



TEST IN CHEMISTRY

2015

I n s t r u c t i o n s

You are given the test booklet and the answer sheet.

Read the description of the task types carefully.

Take into consideration that **only the answer sheet will be marked.**

Attention: Do not fold the answer sheet.

The answers which are written (or circled) in the test booklet will not be marked! The test booklet can only be used as a working sheet (draft) only!

Fill in the answer sheet attentively! Write clearly, use the space given!

Do not write your name or surname. The answer sheet which has an applicant's name and/or surname, or any other means of personal identification (e.g. a nick name) will not be marked!

You are given 3 hours and 30 minutes for the test.

We wish you success!

Instruction for the items 1–30:

The following tasks include a question and four suggest answers, only one of which is correct.

Find the cells which correspond to the answers chosen by you on the answer sheet and put **X**.

1. Four consecutive processes are given:

- I. Methane formed as a result of bacterial decomposition of the plant residues is delivered to thermal powerstation.
- II. In thermal powerstation the methane is burning and the emitted warmth heats water in a boiler.
- III. Water begins to boil and the formed steam rotates the generator turbine.
- IV. The generator transforms mechanical energy into the electric power.

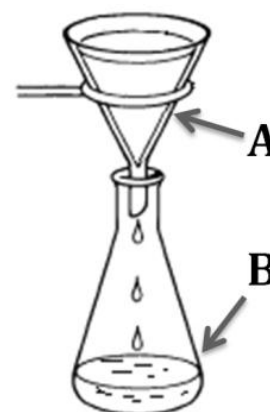
In which process does the **chemical phenomenon** take place?

- a) in I only
- b) in II only
- c) both in I and II
- d) both in II and IV

2. Water was added to solid mix, which contained NaCl and AgNO_3 (molar ratio was 1:1). The obtained mix was carefully mixed and filtered.

Which salt will stay on the filter and which will go into the flask?

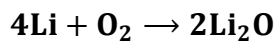
	A (on the filter)	B (into the flask)
a)	NaCl	AgNO_3
b)	AgNO_3	NaCl
c)	NaNO_3	AgCl
d)	AgCl	NaNO_3



3. How the molar mass of substance is expressed?

- a) mol b) g c) g/mol d) g · mol

4. The balanced equation for the reaction is



How many moles of oxygen will be needed to burn 1 mol of lithium?

- a) 1/4 mol
b) 1/2 mol
c) 2 mol
d) 4 mol

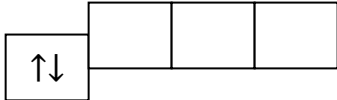
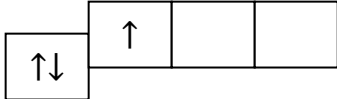
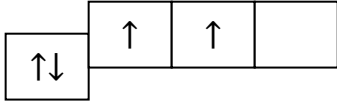
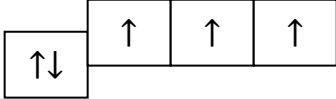
5. The unknown element **X** is in **VIA group** of the long period of a periodic table. According to these data, what formulas correspond to the highest oxide and volatile hydrogen compound of this element?

- a) XO_2 and XH_2
b) XO_2 and XH_3
c) XO_3 and XH_2
d) XO_3 and XH_3

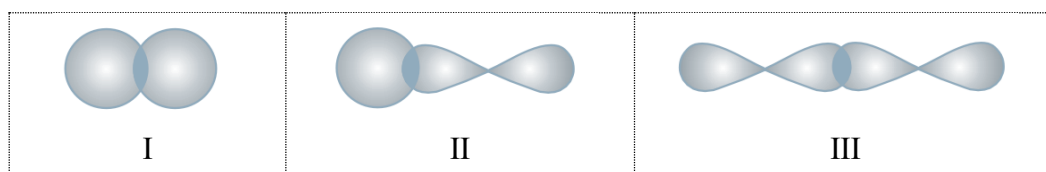
6. Which element is **X**, if the atomic nucleus of its isotope ^{81}X contains 46 neutrons?

