

ÉRETTSÉGI VIZSGA • 2008. május 15.

**KÉMIA
ANGOL NYELVEN**

**EMELT SZINTŰ ÍRÁSBELI
ÉRETTSÉGI VIZSGA**

**JAVÍTÁSI-ÉRTÉKELÉSI
ÚTMUTATÓ**

**OKTATÁSI ÉS KULTURÁLIS
MINISZTERIUM**

Basic guidelines of the evaluation of written exercises

Evaluation of the written test-papers should follow the distributed correction instructions

Evaluation of the theoretical questions

- No deviation from the correction instruction is allowed.
- $\frac{1}{2}$ points can not be given, the questions can only be evaluated according to the allowed part-points in the correction key.

Evaluation of the calculation problems

- Test-papers following the way of solution of the correction instruction, must be evaluated according to the part-points of the correction key.
- Beside objectivity, attention must be paid to **honesty**. During the evaluation, punishment with a pedagogical intention can not be applied!
- In a given – errorless – solution no points can be subtracted because of the lack of **not required** (but in the correction key given) subresults. (Those subresults help only the evaluation of partial solutions.)
- Approaches differing from the correction key – if correct – get maximum points or part-points according to the nodes of the correction key.
- For a bare result **without any derivation or explanation** only 1-2 points can be given **as a maximum** according to the the points of that result in the correction key!
- A calculation problem gets maximum points even if it contains a **theoretically incorrect reaction equation** which is not necessary to the solution (and the question did not ask to write it).
- In case of a problem containing several subproblems, part-points for a given subproblem can be given even if the candidate makes the calculation **using an incorrect result of a foregoing subproblem** – if the solution doesn't lead to a contradiction.
- Relations which can be regarded as **trivial** can be used without any derivation in calculation problems of the maturity examination, and they get maximum points – even without detailed explanation. For example:
 - conversion of mass, number of moles, volume and number of particles,
 - trivial facts following from Avogadro's law (equal stoichiometric ratios or volume ratios in case of gases under the same conditions, and so on),
 - using the mixing (dilution) equation, and so on.
- For each **calculation error** maximum 1-2 points can be subtracted (if the candidate continues the calculation correctly with the incorrect subresult, he or she should get all other part-points for the further part of the calculation)!
- In case of a **smaller error**, the candidate doesn't get points for the incorrect part of the calculation, but the following steps of the calculation using incorrect data should get the corresponding points. A smaller error is for example:
 - incorrect use of density in the conversion of volume and mass,

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- other incorrect simple mathematical procedure,
 - incorrectly balanced equation,
which doesn't lead to an **obviously** unrealistic result.
- In case of a **gross error**, the candidate doesn't get further points **for the given subcalculation** as allowed in the correction key even if he continues the calculation correctly with the incorrect subresult. A gross error is for example:
 - a calculation based on an **incorrect** (e. g. not occurring) **reaction equation**,
 - if the result **estimated** from the data is **obviously unrealistic** (for example if the mass of the solution calculated from the mass of the solute is smaller than the mass of the solute dissolved in it, and so on).(The solution of further subcalculations which can be regarded as independent calculation units can be evaluated of course also in this case according to the previously discussed principles. Points can be given – if calculating correctly with incorrect subresults - if the calculation doesn't lead to unrealistic results.)

1. Essay (10 points)

- a) $2 \text{CH}_4 = \text{C}_2\text{H}_2 + 3 \text{H}_2$ *1 point*
- b) Ethene, ethyne and carbon monoxide. **(the three answers together)** *2 points*
- c) The process is expensive (or requires a high temperature),
part of the methane is wasted,
The method can not be used to produce long-chain hydrocarbons. *1 point*
1 point
1 point
- d) Long chain hydrocarbons. *1 point*
- e) The reaction occurs at lower temperatures than the oxidative method,
there is no waste of methane,
the platinum catalyst is persistent
a variety of alkanes can be prepared
(one answer: 0 point, two or three answers: 1 point) *2 points*
- e) It can not yet be used on industrial scale *1 point*

