

ÉRETTSÉGI VIZSGA • 2019. május 15.

**VEGYÉSZ
ISMERETEK
ANGOL NYELVEN**

**KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA**

2019. május 15. 8:00

Időtartam: 225 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

EMBERI ERŐFORRÁSOK MINISZTERIUMA

Important information

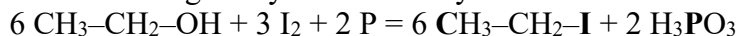
- You may solve the questions in any order you like. In certain places, the sub-questions may be solved even if the preceding sub-question has not been completed.
- You may use a non-programmable calculator to solve the questions, but no other aids are allowed.
- Read the introduction to questions carefully and comply with the instructions given.
- Write your solutions in blue or black pen. Drawings may also be done with black graphite pencil.
- Any solutions or sections of solutions that have been crossed out will not be given any points.
- Maximum points are only awarded for calculation questions if the main steps of calculation are shown in the solution.
- **Certain questions specify that points are deducted for wrong answers.**
- Make sure you manage the time available well; write legibly and attempt to convey your thoughts clearly and coherently.
- If possible, solve the questions in the space provided for this purpose. You may request additional pages if needed, but make sure you mark which question you are solving on the sheet. **Write your name on additional sheet as well.**

Good luck with your examination!

Question 1

20 points total

The chemical equation describing the synthesis of ethyl iodide is:



Read the description of ethyl iodide synthesis, and answer the questions.

3.01 g of red phosphorus and 30 cm³ of anhydrous ethanol (density 0.789 g/cm³) are added to a 100-cm³ round-bottomed flask. With the flask cooled from the outside with cold water, 38.0 g of iodine is added in small portions, within about half an hour, with continuous shaking.

After the addition of all the iodine, a reflux condenser is attached to the flask, and the mixture is gently boiled for one hour.

After boiling the flask is placed in cold water, and when the mixture has cooled, a still head is attached to it.

The reaction mixture is distilled using a water bath, while the receiving vessel is placed in water ice. In the distillate the raw product is coloured brown by unreacted iodine.

The raw product is washed once with 10 cm³ of 1% NaHSO₃ solution and then once with 10 cm³ of cold water.

Washed ethyl iodide is dried over anhydrous CaCl₂ and, after filtration into a distillation flask, it is distilled. The main distillation product is collected at 70–75 °C. The ethyl iodide obtained by this method is a colourless, highly refractive liquid that boils at 72 °C. Its density is 1.95 g/cm³.

A) Calculate the oxidation number of the atoms bolded in the chemical equation:

Phosphorus: Carbon: Iodine:.....

The electronegativity of both iodine and carbon is 2.5.

B) Underline the correct answer.

What type of crystal lattice does red phosphorus possess?

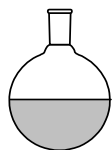
ionic lattice atomic lattice molecule lattice metal lattice

C) Underline the correct statement.

Red phosphorus is toxic.

Red phosphorus is non-toxic.

D) Complete the drawing of the distillation apparatus. Be sure to indicate the flow of cooling water in your drawing.



- E)** The brown colouration of the raw product has to be removed by washing with NaHSO₃. Complete and reorder the equation of discoloration reaction:



- F)** What equipment is used for the NaHSO₃ wash?

Will the product be in the upper or the lower phase during washing?

- G)** What does it mean that the product is highly refractive?

- H)** Calculate the volume of the amount of ethyl iodide that can be theoretically synthesised from the ethanol.

Round the result to the nearest whole number.

$A_r(\text{C}): 12.0$ $A_r(\text{O}): 16.0$ $A_r(\text{H}): 1.00$ $A_r(\text{I}): 127$

- I)** What percentage is the yield based on the amount of ethanol used, if the volume of ethyl iodide actually obtained is 15.0 cm³?