- a) Br b) Te c) Pd d) I

7. How are the electrons allocated on 2s and 2p sublevels in **boron** atom?

- a) 
- b) 
- c) 
- d) 

8. Three cases of an overlap of electronic orbitals are given:



In which case is σ (sigma) bond formed?

- a) in I only
- b) in II only
- c) both in I and III
- d) in I, II and III

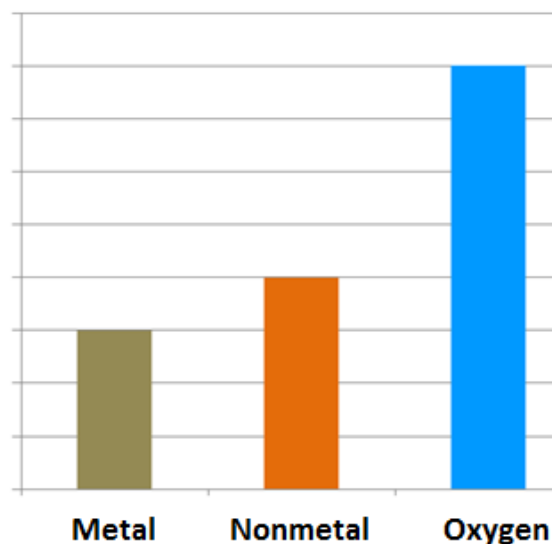
9. Which of the following particles contains the same number of electrons as the ion of Al^{3+} ?

- a) Na^0
- b) S^{2-}
- c) Ar^0
- d) F^-

10. The ratio of mass of metal, nonmetal and oxygen in unknown salt is shown on the diagram.

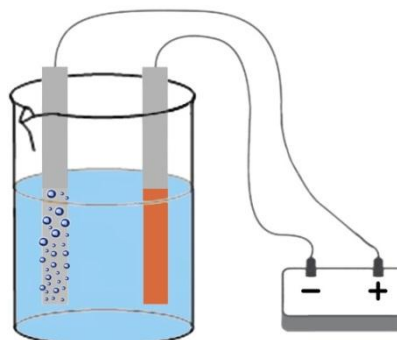
Which salt composition is depicted on this diagram?

- a) $MgCO_3$
- b) $CaCO_3$
- c) $MgSO_4$
- d) $CaSO_4$



11. What will be formed at **the anode** as a result of an electrolysis of aqueous solution of $CuSO_4$?

- a) Cu
- b) H_2
- c) O_2
- d) H_2S



12. The following simpler substances are given:

Al	Na	Fe	Cu
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Which of the above is /are characterized with electronic conductivity?

- a) Cu only
- b) Cu and Al
- c) Cu, Al and Fe
- d) all of them

13. The following compounds are given:

NH ₃	HCl
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Which of the covalent bond species are they in molecules of these compounds?

- a) polar in both
- b) nonpolar in both
- c) nonpolar in NH₃, polar in HCl
- d) polar in NH₃, nonpolar in HCl

14. The following compounds are given:

Fe	FeO	Cu	CuO
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Which of them can form compound with composition of **XCl₂** as a result of the reaction with the hydrochloric acid?

- a) FeO and CuO
- b) Fe, FeO and CuO
- c) Cu, FeO and CuO
- d) all of them

15. Which of the following properties **are characteristic for ammonia (NH₃)**?

- a) it is more dense than air and reacts with alkali
- b) it is more dense than air and reacts with acid
- c) it is less dense than air and reacts with alkali
- d) it is less dense than air and reacts with acid

16. The following salts are given



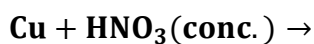
Which of the following statements is correct for these salts?

