



FOR EVALUATORS		
Points: positive: _____	negative: _____	Total: _____
Graded by: _____		

## Part one

Answer by encircling the letter in front of one of the offered answers. Each correct answer is worth 2 points. A wrong answer is penalized by -0.25 points. Unanswered questions do not alter the score. Using a pencil, encircling of two or more answers or drawing over the answer is penalized by -0.25 points.

- Anne was heating certain substance in a test tube. Which of the following statements about the safety regulations that has to be taken during the experiment is **wrong**?
  - The test tube has to be closed with rubber stopper so the liquid does not splash while heated.
  - She can hold the test tube with a test tube clamp.
  - While heated, the test tube has to be pointed away from Anne.
  - It is mandatory for Anne to wear safety glasses.
- Hydrogen forms covalent compounds of the type HX, YH<sub>3</sub>, ZH<sub>4</sub> and H<sub>2</sub>E with the elements from the second period from the Periodic table. The atomic numbers of the atoms X, Y, Z and E are:
  - 17, 13, 14, 16.
  - 11, 13, 14, 12.
  - 9, 5, 6, 8.
  - There are no sufficient data to determine the atomic numbers.
- What is in common for these three particles:  
 ${}_{18}^{40}\text{X}$      ${}_{19}^{41}\text{Y}^{+}$      ${}_{20}^{42}\text{Z}^{2+}$  ?
  - The number of protons, but not the number of electrons.
  - The number of electrons and the number of protons.
  - The number of neutrons, but not the number of electrons.
  - The number of electrons and the number of neutrons.
- Which elements have the same number of valence electrons?
  - Na and K.
  - Na and Mg.
  - Na and Cl.
  - Na and F.
- The chemical formula of silver bromide is:
  - Ag<sub>2</sub>Br<sub>3</sub>.
  - AgBr.
  - AgBrO.
  - AgBrO<sub>2</sub>.
- Which single bond is the most polar one?
  - C–O.
  - B–F.
  - C–F.
  - B–Br.
- Which of these series contains formulas of substances that form only polar covalent bonds?
  - NaCl; HCl; Cl<sub>2</sub>.
  - H<sub>2</sub>O; K<sub>2</sub>O; CaO.
  - NH<sub>3</sub>; N<sub>2</sub>O; H<sub>2</sub>O.
  - Na<sub>2</sub>O; NO; N<sub>2</sub>.
- What happens with the collisions of the particles and the rate of the reaction if the temperature of a certain system increases?
  - The number of collisions will decline and also the rate of reaction will decline.
  - The number of collisions will not change, only particles will gain energy and the rate of the reaction will remain the same.
  - The number of collisions will increase, the particles will gain more energy and the rate of the reaction will increase.
  - The number of collisions will increase, the particles will gain less energy and the rate of the reaction will decrease.
- Jane has put 1 g of zinc granules in the beaker A and 1 g of zinc powder in beaker B. In each beaker Jane added 100 mL HCl with concentration of 0.1 mol/L. What conclusions can be drawn for the rate of the reaction in beaker A compared to the rate of the reaction in beaker B?
  - The rate of the reaction in beaker A is greater due to the lower contact surface of the zinc.
  - The rate of the reaction in beaker A is greater due to the higher contact surface of the zinc.

- C. The rate of the reaction in beaker B is greater due to the lower contact surface of the zinc.
- D. The rate of the reaction in beaker B is greater due to the higher contact surface of the zinc.
10. Determine the coefficients in front of the participants in the reaction written by the equation:  
 $\text{FeCl}_3 + \text{MgO} \rightarrow \text{Fe}_2\text{O}_3 + \text{MgCl}_2$   
 A. 4,6,2,6.  
 B. 2,1,1,1.  
 C. 2,3,1,3.  
 D. 6,9,3,9.
11. The formula of crystalhydrate of sodium carbonate is:  
 A.  $\text{Na}(\text{HCO}_3)_2$ .  
 B.  $\text{Na}_2\text{CO}_3 \cdot (\text{H}_2\text{O})_{10}$ .  
 C.  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ .  
 D.  $\text{Na}_2\text{CO}_4 \cdot 10\text{H}_2\text{O}$ .
12. The products of the reaction  $\text{CuO} + \text{HNO}_3 \rightarrow$  are:  
 A.  $\text{Cu}_2\text{NO}_3 + \text{H}_2\text{O}$ .  
 B.  $\text{Cu}(\text{NO}_3)_2 + \text{H}_2\text{O}$ .  
 C.  $\text{Cu}(\text{NO}_3)_2 + \text{H}_2$ .  
 D.  $\text{Cu}(\text{NO}_2)_4 + \text{H}_2$ .
13. Which process **cannot** be used for zinc sulfate production?  
 A. Addition of zinc to sulfuric acid.  
 B. Addition of zinc carbonate to sulfuric acid.  
 C. Addition of zinc oxide to sulfuric acid.  
 D. Addition of aqueous solution of zinc nitrate to aqueous solution of sodium sulfate.
14. Which property **is not** valid for acids?  
 A. They react with bases and always one of the products is water.  
 B. They react with metals and always hydrogen gas is being produced.  
 C. They react with carbonates and always one of the products is carbon dioxide.  
 D. They always turn the color of the litmus paper to red.
15. Which of the following salts can be obtained by the acid-base titration method?  
 A. copper(II) sulfate.  
 B. lead(II) sulfate.  
 C. sodium nitrate.  
 D. zinc nitrate.

## Part two

Answer according to the requirements. Answers written by pencil will be marked with 0 points.

