Azonosító jel:

ÉRETTSÉGI VIZSGA • 2008. május 15.

KÉMIA
ANGOL NYELVEN

EMELT SZINTŰ ÍRÁSBELI VIZSGA

2008. május 15. 8:00

Az írásbeli vizsga időtartama: 240 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

OKTATÁSI ÉS KULTURÁLIS MINISZTÉRIUM

Important informations

- The examination test should be solved within 240 minutes, after 240 minutes the work should be finished.
- The sequence of answering the questions is free.
- For the solution of the problems calculators without text-storage capability and four-place logarithm tables can be used. Use of other electronic or written help is forbidden.
- Read the introductory text of the questions carefully and keep its instructions.
- Write the answers in ink. If you cancel an answer or part of an answer, the canceled work can not be evaluated.
- For the calculations, you can get maximum number of points only if the main steps of the calculation are indicated, too.
- Please, don't write anything into the gray squares.

1. Essay

Read the following text carefully and answer the questions!

Valuable hydrocarbons from natural gas – without any oxidation

For the chemical industry, ethene, ethyne and carbon monoxide are produced from the methane component of natural gas –quite expensively. During this process, part of the methane is wasted because it yields carbon dioxide which is a less valuable substance for the industry. In the last years, several efforts were made – with not to much success - to produce long-chain hydrocarbons from methane avoiding oxidation.

According to a report of researchers of the University of Nancy, they managed to do it now. They were simply rinsing methane over a platinum catalyst called Euro Pt-1 which had already been used to several purposes. During this process, part of the gas is converted immediately to ethane (and hydrogen). However, some methane molecules are also adsorbed on the surface of platinum and some of them lose a hydrogen atom. The produced active, unsaturated aliphatic particles recombine with each other to give longer hydrocarbon molecules which can be washed off the surface of the catalyst by carbon dioxide. Still unsaturated hydrocarbons can be also removed from the surface of the catalyst. These compounds can be saturated using hydrogen. The composition of the product strongly depends on the conditions of the reaction.

Reductive coupling of the methane molecules has several advantages over the oxidative one. For example, instead of 800 ^{o}C the reaction occurs already at 250 ^{o}C, the unreacted methane can be recycled into the process without any loss and the prepared products are the same as otherwise produced from mineral oil.

The platinum catalyst is relatively persistent but not yet suitable to be used for the production of long-chain hydrocarbons on industrial scale.

Élet és Tudomány, Oct. 11. 1991, Bild der Wissenschaft

a) Write the reaction equation of the industrial preparation of acetylene from methane.

b) According to the text, which compounds were prepared from methane in the presence of oxygen?

c) What are the disadvantages of the oxidative process?

d) Which compounds were prepared by the researchers of the University of Nancy?

e) What are the advantages of the reductive process?

f) Name a disadvantage of the reductive process.

10 points	

2. Analytical question and calculation

During the dissolution of metals in nitric acid, beside metal nitrates different gases are produced depending on the standard potential of the metal and the concentration of the nitric acid. These gases are: hydrogen, nitrogen, different nitrogen compounds (mostly nitrogen oxides) and their mixtures.
Based on the informations of the following problem, write and balance the equation of the dissolution of copper in nitric acid of the given concentration and answer the listed questions.
Copper powder is dissolved in 56.0 mass% nitric acid having a density of 1.26 g/cm^3. The evolved gas mixture of nitrogen monoxide and nitrogen dioxide has a density of 1.55 g/dm^3 at 25 ^{o}C and standard pressure.

a) State whether copper can evolve hydrogen from a nitric acid solution of any concentration. How did you come to this conclusion?

b) Calculate the mol percent composition of the evolved gas mixture.

c) State whether the components of the evolved gas mixture can be separated by bubbling through a gas washer containing water. Why?

d) Write balanced equations of the reactions occurring during the dissolution of copper.

11 points	

3. Panel question

In the empty cells of the table, write your answers given to the aspects of the comparison.

	NH_3	HCl
Phase state (at 25 °C and standard pressure)	**1.**	**2.**
In solid state the strongest attracting force in the lattice	**3.**	**4.**
Solubility in water (at 25 °C and standard pressure): good or bad	**5.**	**6.**
pH of its aqueous solution: acidic, basic or neutral	**7.**	**8.**
Adding silver nitrate solution to its aqueous solution, in both cases a precipitate is formed. **– Colour of the precipitate** **– Ionic equation of the occurring reaction**	**9.** **10.**	**11.** **12.**
Trivial name of any salt **(The two answers should be different!)**	**13.**	**14.**
Their reaction with each other **– Equation of the reaction** **The product of the former reaction is dissolved in water.** **– pH of the aqueous solution: acidic, basic or neutral** **– Explain the pH (writing ionic equation)**	**15.** **16.** **17.**	

15 points	

4. Panel question

In the variety of our diet, there are more and more sorts of milk products. A lot of people like different-tasted yogurts. They contain a lot of valuable nutrients. They contain proteins, carbohydrates (in the low-energy versions, there are sweeteners instead of sugar), organic acids, fats, pieces of fruits (or flavouring substances replacing the fruits).
In the table below, some organic components of a fruit-tasted yogurt are collected.
Based on the given informations, identify and characterize the compounds according to the aspects listed in the table.

