 84 g/mol **D** 164 g/mol

Molar mas = the sum of molar mass for all elements in the compounds

(1 x 23) + (1x1) + (1 x 12) + (3 x 16) = 84 g/mol →C

**55** **How many molecules in 360g of $C_6H_{12}O_6$**
**(Molar mass of H = 1, C = 12, O= 16 g/mol)**
$N_A = 6.02 \times 10^{23}$

CH 3
**A** $2 \times 10^{23}$ **B** $24.08 \times 10^{23}$
**C** $12.04 \times 10^{23}$ **D** $8.06 \times 10^{23}$

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$
$$= \frac{360\ g}{180\ g/mol}$$
$$= 2\ mol$$
$$\text{Number of Molecules} = \text{number of moles} \times N_A$$
$$\text{Number of Molecules} = 2 \times 6.02 \times 10^{23}$$
$$= 12.04 \times 10^{23}\ \text{Molecule}$$
→C

**56** **How many grams are there in Molecules of $24.08 \times 10^{23}$ $H_2O$?**
**(Molar mass of H = 1, O= 16 g/mol)**
**$N_A = 6.02 \times 10^{23}$**

CH 3
**A** 144 g **B** 216 g
**C** 72 g **D** 18 g

$$\text{Number of moles} = \frac{\text{number of molecules}}{N_A}$$
$$= \frac{24.08 \times 10^{23}}{6.02 \times 10^{23}}$$
$$= 4\ mol$$
$$\text{Mass in gram} = \text{number of moles} \times \text{Molar mass}$$
$$= 4\ mol \times 18\ g/mol$$
$$= 72\ g$$
→C

**57** **How many moles of oxygen (O) in 2 moles of Carbonic acid $H_2CO_3$**

CH 3
**A** 1 mol **B** 2 mol
**C** 3 mol **D** 6 mol
Mole ratio between $H_2CO_3$ and O is 1:3 →D

**58** **How many moles of carbon (C) in 88 grams of propane $C_3H_8$**

CH 3
**A** 1 mol **B** 2 mol
**C** 3 mol **D** 6 mol
Mole ratio between $C_3H_8$ and C is 1:3 →D

**2** **How many grams of mercury Hg in 3 mole of mercury )(Molar mass of Hg = 200 g/mol)**

Do It?
**A** 200 g **B** 300 g
**C** 600 g **D** 1200 g

**3** **How many moles of lead Pb in 414g of lead (Molar mass of Pb = 207 g/mol)**

Do It?
**A** 1 mol **B** 2 mol
**C** 3 mol **D** 4 mol

**4** **How many molecules in 5 moles of ammonia $NH_3$**
**(Molar mass of H = 1, N = 14 g/mol)**
$N_A = 6.02 \times 10^{23}$

Do It?
**A** $6.02 \times 10^{23}$
**B** $12.04 \times 10^{23}$
**C** $30.1 \times 10^{23}$
**D** $60.2 \times 10^{23}$

**5** **How many moles in $6.02 \times 10^{22}$ molecules of ammonia $NH_3$?**
**(Molar mass of H = 1, N = 14 g/mol)**
$N_A = 6.02 \times 10^{23}$

Do It?
**A** 1 mol
**B** 0.1 mol
**C** 2 mol
**D** 0.2 mol

**6** **What is the molar mass of $H_3PO_4$ phosphoric Acid.**
**(Molar mass of H = 1, P = 31, O= 16 g/mol)**

Do It?
**A** 310 g/mol
**B** 98 g/mol
**C** 196 g/mol
**D** 49 g/mol

**7** **How many moles of lithium hydroxide LiOH in 72 g of LiOH?**
**(Molar mass of H = 1, Li = 7, O= 16 g/mol)**

Do It?
**A** 1 mol
**B** 2 mol
**C** 3 mol
**D** 4 mol

**8** **How many molecules in 90g of ethanoic acid $CH_3COOH$**
**(Molar mass of H = 1, C = 12, O= 16 g/mol)**
$N_A = 6.02 \times 10^{23}$

Do It?
**A** $2 \times 10^{23}$ **B** $9.03 \times 10^{23}$
**C** $12.04 \times 10^{23}$ **D** $18.06 \times 10^{23}$

**9** **How many grams of carbon dioxide $CO_2$ in $12.04 \times 10^{22}$ molecules of $CO_2$?**
**(Molar mass of H = 1, Li = 7, O= 16 g/mol)**
$N_A = 6.02 \times 10^{23}$

Do It?
**A** 44g
**B** 4.4g
**C** 88g
**D** 8.8g

## Part 4: Stoichiometry

**What is Stoichiometry?**

Stoichiometry is the study of quantitative relationships between the amounts of reactants used and the amounts of products formed by a chemical reaction.