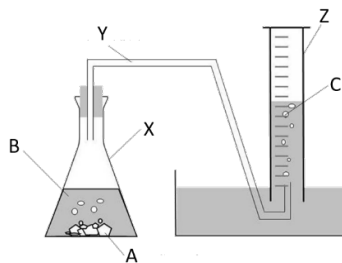
1. (Total 4 points) The arrangement for the electrons of the atoms X, Y, Z, R and V is as follows:

X	Y	Z	R	V
2,8	2,8,1	2,8,2	2,8,7	2,8,8

Answer the following questions by writing the symbols of the corresponding elements. Do not write more elements than necessary since every additional wrong answer will result in 0.5 points deduction.

- A. Which atom will lose electron/s most easily? \_\_\_\_\_
- B. Which atom will gain electron/s most easily? \_\_\_\_\_
- C. Which elements belong to the same group in the Periodic table? \_\_\_\_\_
- D. Which elements belong to the same period? \_\_\_\_\_

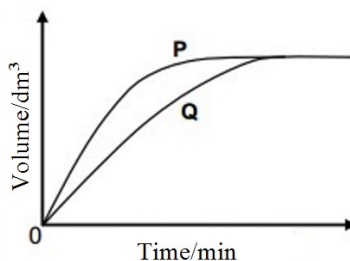
2. **(Total 8 points)** The apparatus setup given on the figure below is used for studying the rate of hydrogen production when certain amount of magnesium reacts with diluted solution of hydrochloric acid.



- A. Write the balanced equation for the studied reaction. **(1)**
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- B. Write down the names of the laboratory equipment used to set this apparatus: **(1.5)**  
 X: \_\_\_\_\_, Y: \_\_\_\_\_, Z: \_\_\_\_\_
- C. What is the purpose of the vessel marked as Z in this experiment? **(1)**
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- D. Write down the chemical formulas of the substances marked as A, B and C. **(1.5)**  
 A: \_\_\_\_\_, B: \_\_\_\_\_, C: \_\_\_\_\_
- E. Ivo and Martha, by using the above apparatus, conducted two experiments. The conditions under which the experiments were conducted are given in the table below.

	Experiment 1	Experiment 2
magnesium	0.1 g powder	0.1 g powder
hydrochloric acid	0.1 mol/dm <sup>3</sup>	0.2 mol/dm <sup>3</sup>
temperature	25 °C	25 °C

In both experiments, the volume of the hydrogen gas was measured. The obtained results are shown in the plot (graph) below.



Which plot curve, P or Q, represents the results from experiment 2? Use the data from the table and the plot to explain your answer. **(2 = 0.5 + 1.5)**

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Give one reason why the rate of hydrogen production has been reduced at the end of the experiment. **(1)**

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3. (Total 4 points) Write down the chemical formulas or the names of the following compounds:

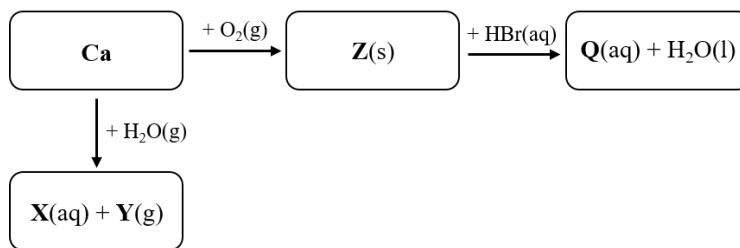
KMgCl<sub>3</sub> · 6H<sub>2</sub>O \_\_\_\_\_

Ammonium phosphate \_\_\_\_\_

Fe<sub>2</sub>(SO<sub>3</sub>)<sub>3</sub> \_\_\_\_\_

Aluminium sulfide \_\_\_\_\_

4. (Total 4 points) Study the scheme and determine the compounds marked as X, Y, Z and Q. Use the corresponding chemical formulas to write the answers.



Chemical formula of X: \_\_\_\_\_

Chemical formula of Y: \_\_\_\_\_

Chemical formula of Z: \_\_\_\_\_

Chemical formula of Q: \_\_\_\_\_

P.e	Group																18																			
1																	18																			
1	1 H																2																			
2	Group																																			
2	1 Li		2 Be														13 B		14 C		15 N		16 O		17 F		18 Ne									
3	3 Na		4 Mg														5 Al		6 Si		7 P		8 S		9 Cl		10 Ar									
4	4 K		5 Ca		6 Sc		7 Ti		8 V		9 Cr		10 Mn		11 Fe		12 Co		13 Ni		14 Cu		15 Zn		16 Ga		17 Ge		18 As		19 Se		20 Br		21 Kr	
5	5 Rb		6 Sr		7 Y		8 Zr		9 Nb		10 Mo		11 Tc		12 Ru		13 Rh		14 Pd		15 Ag		16 Cd		17 In		18 Sn		19 Sb		20 Te		21 I		22 Xe	
6	6 Cs		7 Ba		8 La		9 Hf		10 Ta		11 W		12 Re		13 Os		14 Ir		15 Pt		16 Au		17 Hg		18 Tl		19 Pb		20 Bi		21 Po		22 At		23 Rn	
7	7 Fr		8 Ra		9 Ac		10 Rf		11 Db		12 Sg		13 Bh		14 Hs		15 Mt		16 Ds		17 Rg		18 Cn		19 Uut		20 Uuq		21 Uup		22 Uuh		23 Uus		24 Uuo	

Atomic Mass	Symbol	Atomic Number	Electron Configuration	Selected Oxidation States
12.011	C	6	2-4	-4, +2, +4

Relative atomic masses are based on <sup>12</sup>C = 12 (exact)  
 Note: Numbers in parentheses are mass numbers of the most stable or common isotope.