Brainiacs Chemistry Olympiad Preliminary Round Sample Exam Paper 3

Category II – grades 9 and 10

Q1.

Which property decreases across a period in the periodic table?

A) Atomic radius
B) Ionization energy
C) Electronegativity
D) Nuclear charge

Q2.

Identify the element with the following configuration: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$.

A) Neon
B) Chlorine
C) Argon
D) Sulfur

Q3.

Which compound exhibits hydrogen bonding?

A) CH_4
B) NH_3
C) CCl_4
D) CO_2

Q4.

What is the primary greenhouse gas responsible for ocean acidification?

A) Methane
B) Carbon dioxide
C) Nitrous oxide
D) Chlorofluorocarbons [3]

Q5.

What is the oxidation state of sulfur in H_2SO_4?

A) +2
B) +4

C) +6
D) 0

Q6.

Which element is used as a reducing agent in the thermite reaction?

A. Iron
B. Aluminum
C. Sodium
D. Carbon

Q7.

Which functional group is present in alcohols?

A) -COOH
B) -OH
C) -CHO
D) $-NH_2$

Q8.

What is the major product of the reaction between ethene and hydrogen bromide?

A) Ethanol
B) Ethane
C) Bromoethane
D) Dibromoethane

Q9.

Which process is used to separate a mixture of liquids based on boiling points?

A) Filtration
B) Distillation
C) Chromatography
D) Crystallization

Q10.

How many moles of oxygen are required to combust 1 mole of methane (CH_4)?

A) 1
B) 2

C) 3
D) 4

Q11.

What is the molecular formula of a compound with an empirical formula CH_2 and a molar mass of 56 g/mol?

A) CH_2
B) C_2H_4
C) C_4H_8
D) C_6H_{12}

Q12.

Which type of bond involves the sharing of three pairs of electrons?

A) Single bond
B) Double bond
C) Triple bond
D) Ionic bond

Q13.

The second largest crater lake of the world, Issyk-kul lake is located in Kyrgyzstan. It contains nearly 0.38% sodium chloride by mass. A sample taken from "The Issyk-kul Lake" contains 3.8 g of sodium chloride (NaCl) in one liter of solution. Find the molarity of sodium chloride in the sample.
A) 0,065M
B) 0,045M
C) 0,035M
D) 0,055M

Q14.

How many mL of 0.4 M sulfuric acid solution should be used to neutralize 8 g of sodium hydroxide?

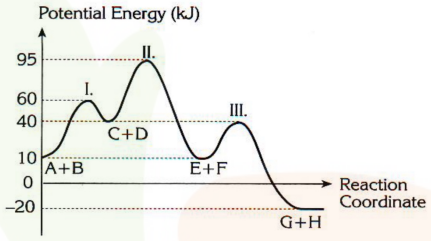
A) 100ml
B) 150ml
C) 200ml
D) 250ml

Q15.

I. A + B → C + D

II. C + D → E + F

III. E + F → G + H



Which of the following is wrong?

A) The enthalpy of 2nd reaction is equal to that of 3rd reaction.
B) The enthalpy of the overall reaction is equal to that of the 2nd reaction.
C) The overall reaction is exothermic.
D) The 1st reaction is the fastest step.

Q16.

$H_2(g) + F_2(g) = 2HF(g)$

The reaction starts with 2 mol of HF in a 5 L container. When the equilibrium is established and the temperature is decreased to the initial temperature, the K_c value is found to be 100. What is the equilibrium concentrations of HF?

A) 0,33M
B) 0,66M
C) 0,2M
D) 0,4M

Q17.

Under standard conditions, the heat of complete combustion of white phosphorus is 760.1 kJ/mol, and the heat of complete combustion of black phosphorus is 722.1 kJ/mol. What is the heat of the transformation of black phosphorus into white phosphorus under standard conditions?

A) -38 kJ/mol
B) 38 kJ/mol
C) -19 kJ/mol
D) 19 kJ/mol

Q18.

During the thermal decomposition of potassium chlorate ($KClO_3$), oxygen gas is released and potassium chloride is formed as a residue. Derive the balanced chemical equation for this decomposition reaction. Additionally, calculate the mass of oxygen gas liberated when 12.25 g of $KClO_3$ is heated.

A) $2KClO_3 \rightarrow 2KCl + 3O_2$; Oxygen mass = 4.8 g
B) $KClO_3 \rightarrow KCl + O_2$; Oxygen mass = 1.4 g
C) $2KClO_3 \rightarrow KClO_4 + KCl$; Oxygen mass = 5.6 g
D) $KClO_3 \rightarrow KCl + 1.5O_2$; Oxygen mass = 4.2 g

Q19.

To an acidified solution containing 0.543 g of a certain salt composed of sodium, chlorine, and oxygen, a potassium iodide solution was added until iodine release ceased. The mass of the iodine formed was 3.05 g. Determine the formula of the salt. By what percentage will the mass of the solid substance decrease upon the complete thermal decomposition of the original salt?

A) 20,5%

B) 35,4%

C) 44,6%

D) 12,7%

Q20.

A 1.12 L STP mixture of acetylene and ethylene can react in the dark with 3.82 mL of bromine (density 3.14 g/mL). How many times will the volume of this same gas mixture decrease after passing it through an ammonia solution of silver oxide?

A) 2 times

B) 3 times

C) 4 times

D) 5 times