PEOPLES´ FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA

RUDN UNIVERSITY

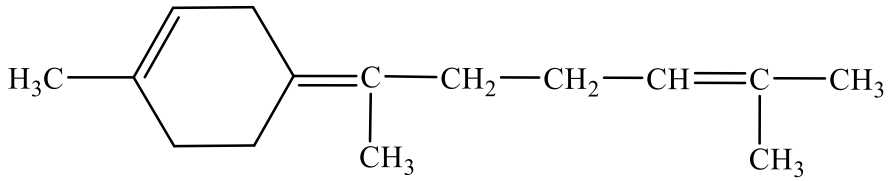
Tests for RUDN University Open Olympiad for Foreign Citizens

CHEMISTRY (B)

Variant 1

1.

Analyze the structure of the substance and do Task 1



GAMMA-BISABOLENE
(lemon oil component)

A		B		C	
What class/group of organic compounds does bisabolene belong to?		Indicate how many double bonds in a bisabolene molecule can be centres of geometric isomerism		Indicate the number of products which can be formed during the oxidation of bisabolene with an acidified solution of potassium permanganate	
1	Cycloalkynes	1	One double bond	1	1
2	Alkynes	2	Two double bonds	2	2
3	Dienes	3	All double bonds	3	3
4	Trienes	4	No geometric isomers	4	4

Answer:	**A**	**B**	**C**

2.

Match the formulas of the starting substances and the reaction products. Give your answer as a sequence of numbers corresponding to the letters in the alphabet.

Starting substances		Reaction products	
A)	$Ca(OH)_2 + N_2O_3$	1)	$Ca(NO_3)_2 + NH_4NO_3 + H_2O$
B)	$Ca + HNO_3$	2)	$Ca(NO_3)_2 + H_2O$
C)	$CaO + HNO_3$	3)	HNO_2
D)	$H_2O + NO_2 + O_2$	4)	$Ca(NO_2)_2 + H_2O$
E)	$H_2O + N_2O_3$	5)	HNO_3

Answer:	**A**	**B**	**C**	**D**	**E**

3.

cis-2-butene and _trans_-2-butene are isomers characterized by

1) optical isomerism
2) position isomerism
3) geometric isomerism
4) carbon skeleton isomerism

Answer:	

4.

When bromine Br2 reacts with propane when warmed, it mainly forms

1) CH_3-CH_2-CH_2Br and HBr
2) CH_3-CHBr-CH_3 and H_2
3) CH_3-CHBr-CH_3 and HBr
4) C_2H_5Br and HBr

Answer:	

5.

Litmus turns blue in the solution of

1) Na_2SO_4 2) Na_3PO_4 3) $NaHSO_4$ 4) NaCl

Answer:	

6.

In what order will the following ions be discharged at the cathode:

1) Fe^{2+}, 2) Zn^{2+}, 3) Ni^{2+}, 4) Cu^{2+}?

Give your answer as a sequence of four numbers.

Answer:	

7.

In the transformation scheme: toluene $\xrightarrow{X}$ 4- nitrotoluene $\xrightarrow{Y}$ 4- nitrobenzoic acid, substances X and Y are:

1) $HNO_{3\,(conc.)} + H_2SO_{4\,(conc.)}$ 2) $HNO_{3\,(dil.)}$ 3) $KMnO_4 + H_2SO_4$
4) $KMnO_4 + KOH$ 5) KNO_3

Answer:	

8.

The rate of reaction of zinc granules with 10% solutions of the two following acids is minimal

1) hydrofluoric acid
2) hydrochloric acid
3) acetic acid
4) sulfuric acid
5) nitric acid

Answer:	

9.

Match the substances and the sign of the reaction occurring between them.

A) sodium carbonate$_{(aq)}$ and hydrochloric acid
B) potassium hydroxide$_{(aq)}$ and zinc hydroxide
C) carbon dioxide and calcium hydroxide$_{(aq)}$
D) calcium nitrate$_{(aq)}$ and hydrochloric acid

1) dissolution of the precipitate
2) no visible signs
3) discoloration of the solution
4) gas evolution
5) formation of a white precipitate

Answer:	**A**	**B**	**C**	**D**

10.

Match a reagent acting on ethanol and the resulting product or indicate that there is no reaction.

A) $H_2SO_{4(conc.)}$, 170 °C
B) NH_3, Al_2O_3, 350 °C
C) CuO, *t*
D) Na

1) ethanal
2) ethylene
3) sodium ethoxide
4) diethyl ether
5) ethylamine
6) no reaction

Answer:	**A**	**B**	**C**	**D**

11. 3 points

Using the electron balance method, write the reaction equation:

$$Cr_2(SO_4)_3 + KMnO_4 + \ldots \rightarrow K_2CrO_4 + \ldots + K_2SO_4 + H_2O$$

Determine the oxidizing and reducing agents.

12. 3 points

A solution is obtained by mixing 150 ml of a 14% solution of HNO_3 (ρ=1,080 g/ml) and 250 ml of a 4% solution of HNO_3 (ρ=1,022 g/ml). Calculate the mass fraction of acid in it.

Answer:		%

(Write down the number to the tenths.)

13. 3 points

The combustion of 46.8 g of hydrocarbon produced 32.4 g of water and carbon monoxide (IV).
Write the equation for the combustion reaction of hydrocarbons in general form, determine the amount of carbon and hydrogen atoms in a hydrocarbon, determine the volume of oxygen consumed (n.c.).

14. 2 points

The pH of the solution is 3.7. Calculate the concentration of hydrogen ions in the solution.

15. 4 points

Aluminum carbide was dissolved in hydrochloric acid. A sodium carbonate solution was added to the resulting solution until a white precipitate formed. The white precipitate was filtered and calcined. The resulting solid was dissolved in sodium hydroxide solution. Write the equations for the four reactions listed.