Stoichiometry is based on the law of conservation of mass. (***The mass of reactants equals the mass of the products)***

- Stoichiometry is based on the chemical equation and mole ratios between reactants and products

**Steps for balancing equations**

-Count the atoms of the elements in the reactants. If a reaction involves identical polyatomic ions in the reactants and products, count the ions as if they are elements

-Count the atoms of the elements in the products

Change the coefficients to make the number of atoms of each element equal on both sides of the equation. Never change a subscript in a chemical formula to balance an equation because doing so changes the identity of the substance.

- Write the coefficients in their lowest possible ratio. The coefficients should be the smallest possible whole numbers.

**Limiting Reactants**

• Reactions proceed until one of the reactants is used up and one is left in excess.

• The limiting reactant limits the extent of the reaction and, thereby, determines the amount of product formed.

• The excess reactants are all the leftover unused reactants.

**Percent Yield**

• Laboratory reactions do not always produce the calculated amount of products.

• Reactants stick to containers.

• Competing reactions form other products.

•The ***theoretical yield*** is the maximum amount of product that can be produced from a given amount of reactant.

• The ***actual yield*** is the amount of product actually produced when the chemical reaction is carried out in an experiment.

• The percent yield of a product is the ratio of the actual yield expressed as a percent.

$$\text{Percent Yeild} = \frac{\text{Actualyeild}}{\text{Theoriticalyeild}} \times 100\%$$

• Percent yield is important in the cost-effectiveness of many industrial manufacturing processes

**59** **The mole ratios can be determined only if what?**
CH 3
**A** All the reactants are present in unequal amounts
**B** The reactants do not have coefficients
**C** The products do not have coefficients
**D** The equation is balanced
Mole ratio depends on balanced chemical equation →D

**60** **The coefficient x in the balanced chemical equation** $N_2 + xH_2 \rightarrow 2NH_3$ **is …**
CH 3
**A** 3 **B** 6
**C** 2 **D** 12
$N_2 + 3H_2 \rightarrow 2NH_3$ →A

**61** **Which of the following is the correct mole ratio for the following equation?** $Al(s) + Br_2(l) \rightarrow AlBr_3(s)$
CH 3
**A** 2 mol Al : 3 mol Br
**B** 3 mol $Br_2$ : 2 mol Al
**C** 2 mol $AlBr_3$ : 1 mol $Br_2$
**D** 2 mol Br : 2 mol Al
Balanced chemical equation is
$2Al(s) + 3Br_2(l) \rightarrow 2AlBr_3(s)$
3 mol $Br_2$:2 mol Al →B

**63** **Mass of reactants and mass of products in a chemical reaction...**
CH 3
**A** Are not equal
**B** Are increased equally
**C** Are equal
**D** are unrelated
The law of conservation of mass. (The mass of reactants equals the mass of the products) →C

**62** **How many moles of $CO_2$ will be produced in the following reaction if the initial amount of $CH_4$ were 2 moles?** $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
CH 3
**A** 3 **B** 4 **C** 2 **D** 1
The mole ratio between $CH_4$ and $CO_2$ is 1:1 →C

**64** **The amount of product that can be produced from a given amount of reactants based on stoichiometric calculations is:**
CH 3
**A** Actual yield
**B** Percent yield
**C** Theoretical yield
**D** Stoichiometric yield
The theoretical yield is the maximum amount of product that can be produced from a given amount of reactant. →C

**65** **The mass of the final product in a chemical reaction is based on what?**
CH 3
**A** The amount of excess reactant
**B** The amount of limiting reactant
**C** The presence of a catalyst
**D** The amount of $O_2$ present
The amount of limiting reactant →B

**10** **How many moles of $CO_2$ will be produced when 4 moles of $C_4H_{10}$ reacted with enough amount of oxygen.**
$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$
Do It?
**A** 2 **B** 4
**C** 8 **D** 16

Chapter 3: Do It Answer key

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| B | C | B | C | B | B | C | B | D | D |