Brainiacs Chemistry Olympiad Preliminary Round Sample Exam Paper

Category I – grades 7 and 8

Q1.

Which of the following processes involves a physical change only?

A) Combustion of methane

B) Dissolving sugar in water

C) Rusting of iron

D) Decomposition of water by electrolysis

Q2.

Which subatomic particle is not present in the nucleus of an atom?

A) Proton

B) Neutron

C) Electron

D) None of the above

Q3.

The isotope of hydrogen with two neutrons is called:

A) Protium

B) Deuterium

C) Tritium

D) Hydrogenium

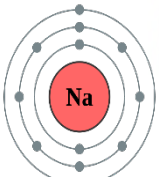
Q4.

Four isotopes of different elements are listed below. Determine which isotope has the greatest number of neutrons:

A) U-235 **B)** U-238 **C)** Th-232 **D)** Pb-207

Q5.

An atom has 11 protons, 12 neutrons, and 11 electrons. Which of the following correctly identifies the atom, along with its isotopic representation and general properties?



A) Sodium (Na), Mass number: 23 **B)** Magnesium (Mg), Mass number: 23
C) Sodium Ion (Na^+), Mass number: 23 **D)** Potassium (K), Mass number: 39

Q6.

Which of the following elements is classified as a **metalloid** and exhibits properties of both metals and non-metals?

A) Carbon **B)** Silicon **C)** Aluminum **D)** Oxygen

Q7.

An unknown element X is located in Period 3 and Group 16 of the periodic table. Based on its position: Predict its number of valence electrons.

A)2 **B) 4** **C) 6** **D) 7**

Q8.

An element X is in Group 1 of the periodic table and reacts vigorously with water to form a solution of XOH and releases hydrogen gas. Which of the following best describes this element?

A) Lithium (Li), Alkali metal, Least reactive in Group 1
B) Sodium (Na), Alkali metal, Reacts moderately with water
C) Potassium (K), Alkali metal, Reacts vigorously with water
D) Calcium (Ca), Alkaline earth metal, Reacts slowly with water

Q9.

An unknown element X has the following properties:

- It is located in Period 4 and Group 17 of the periodic table.
- It exists as a diatomic molecule in its elemental state.
- It reacts with metals to form salts and is highly electronegative.

Which of the following statements about X is correct?

A) The element is Chlorine (Cl_2), has 7 valence electrons, and is a halogen.
B) The element is Bromine (Br_2), has 7 valence electrons, and is not a noble gas.
C) The element is Krypton (Kr), has 8 valence electrons, and is a halogen.
D) The element is Fluorine (F_2), has 7 valence electrons, and is in Period 4.

Q10.

A compound X reacts with water to produce H_2SO_4. Based on its classification, which of the following could X be?

A) Sulfur dioxide **B)** Sulfur trioxide **C)** Calcium sulfate **D)** Sodium sulfite

Q11.

A solid compound A_2O_3 reacts with both acids and bases to form salts. What is the classification of A_2O_3, and which element does it most likely contain?

A) Basic oxide, Calcium **B)** Acidic oxide, Sulfur
C) Amphoteric oxide, Aluminum **D)** Neutral oxide, Nitrogen

Q12.

A compound X is known to behave as both a Brønsted-Lowry acid and a Brønsted-Lowry base depending on the reaction conditions. Its amphiprotic nature allows it to donate or accept a proton. Which of the following correctly identifies the compound and provides an example of its dual behavior?

A) Water **B**) Sodium hydroxide **C)** Ammonia **D)** Hydrochloric acid

Q13.

A compound X exhibits the following properties:

1. It reacts with hydrochloric acid to produce hydrogen gas.
2. It reacts with sodium hydroxide to form a salt and water.
3. It is amphoteric and found in nature as part of bauxite ore.

Which of the following statements about X is correct?

A) X is Zinc oxide, which reacts with both acids and bases to form salts.
B) X is Aluminum hydroxide, which behaves as an acid with bases and as a base with acids.
C) X is Magnesium oxide, which reacts only with acids and is not amphoteric.
D) X is Calcium hydroxide, which reacts only with acids to form salts.

Q14.

An unknown compound X exhibits the following behavior:

1. When dissolved in water, it increases the concentration of hydrogen ions and lowers the pH below 2.
2. When heated, it decomposes to produce a gaseous oxide Y and water.
3. The gaseous oxide Y reacts with water to form a strong acid.

