

[X]: Show the correct answers.

1. Indicate which of the following statements is correct:

- a) An atom consists of a nucleus containing protons and neutrons, and electrons outside the nucleus. [X]
- b) Most of an atom's space is occupied by the nucleus, which contains a significant portion of the atomic mass.
- c) In a neutral atom, the number of protons equals the number of electrons. [X]
- d) Atoms are arranged in the modern periodic table based on their mass.
- e) The atomic mass of an atom is equal to the number of protons plus neutrons in its nucleus. [X]

Note: Make sure to select all correct options - there may be more than one!

2. Indicate which of the following statements is correct:

- a) The mass of a hydrogen atom is 1.0 gram.
- b) Isotopes of an element differ in their mass because they contain a different number of neutrons in the nucleus. [X]
- c) The mass of the carbon isotope with mass number 12, the most abundant isotope of carbon, is 12.011 atomic mass units (as shown on the Periodic Table for Carbon).
- d) The mass of one mole of oxygen atoms is 16.0 atomic mass units. e) In the periodic table, the atomic mass of an element is a weighted average of the masses of all isotopes of that element. [X]

Note: Make sure to select all correct options - there may be more than one!

[explanation] If you didn't answer this question correctly, review chapters 1 and 2 carefully. Review the definitions of isotopes and the first part of the text "Isotopes, the definition of the standard element, and the mole" in this course, which discusses how atomic mass in the Periodic Table is related to them. [explanation]

3. When a chemical reaction occurs, what can be stated?

- a) Mass is conserved [X]
- b) The number of molecules is conserved
- c) The number of atoms is conserved [X]
- d) The number of moles is conserved

Note: Make sure to select all correct options - there may be more than one!

[explanation]

In a chemical reaction, the law of conservation of mass is fulfilled. From the microscopic point of view, the atoms are conserved (atoms are not created or destroyed in a chemical reaction; they are only rearranged to form products). Note that the conservation of atoms ensures the conservation of mass in a chemical reaction.
[explanation]

4. The chemical equation representing the reaction of solid aluminum, Al(s), with gaseous chlorine, Cl₂(g), to produce solid aluminum chloride, AlCl₃(s), is:

- a) Al(s) + Cl₂(g) → AlCl₃(s)
- b) 2 Al(s) + 3 Cl₂(g) → 2 AlCl₃(s). [X]
- c) 3 Al(s) + 3 Cl₂(g) → 3 AlCl₃(s)
- d) 3 Al(s) + Cl₂(g) → 4 AlCl₃(s)

[explanation] Atoms must be conserved. [explanation]

5. In a reaction vessel, 200 molecules of H₂ and 200 molecules of O₂ are placed, which react according to: H₂ + ½ O₂ → H₂O. After a certain time t, it is observed that there are 80 molecules of H₂O in the vessel. It can be stated that at that instant, in the vessel there are:

- a) 80 molecules of H₂ and 40 molecules of O₂
- b) 280 molecules of H₂ and 240 molecules of O₂
- c) 120 molecules of H₂ and 160 molecules of O₂ [X]
- d) It cannot be known until the reaction is complete.

[explanation] If 80 molecules of water were formed, then 80 molecules of H₂ and 40 molecules of O₂ must have reacted. Therefore, there should be (200-80) = 120 molecules of H₂ and (200-40) = 160 molecules of O₂ remaining. [explanation]

6. We can state that one mole of water molecules, H₂O, and one mole of oxygen molecules, O₂:

- a) Have the same mass
- b) Contain one molecule of each
- c) Have a mass of 1 gram each
- d) Contain the same number of molecules [X]

[explanation] Being a mole a fixed amount of units, then in one mole of different compounds, there is always the same number of units of that compound. [explanation]

7. A sulfur molecule contains 8 sulfur atoms, S₈. Therefore, one mole of sulfur molecules will contain:

- a) 8 grams of sulfur
- b) 8 moles of sulfur atoms [X]
- c) 6.02×10^{23} sulfur atoms
- d) 8 sulfur atoms

[explanation] Being a mole has a fixed number of units, then in one mole of S₈ there are 8 moles of S atoms. [explanation]

8. Ammonia, NH₃, can be prepared by the reaction between nitrogen (N₂) and hydrogen (H₂), according to $\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \rightarrow 2 \text{NH}_3(\text{g})$. How many moles of hydrogen are required to prepare 1 mole of ammonia? (Assume that all the nitrogen needed is available).

- a) 1
- b) 3/2 [X]
- c) 2/3
- d) 3
- e) 2

9. When methane, CH₄, reacts with oxygen (O₂), water, H₂O, and carbon dioxide (CO₂) are formed. How many grams of methane are needed to produce 110 grams of water?

- a) 55 grams
- b) 110 grams
- c) 49 grams [X]
- d) 30 grams
- e) 3 grams

10. Aluminum reacts with hydrogen chloride to produce aluminum chloride and hydrogen gas according to: $2 \text{Al}(\text{s}) + 6 \text{HCl}(\text{g}) \rightarrow 2 \text{AlCl}_3(\text{s}) + 3 \text{H}_2(\text{g})$. Calculate the mass of aluminum chloride formed when 2.70 grams of aluminum react with 4.00 grams of hydrogen chloride.

- a) 4.93 grams [X]
- b) 13.3 grams
- c) 2.70 grams
- d) 1.70 grams
- e) 4.00 grams