- a) I is neutral salt, II is acid salt
- b) I is acid salt, II is neutral salt
- c) both are acid salts
- d) both are neutral salts

17. How will **litmus** be coloured in the following aqueous solutions?

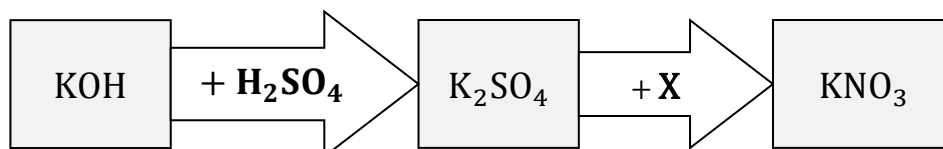
	Aqueous solution of CH_3COOH	Aqueous solution of HCl
a)	blue	purple (violet)
b)	blue	red
c)	red	purple (violet)
d)	red	red

18. Which substance will be released as **gas** as a result of reaction between concentrated nitric acid and copper?



- a) H_2 b) NH_3 c) NO_2 d) N_2O_5

19. The scheme of compounds transformation is



Which of the following compounds can compound **X** be, if reactions occur in aqueous solutions?

- a) HNO_3
- b) $\text{Al}(\text{NO}_3)_3$
- c) $\text{Mg}(\text{NO}_3)_2$
- d) $\text{Ba}(\text{NO}_3)_2$

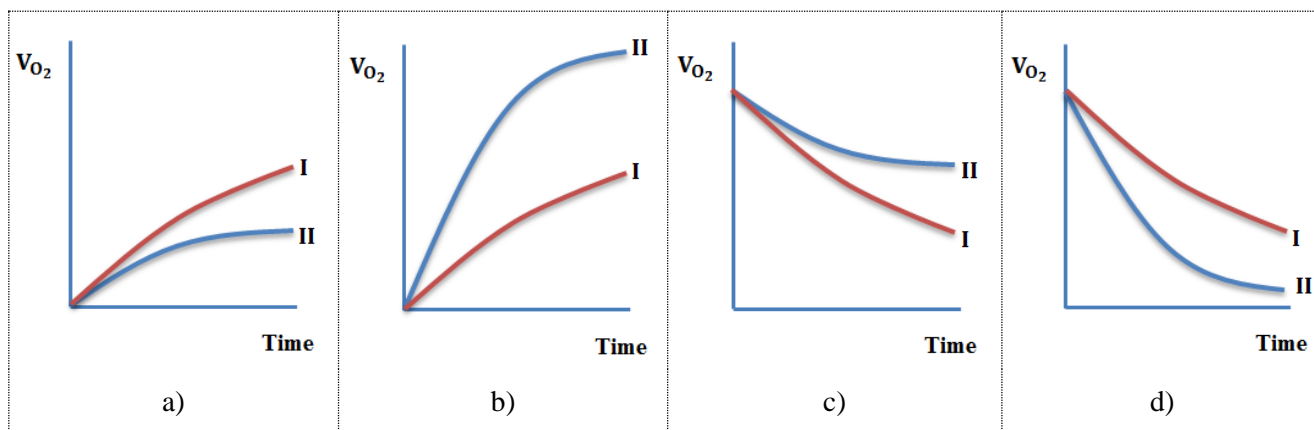
20. The decomposition reaction of hydrogen peroxide ($2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2\uparrow$) was carried out in identical physical conditions via two ways:

I – without catalyst

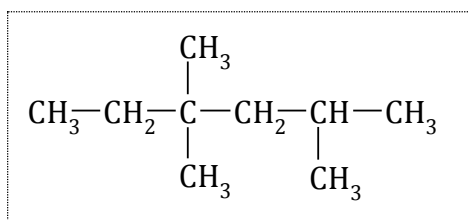
II – with catalyst

The volume of the oxygen that was released as a result of reaction was measured in each case. According to the obtained data the curves of reaction rates were depicted on a diagram. The rate of reaction carried out via I way was depicted as a red curve, and the rate of reaction carried out via II way was depicted as a blue curve.

Which of following diagrams correctly represents the dependence of total volume of the released oxygen on time?

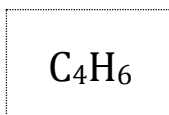


21. Which of the following is the correct name for the hydrocarbon with a formula



- a) 2,4,4-trimethylhexane
- b) 3,3,5-trimethylhexane
- c) 2,4,4-trimethylnonane
- d) 3,3,5-trimethylnonane

22. The formula of the hydrocarbon is



Which of the following could be **homologue** of the above hydrocarbon?