Question 2

17 points total

Cold degreaser contains a large amount of KOH. You have a hydrochloric acid titrating solution with a nominal concentration of 0.2 mol/dm^3 available for the determination of KOH content.

A) The exact concentration of the titrating solution is determined using KHCO_3 as titrating agent. Write down the equation for the reaction taking place during the determination of the exact concentration of the titrating solution.

B) Approximately how many grams of KHCO_3 must be dissolved in order to expect the use of 20 cm^3 of the HCl solution when its exact concentration is determined by titration?

$$M(\text{KHCO}_3) = 100.12 \text{ g/mol}$$

C) Calculate the exact concentration of the HCl solution if the consumption of HCl solution for the titration of 0.4045 g of KHCO_3 was 19.8 cm^3 .



D) The KOH content of the cold degreaser was determined using hydrochloric acid as titrating solution. Write down the equation of the reaction.

E) In order to determine the KOH content, a 10.0 cm^3 sample of cold degreaser was used to prepare 200.0 cm^3 of stock solution. An average of 23.5 cm^3 of the titrating solution whose concentration was determined under C) was consumed when titrating 20.0 cm^3 portions of the stock solution. Calculate the KOH content of the cold degreaser in units of mass percent. The density of cold degreaser is 1.120 g/cm^3 .

$$M(\text{KHCO}_3) = 100.12 \text{ g/mol}$$

$$M(\text{KOH}) = 56.1 \text{ g/mol}$$

- F) The following hazard pictograms are displayed on the packaging of cold degreaser. From the meanings listed beside the pictograms, underline the one that actually belongs to the given pictogram. (The frames of the pictograms are red.)
In each case, only one meaning should be underlined.

	Eye and skin irritation. Toxic to aquatic life. Suspected of causing cancer.		May be corrosive to metals. Fatal in contact with skin. Flammable liquid and vapour.
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Question 3

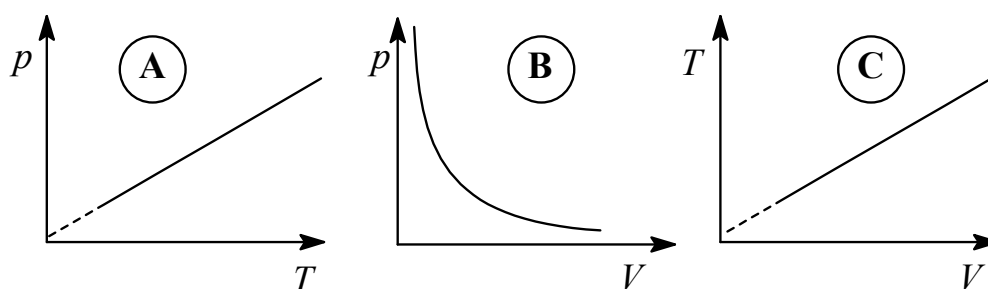
9 points total

In a 20 dm³ flask there is helium gas at a pressure of 180 bar at 22 °C. This amount is sufficient to fill 290 balloons of 12 dm³ volume each.

$$A_r(\text{He}) = 4.00$$

- A) How many kilograms of helium are in the flask?
- B) What is the pressure in the balloons if we assume that the temperature of the gas is unchanged? How much greater (as a percentage) is this pressure than the normal atmospheric pressure (101 325 Pa)?

C)



Which figure corresponds to the thermodynamic process that occurs when the balloons are filled?

ID letter of the process (A, B or C):

Name of the thermodynamic process:

Question 4

10 points total

In the table below you have to compare two compounds. Put the appropriate letters (A, B, C or D) into the empty cells following the statements in the table.

- A) Propene
- B) Propane
- C) Both
- D) Neither

1.	Starting material for making several plastics.	
2.	One of the ingredients of household PB gas.	
3.	Is in gas phase at standard pressure and 0 °C temperature.	
4.	Yields propan-1-ol upon water addition.	
5.	A gas with a higher density than that of air.	
6.	Reacts with HCl in a substitution reaction.	
7.	Has cis-trans isomeric forms.	
8.	The angle of bonds between carbon atoms is 120°.	
9.	Unsaturated compound.	
10.	Is highly soluble in water.	