2. Analytical question and calculation problem (11 points)

- a) No, because the standard potential of copper is positive. **(only with explanation!)** *2 points*
- b) $M = \rho \cdot V_m = 1.55 \text{ g/dm}^3 \cdot 24.5 \text{ dm}^3/\text{mol} = 38.0 \text{ g/mol}$ *1 point*
in case of x mol NO and $(1 - x)$ mol NO_2 :
 $30x + 46(1 - x) = 38$ *1 point*
 $x = 0.500 \text{ mol}$
- The evolved gas mixture contains the two components in **50.0-50.0 mol %** . *1 point*
- c) Yes, because NO_2 is dissolved in water but NO is not dissolved.
(only with explanation!) *2 points*
- d) $3 \text{Cu} + 8 \text{HNO}_3 = 3 \text{Cu}(\text{NO}_3)_2 + 2 \text{NO} + 4 \text{H}_2\text{O}$ *2 points*
 $\text{Cu} + 4 \text{HNO}_3 = \text{Cu}(\text{NO}_3)_2 + 2 \text{NO}_2 + 2 \text{H}_2\text{O}$ *2 points*
- Writing correct formulas** *1 point*
- Correct balancing of the equation** *1 point*

3. Panel question (15 points)

1. Gas
2. Gas **the two answers together: 1 point**
3. Hydrogen bonding **1 point**
4. Dipole-dipole interaction **1 point**
5. Good
6. Good **the two answers together: 1 point**
7. Basic
8. Acidic **the two answers together: 1 point**
9. A brown precipitate is formed. **1 point**
10. $2 \text{Ag}^+ + 2 \text{OH}^- = \text{Ag}_2\text{O} + \text{H}_2\text{O}$ **2 points**
(For the equation $\text{Ag}^+ + \text{OH}^- = \text{AgOH}$ **1 point** can be given,
in this case, for denoting a **white precipitate** in the **9.** question **1 point** can be given.)
11. A white precipitate is formed. **1 point**
12. $\text{Ag}^+ + \text{Cl}^- = \text{AgCl}$ **1 point**
13. For example ammonium chloride. **1 point**
14. For example table salt (common salt, sodium chloride). **1 point**
15. $\text{NH}_3 + \text{HCl} \rightleftharpoons \text{NH}_4\text{Cl}$ **1 point**
16. Acidic **1 point**
17. $\text{NH}_4^+ + \text{H}_2\text{O} = \text{NH}_3 + \text{H}_3\text{O}^+$ **1 point**

4. Panel question (14 points)

1. $C_{12}H_{22}O_{11}$ *1 point*
 2. Lactic acid (2-hydroxypropanoic acid, α -hydroxypropanoic acid) *1 point*
 3. Pentyl acetate (pentyl ethanoate) *1 point*
 4. Disaccharide (saccharide, carbohydrate) *1 point*
 5. (Hydroxy) carbonic acid *1 point*
 6. Ester (fruit ester) *1 point*
 7. Ester (glycerile ester) *1 point*
 8. Yes *1 point*
 9. No
 10. No **9. and 10. only together: 1 point**
 11. No *1 point*
 12. Glucose (α -D-glucose)
 13. Fructose (β -D-fructose) **12. and 13. only together: 1 point**
- (Answers 12. and 13. can be inverted)**
14. Sodium stearate (or soap) *1 point*
 15. It is a nutrient (it increases nutritive value) and flavours (gives a sweet taste)
(the two answers together:) *1 point*
 16. It is a nutrient (it increases nutritive value) *1 point*

5. Simple choice (12 points)

1. D
 2. D
 3. B
 4. A
 5. D
 6. B
 7. D
 8. A
 9. B
 10. A
 11. C
 12. C
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6. Calculation problem (6 points)

- The molecule contains one single N atom,
 therefore, its molar mass: $(14.0 : 0.311) = 45.0 \text{ g/mol}$ *1 point*
- The molar mass of the (NH_2^-) amino group is 16.0 g/mol , *1 point*
- For the alkyl group, there remains $45.0 \text{ g/mol} - 16.0 \text{ g/mol} = 29.0 \text{ g/mol}$ *1 point*
- This is the ethyl group. *1 point*
- The chemical formula of the molecule is: $\text{C}_2\text{H}_7\text{N}$ *1 point*
- Its name is **ethylamine** *1 point*
- (Every other correct way of calculation can be accepted!)**