- a) propyne
- b) propene
- c) butane
- d) butene

23. Which of the following hydrocarbons can decolourize the bromine water?

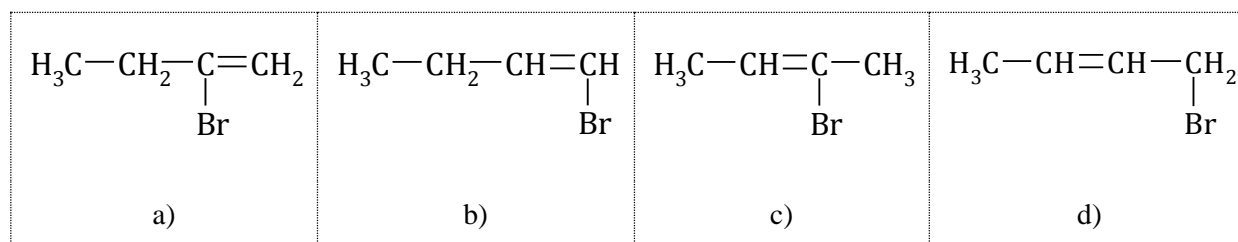
I – Hexene

II – Hexyne

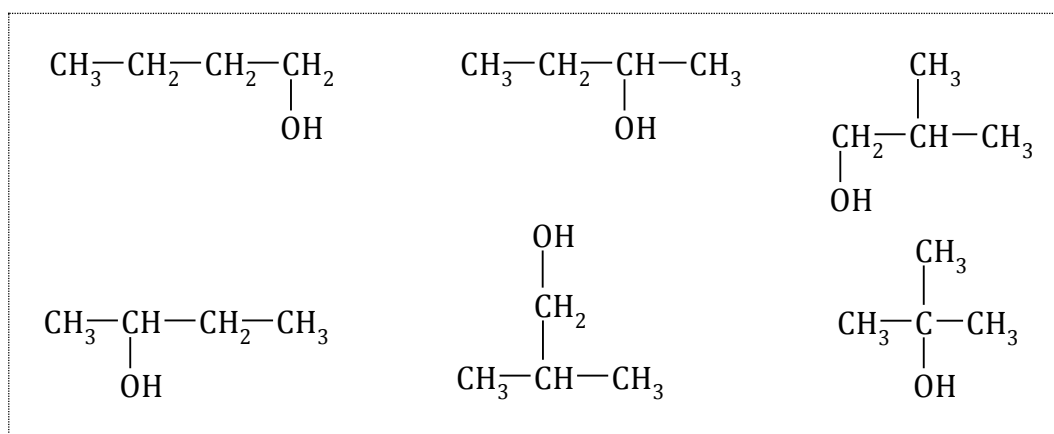
III – Benzene

- a) I only
- b) both I and II
- c) both I and III
- d) both II and III

24. Which of the following compounds is preferably formed as a result of the addition reaction between 1 mol of 1-butyne and 1 mol of HBr?