Which of the following correctly identifies X and its decomposition products?

A) X=H_2CO_3, Y=CO_2, Decomposition: $H_2CO_3 \rightarrow CO_2+H_2O$
B) X=H_2SO_4, Y=SO_3, Decomposition: $H_2SO_4 \rightarrow SO_3+H_2O$
C) X=HCl, Y= Cl_2, Decomposition: $HCl \rightarrow Cl_2+H_2$
D) X=HNO_3, Y=NO_2, Decomposition: $HNO_3 \rightarrow NO_2+H_2O$

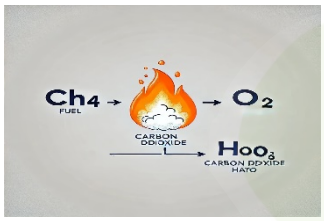
Q15.

A 10 g sample of a compound containing carbon, hydrogen, and oxygen is burned completely in excess oxygen. The reaction produces 14.66 g of carbon dioxide and 6 g of water. Determine the empirical formula of the compound.

A) CH_2O **B)** $C_3H_8O_2$ **C)** $C_3H_4O_3$ **D)** C_2H_6O

Q16.

The combustion of methane in the presence of oxygen produces carbon dioxide and water as shown in the picture:



If 8.00 g of methane is burned completely: Determine the volume of oxygen gas required at STP (1 atm, 273 K).

A) 22.4 **L** **B)** 44.8 L **C)** 11.2 L **D)** 33.6 L

Q17.

An unknown element X, located in Group 2 of the periodic table, reacts with water to produce a hydroxide and hydrogen gas. A 12.0 g sample of this element reacts completely with water, producing 6.72 L of hydrogen gas at STP. Identify the element X

A) Magnesium **B**) Calcium **C)** Barium **D)** Strontium

Q18.

Three compounds—CO_2, CaO, and Al_2O_3—are tested to determine their chemical behavior. Each compound is dissolved in water, and the resulting solution is tested with red and blue litmus paper. The following observations are made:

1. CO_2: Turns blue litmus red but does not affect red litmus.
2. CaO: Turns red litmus blue but does not affect blue litmus.
3. Al_2O_3: Does not affect either litmus when dissolved in water.

Based on these observations:

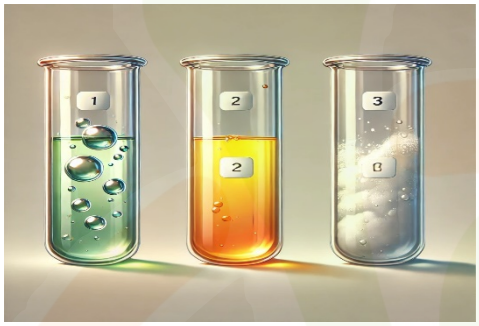
Classify each oxide as acidic, basic, or amphoteric.

A) Acidic oxide: CO_2; Basic oxide: CaO; Amphoteric oxide: Al_2O_3
B) Acidic oxide: CaO; Basic oxide: CO_2; Amphoteric oxide: Al_2O_3
C) Acidic oxide: Al_2O_3; Basic oxide: CO_2; Amphoteric oxide: CaO
D) All are acidic oxides

Q19.

A student conducts experiments to test the chemical properties of three unknown compounds: X, Y, and Z. The following observations are recorded:

1. Compound X: When dissolved in water, it turns red litmus paper blue. When mixed with HCl, it produces a gas that turns limewater milky.
2. Compound Y: When dissolved in water, it turns blue litmus paper red. It reacts with NaOH to form a salt and water.
3. Compound Z: Does not affect red or blue litmus paper when dissolved in water. However, it reacts with both HCl and NaOH to form salts.



Identify compounds X, Y, and Z based on their properties.

A) X: Sodium carbonate, Y: Hydrochloric acid, Z: Aluminum hydroxide
B) X: Calcium hydroxide, Y: Sulfuric acid , Z: Zinc oxide
C) X: Magnesium carbonate, Y: Acetic acid, Z: Aluminum hydroxide
D) X: Sodium hydroxide, Y: Hydrochloric acid , Z: Zinc oxide

Q20.

What is the greenhouse gas with the highest global warming potential?

A) CO_2

B) CH_4

C) N_2O

D) CFCs