7. Calculation problem (10 points)

- a) Reaction equations: *1 point*
- $$\text{Ca} + 2 \text{H}_2\text{O} = \text{Ca}(\text{OH})_2 + \text{H}_2$$
- $$\text{CaO} + \text{H}_2\text{O} = \text{Ca}(\text{OH})_2$$
- 1 point*
- b) The amount of the produced OH^-
- $\text{pH} = 12.0 \rightarrow \text{pOH} = 2.00$,
- $c(\text{OH}^-) = 1.00 \cdot 10^{-2} \text{ mol/dm}^3$, *1 point*
- $n(\text{OH}^-) = cV = 0.00500 \text{ mol} = 5.00 \text{ mmol}$ *1 point*
- The number of moles of the mixture is half of that: 2.5 mmol *1 point*
- CaO: $x \text{ mmol}$
- Ca: $(2.50 - x) \text{ mmol}$ *1 point*
- The mass of the mixture is
- $56.08 x + 40.08 \cdot (2.50 - x) = 121.6 \text{ g}$ *1 point*
- $x = 1.34 \text{ mmol}$ *1 point*
- 53.6 %** of the mixture is **CaO**, **46.4 %** of the mixture is **Ca**. *1 point*
- c) $(1.35/2.50) \cdot 100.0 = \mathbf{53.6\%}$ of the Ca was oxidized. *1 point*
- (Every other correct way of calculation can be accepted!)**

8. Calculation problem (10 points)

- a) Molar mass of the crystalline salt or use of it *1 point*
 Its salt content is $13.3 \cdot \frac{106}{286} = 4.93$ gram *1 point*
 In the solution, there remained: $200 \cdot 0.314 - 4.93 = 57.9$ gram salt *1 point*
 The mass of the residual saturated solution: $57.9 : 0.314 = 184$ gram *1 point*
 The mass of decomposed water: $200 - 184 - 13.3 = 2.70$ gram *1 point*
(The result of a calculation with more significant figures is 2.40 g!)
- b) For the decomposition of 1 mol water 2 mol electrons are needed *1 point*
 $n(\text{water}) = 2.70 \text{ g} : 18 \text{ g/mol} = 0.150 \text{ mol}$ *1 point*
 $n(e^-) = 0.3 \text{ mol}$ *1 point*
 $t = Q : I = (0.3 \cdot 96500) : 2 = 14475 \text{ s}$ *1 point*
 For the electrolysis **241 minutes** were needed. *1 point*
 If the candidate calculates with 4.05 gram water,
 every subresult is increased 1.5 times,
 the correct final result is: 362 minutes
(If the candidate uses 2.40 g water for the calculation which was obtained as a result of part a), the time needed is 214 minutes.)
(Every other correct way of calculation can be accepted!)

9. Calculation problem (10 points)

- a) $\text{CH}_3\text{-CHOH-CH}_3$, $\text{CH}_3\text{-CH}_2\text{-COOH}$ *1 point*
 $\text{CH}_3\text{-CH}_2\text{-COOH} + \text{CH}_3\text{-CHOH-CH}_3 \rightleftharpoons \text{CH}_3\text{-CH}_2\text{-COO-CH(CH}_3)_2 + \text{H}_2\text{O}$ *1 point*
- b) The mass of 3.00 mol mixture is: $60.0 + 2 \cdot 74.0 = 208$ gram *1 point*
 The number of moles of the ester is: $(208 \cdot 0.418) \text{ g} : 116 \text{ g/mol} = 0.750 \text{ mol}$ *1 point*
 0.750 mol alcohol and acid were converted, the same number of moles of water was produced. *1 point*
 This means a **75.0%** conversion with respect to the alcohol. *1 point*
- c) In equilibrium, there are: $1.00 - 0.750 \text{ mol} = 0.250 \text{ mol}$ alcohol, *1 point*
 $2.00 - 0.750 \text{ mol} = 1.25 \text{ mol}$ acid, *1 point*
 0.750 mol ester,
 0.750 mol water.
- $$K = \frac{[\text{ester}] \cdot [\text{water}]}{[\text{alcohol}] \cdot [\text{acid}]} \quad (\text{or use of it}) \quad \text{1 point}$$
- $$K = \frac{0.75 \cdot 0.75}{0.25 \cdot 1.25} = 1.80 \quad \text{1 point}$$
- (Every other correct way of calculation can be accepted!)**

The precision of data in the final results:

- **7. Calculation problem:** 3 significant figures in the final results
- **8. Calculation problem:** 3 significant figures in the final results
- **9. Calculation problem:** 3 significant figures in the final results