Question 5

6 points total

Write the **formula** (not the name) of the compounds listed below into the appropriate columns of the table.

ammonia
phenol

propionic acid ethyl ester
dimethyl ether

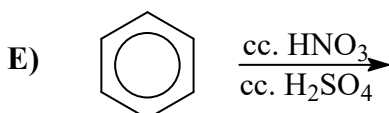
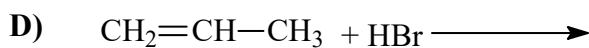
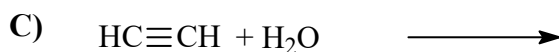
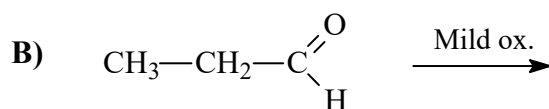
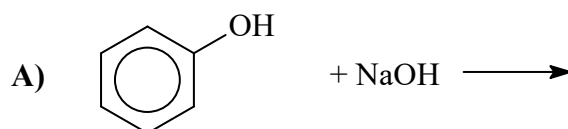
ethanol
acetone

Acidic	Neutral	Basic

Question 6

12 points total

Complete the reaction equations below and write down the names of organic compounds produced.



Question 7

10 points total

Write in the empty cells the terms that correspond to the definitions in the first column of the table.

Definition	Term
A) A system that contains more dissolved material than the maximal amount allowed by the solubility of the material at the given conditions (temperature, pressure).	
B) Its natural ingredients are N ₂ , O ₂ , CO ₂ , H ₂ O and inert gases.	
C) The point in the process of titration when neither the titrating compound nor the measured compound is in excess.	
D) The elemental gas with the lowest density under a given set of conditions.	
E) Increasing the concentration of a compound by evaporating part of the solvent.	
F) The mass of a compound of unit volume.	
G) A group of organic compounds in which hydrocarbon groups are joined together by a carbonyl group.	
H) A solution in which the electrolytic dissociation constant of the dissolved compound is less than 0.001.	
I) The ability of atoms participating in a covalent bond to attract the electron pairs that create the bond (electron affinity).	
J) A process resulting in a decrease of the energy of the system.	

Question 8

7 points total

The task is to make 368 g of ethanol-water mixture with a concentration of 60.0 percent ethanol (w/w).

- A)** Calculate how many grams of (1) absolute ethanol and (2) water are required.

B) Calculate the final volume of the mixture. How much is the change of volume that occurs during mixing (expressed as a percentage of the original volume)?

Densities:	Absolute ethanol	0.789 g/cm ³
	Water	0.998 g/cm ³
	60.0 % (w/w) mixture	0.891 g/cm ³ .

Question 9

9 points total

We mix 10.0 g of 14.0% sulfuric acid and 10.0 g of 16% sodium hydroxide in a 2000 cm³ measuring flask. The flask is filled up to the mark with water and the solution is mixed. Calculate the pH of the resulting solution.

$$M(\text{H}_2\text{SO}_4) = 98.0 \text{ g/mol} \quad M(\text{NaOH}) = 40.0 \text{ g/mol}$$

Question number	Theoretical questions	Calculation questions	Total	Points scored
	maximum points			
1.	14	6	20	
2.	2	15	17	
3.	2	7	9	
4.	10	0	10	
5.	6	0	6	
6.	12	0	12	
7.	10	0	10	
8.	0	7	7	
9.	0	9	9	
Total:	56	44	100	
Points scored in written examination:				

_____ date

_____ correcting teacher

	pontszáma egész számra kerekítve	
	elért	elért
Feladatlap		

_____ dátum

_____ dátum

_____ javító tanár

_____ jegyző