Empirical formula of the compound	**1.**	**$C_3H_6O_3$**	**$C_7H_{14}O_2$**	**$C_{57}H_{110}O_6$**
Name	**Sucrose**	**2.**	**3.**	
Exact name of the group of the compounds	**4.**	**5.**	**6.**	**7.**
State whether the molecule contains a chiral C atom.	**8.**	**yes**	**9.**	**10.**
State whether the compound gives a positive silver mirror test.	**11.**			
Products of its hydrolysis	**acidic hydrolysis: 12. and 13.**	**does not hydrolyse**	**basic (NaOH) hydrolysis: n-pentanol and sodium acetate**	**basic (NaOH) hydrolysis: glycerol and 14.**
Its role(s) in yogurt as a foodstuff	**15.**	**gives acidic taste**	**fruit flavouring substance**	**16.**

14 points	

5. Simple choice

Write the only correct letter mark into the empty cell on the right-hand side of the answers.

1. How many unpaired electrons are contained in the ground state $_{15}$P atom?

A) 0
B) 1
C) 2
D) 3
E) 5

2. Which of the following substances has the smallest size?

A) Oxide ion
B) Neon atom
C) Sulfide ion
D) Magnesium ion
E) Argon atom

3. Which line contains particles having the same spatial structure?

A) NH_3, PH_3, SO_3
B) CH_4, NH_4^+, PO_4^{3-}
C) CO_2, SO_2, C_2H_2
D) CO_3^{2-}, SO_3, H_3O^+
E) CS_2, H_2S, SO_2,

4. Which molecule does *not* contain delocalized electrons?

A) Ethene
B) Pyrrol
C) Benzene
D) Phenol
E) Formamide

5. Which of the following substances has the strongest attractive forces in the lattice structure in the solid state?

A) Formaldehyde
B) Methanol
C) Acetic acid
D) Glycine
E) Methylamine

6. Which of the following processes is always exothermic?

A) Sublimation
B) Combustion
C) Dissolution
D) Melting
E) Formation of cations from free atoms

7. Which of the following gases has no environmental pollutant effect?

A) SO_2
B) CO
C) NO_2
D) Ne
E) HCl

8. Which of the following compounds is a constitutional isomer of 2-methylbuta-1,3-diene (2-methyl-1,3-butadiene)?

A) cyclopentene
B) but-2-yne (2-butyne)
C) 2,3-dimethylbut-2-ene (2,3-dimethyl-2-butene)
D) 2,2-dimethylpropane (2,2-dimethyl propane)
E) 2-methylbut-1-ene (2-methyl-1-butene)

9. Which of the following processes is not a redox reaction?

A) Disinfection using hypochlorite.
B) Dissolution of limescale deposit with acetic acid.
C) Acetification of wine.
D) Rusting of an iron gate.
E) Bleaching hair.

10. Which of the following organic substances has the best solubility in water (at 25 °C and standard pressure)?

A) Pyridine
B) Phenol
C) Ethyl acetate
D) Diethyl ether
E) Palmitic acid

11. In which case is iron saved most effectively from corrosion?

A) If keeping its surface wet.
B) If coating its surface with a laquer.
C) If coating its surface with zinc.
D) If coating its surface with tin.
E) If painting its surface with oil-colour.

12. Which of the following statements is correct from chemical point of view?

A) Sugar is molten in tea.
B) A limescale deposit is actually calcium.
C) While preparing cocoa drink, cocoa forms a suspension with milk.
D) By spraying hot paraffin oil in air, a fume is formed.
E) In river water, there is more sugar than in sea water.

12 points	

6. Calculation problem

The nitrogen content of an aliphatic, saturated, monovalent primary amine is 31.1 mass%. Determine its empirical formula and name.

6 points	

7. Calculation problem

121.6 mg of a partly oxidized calcium sample was dissolved in 500 cm^3 water. The volume of the solution remained practically unchanged. The pH of the solution was measured to be 12.0. (The produced compound is supposed to dissociate completely.)

a) Write balanced equation of the occurring chemical reactions.

b) Calculate the mol percent composition of the sample.

c) What percentage of the calcium sample was oxidized?

10 points	

8. Calculation problem

200 gram of a saturated sodium carbonate solution is electrolyzed using platinum electrodes at 80.0 ^{o}C by passing a current of 2.00 A. During the electrolysis, water is decomposed.
At 80.0 ^{o}C, the concentration of saturated sodium carbonate solution is 31.4 mass%, the crystallized salt has a stoichiometric composition, one mol is crystallized with 10 mol of water.

a) What mass of water was decomposed during electrolysis, if 13.3 gram crystalline salt was separated from the solution?

b) What time was needed for this electrolysis?
This part of the calculation can be solved independently from part a). In this case, calculate what time should have been needed to decompose 4.05 gram water.

10 points	

9. Calculation problem

By mixing 1.00 mol propan-2-ol and 2.00 mol propanoic acid, an equilibrium system is formed which contains 41.8 mass% ester.

a) Write constitutional formulae of the reacting substances and write the equation of the ester formation.

b) How many % of the alcohol was converted?

c) Calculate the equilibrium constant of the ester formation.

10 points	

Attention, please! It should be filled by the evaluating teacher.

	maximum points	reached points
1. Essay	**10**	
2. Analytical question and calculation	**11**	
3. Panel question	**15**	
4. Panel question	**14**	
5. Simple choice	**12**	
6. Calculation problem	**6**	
7. Calculation problem	**10**	
8. Calculation problem	**10**	
9. Calculation problem	**10**	
Correct use of notations and units	**1**	
For calculations, if the results have a precision corresponding to that of the given data	**1**	
TOTAL	**100**	

marking teacher

Date: _____

	elért pontszám reached points	programba beírt pontszám points written in the program
Feladatsor Test		

javító tanár
marking teacher

jegyző
underwriter

Dátum/Date: ..... Dátum/Date: .....