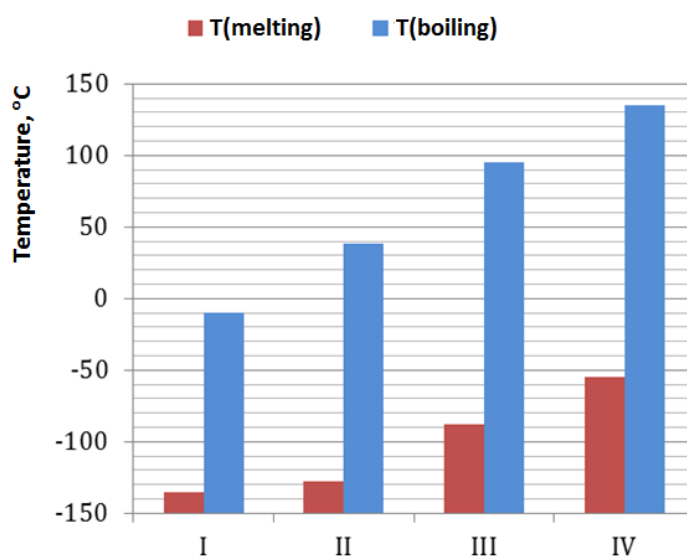


25. How many different substances are represented by the following formulas?



- a) three
- b) four
- c) five
- d) six

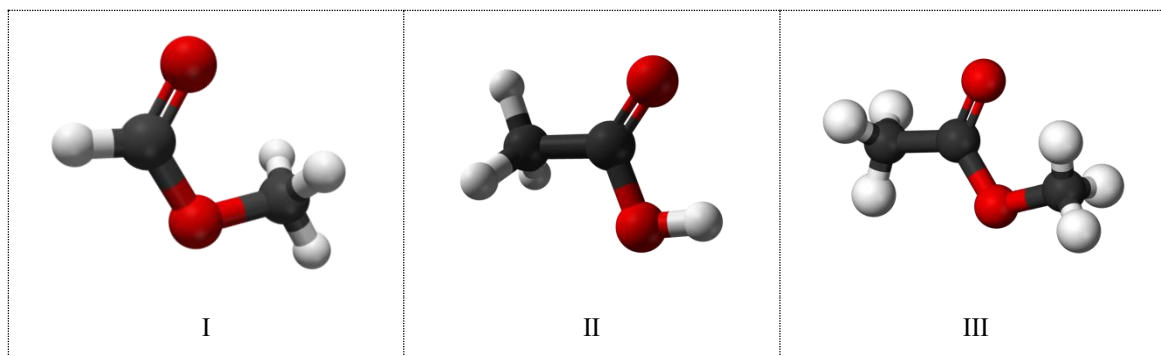
26. The melting and boiling points of some alkanes are shown on the diagram:



Which of the following statements is true according to the above diagram?

- a) All four alkanes are in gas state at standart conditions (STP)
- b) All four alkanes are in liquid state at STP
- c) Only the I alkane is in gas state, and other three are in liquid state at STP
- d) Only the I alkane is in liquid state, and other three are in gas state at STP

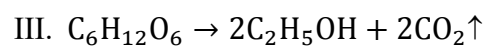
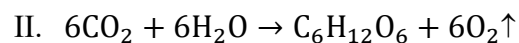
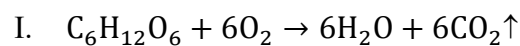
27. Models of molecules in which black coloured balls represent atoms of carbon, white – hydrogen and red – oxygen are given:



Which of the model/models corresponds/responds to the ester?

- a) both I and II
- b) both I and III
- c) III only
- d) I, II and III

28. The chemical reactions describing the biological processes are given:



Which of the above reaction(s) describe(s) the process of photosynthesis?

- a) I only
- b) II only
- c) both I and II
- d) both II and III

29. The following carbohydrates are given:

I – Sucrose

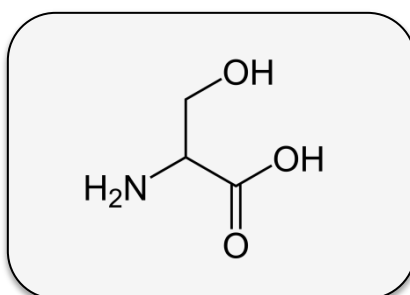
II – Starch

III – Cellulose

Which of the above carbohydrates forms **only** glucose as a result of the complete hydrolysis?

- a) both I and II
- b) both I and III
- c) both II and III
- d) I, II and III

30. The linear structure of carbon skeleton of organic compound is given:



Which of the following is the correct molecular formula of this compound?

- a) C₃H₅NO₃
- b) C₃H₇NO₃
- c) C₅H₅NO₃
- d) C₅H₇NO₃

Instruction for the items 31–34:

Match the objects/phenomena given in two lists. Fill in the table in the following way:

Match each object/phenomena with **the letters** with the corresponding object/phenomena with **the numbers**. Mark the corresponding cell of the table by **X**.

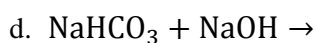
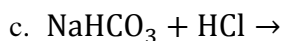
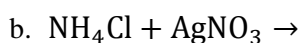
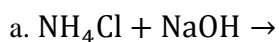
Please consider that the object/phenomena from one list may correspond to one, more than one, or NO object/phenomena from the other list.

31. Match the oxygen compounds (1–3) with the types of oxides (a–d).

Mark the corresponding cell of the table by **X**:

	a	b	c	d
	Neutral oxides	Basic oxides	Acidic oxides	Amphoteric oxides
1	NO			
2	ZnO			
3	SrO			

32. The incomplete chemical reactions that occur in aqueous solutions are given:



Which of the above reaction(s) occur(s) with release of gas?

Mark the corresponding cell of the table by **X**:

a	b	c	d

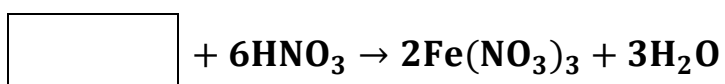
35. Fill in the table; write the valency and the oxidation state of indicated elements in the blank cells.

	a	b	c	d
Compound	CaH ₂	(CH ₃ COO) ₂ Ca	K ₂ Cr ₂ O ₇	CH ₃ Cl
Element	Ca	Ca	Cr	C
1 Valency of the element				
2 Oxidation state of the element				

36. Fill in blank cells of the table:

a	b	c
Formula of particle	Formula of electron configuration	The number of protons in particle
F ⁰		
	1s ² 2s ² 2p ⁶	12
S ²⁻		16

37. Write the formula of the substance that is missing in the chemical equation (Write the formula in the cell)



38. The formula of salt is Na_3PO_4 .

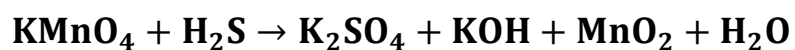
<p>38.1. Write the name of this salt</p>	<p>38.2. Write formulas of corresponding hydroxide and acidic oxide</p>
<p>38.3. Write reaction between this salt and calcium chloride</p> <p>a) as molecular equation</p> <p>b) as net ionic equation</p>	

39. Present the following schemes as chemical equations.

Sign \cdots means one substance only.

<p>39.1. Complete and balance the equation for the reaction according to the following scheme:</p> $\cdots + \text{Acid} \rightarrow \text{K}_3\text{PO}_4 + \cdots$ <p><i>Note: According to this scheme there are several possible answers. Write only one answer.</i></p>
<p>39.2. Complete and balance the equation for the reaction according to the following scheme:</p> $\cdots + \cdots \longrightarrow \text{Lead(II) sulfate} + \text{Aluminium nitrate}$

40. The unbalanced equation for the oxidation-reduction reaction is



40.1. Compose the electronic balance

40.2. Write the balanced equation for the above reaction

41. The scheme of transformation of organic compounds is



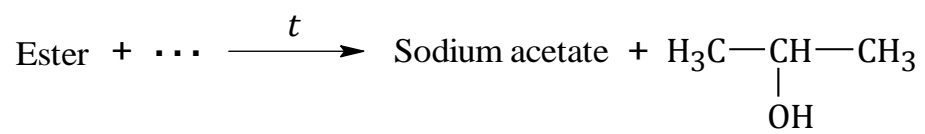
According to this scheme:

41.1. Write equation for I reaction

41.2. Write equation for II reaction

41.3. Write equation for III reaction

42. Complete the equation for the reaction according to the following scheme:
(Present the formula of the ester as a structural formula)



Instruction for the items 43–45:

In the corresponding space of the answer sheet briefly and clearly state the way for solving the problem.

Otherwise, the answer will not be marked!

Some problems may have several ways for solution. In such cases, it is enough to show one of the ways only.

43. 21.6 g of a nitrogen(V) oxide was added to 178.4 g solution that contains 0.2 mol of sodium alkali.

43.1. Calculate of the molar ratio of the initial compounds

43.2. Calculate, whether any of the initial compounds is excess.

43.3. Calculate the composition of the obtained solution (in percentages).

44. The aqueous solution of aluminium sulfate and potassium sulfate contains 0.7 mol of sulfate ions and 0.2 mol of potassium ions. How many of the aluminium ions are in this solution?

45. Relative density of the unknown alkene with respect to nitrogen equals 2.
What is the volume (at STP) of carbon dioxide, produced as a result of complete burning of 14 g of the given alkene?