Test 3

Number of school:…… Number of teacher:….. Number of group:…….. Number of student: ..…..

The aim of our research is to make the teaching of chemistry as interesting and effective as possible.

Thank you for completing this test according to the best of your knowledge, because you help our work. Please, write your answers only on this sheet of paper and do not use any other piece of paper.

1. a) What chemical processes are called reduction?

…………………………………………………………………………………………………………………………………………………………

BN

1. b) Alkali metals have got low electronegativity. Are they usually oxidising or reducing agents? **Explain**

BO

**your answer!**………………………………………………………………………………………………………………………

2. Does the catalyst participate in the chemical reaction? **Explain your answer!**

…………………………………………………………………………………………………………………………………………

BP

3. The equation of the reaction that takes place between the bromine water and the formic acid: Br2 + HCOOH = 2 HBr + CO2

The bromine water is yellow and all the other materials participating in the reaction are colourless. Using this information, prove that the rate of reaction depends on the concentrations of the starting materials. You can choose among the following materials and equipment: formic acid solution (in a glass bottle), bromine water (in a glass bottle), distilled water (in a flask), 4 beakers (50 cm3, with a scale on their side to show the volume), 4 eyedroppers (without a scale), 4 Pasteur pipette (with a scale on their side to show the volume), 4 measuring cylinder (10 cm3, with a scale on their side to show the volume), stopwatch.

a) What equipment and **how many pieces** of them are needed among the above listed ones for the

experiment?.............................................................................................................................................

BQ

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b) Which materials and how much of them would you put into the chosen equipment at the time of the **preparation** of the experiment?

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BR

c) How would you **start** the experiment?

BS

………………………………………………………………………………………………………………………………………..

d) What **experiences** would you expect by the end of the experiment?

BT

…………………………………………………………………………………………………………………………………………

e) Based on your experiences, how could you **decide**, how the rate of reaction depends on the concentrations of the starting materials?

BU

…………………………………………………………………………………………………………………………………………

4. a) What happens between the system and its environment at the time of an endothermic reaction?

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BV

4. b) You read the following on the internet how a feeding-bottle warmer works: *There is a very fine aluminium powder in it. If the outside wrapping is torn, the aluminium powder that has no protective oxide layer, is contacted with the air and begins to oxidise. This ensures the heat that warms up the content of the feeding-bottle.* What data or information would you need to judge whether this process really causes warming?

………………………………………………………………………………………………………………………………………….

BW

5. The longer the wavelength of the light, the smaller the energy that its photons have. Explain, using this figure, whether the red colour flame test of the lithium or the violet colour flame test of the potassium indicates higher excitation energy!

BX

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6. a) We measured the volumes of the drops of two liquids that have similar density. In which liquid has got stronger interactions among the particles: the liquid with a smaller or a bigger volume of drop?

BY

**Explain your answer!**……………………………………………………………………………………………….………..

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6. b) Why is it that a drop of water has got a spherical shape in the space, where the gravitation is

negligible?………………………………………………………………………………………………………………………….

BZ

7. Which substances are called acids?………………………………………………………………………………………………….

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CA

8. We want to identify the following three water samples, with the help of acid-base indicators:

**A**) Rainwater that is only slightly acidic because of the carbon dioxide dissolved in it, and its pH is 5.6.

**B**) Acid rain water that was collected on a very polluted area and its pH is 2.8.

**C**) A water sample collected from the Lake Balaton that has got a pH 8.0, because the waterbed is made of alkaline rocks.

We can only do two experiments as a maximum and we can choose the indicators from the following table. (Between the two pH values belonging to the two colours, the transition colour of the indicator could be seen that changes depending on the pH.)

|  |  |  |
| --- | --- | --- |
| Name of the acid-base indicator | One colour of the indicator | The other colour of the indicator |
| phenolphthalein | colourless, if pH≤8.2 | purple, if pH≥10.0 |
| bromothymol blue | yellow, if pH≤6.0 | blue, if pH≥7.6 |
| crystal violet | green, if pH≤0.8 | blue, if pH≥2.6 |
| litmus | red, if pH≤5.0 | blue, if pH≥8.0 |
| methyl orange | red, if pH≤3.1 | orange, if pH≥4.4 |

a)Which indicator would you use for the Experiment 1? What would you conclude of the possible

**experiences**? ……………………………………………………………………………………………………………………………………….

CB

…………………………………………………………………………………………………………………………………………

b) Which indicator would you use for the Experiment 2? What would you conclude of the possible

**experiences**?………………………………………………………………………………………………………………………………………..

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CC

c) Would it lead to a fake result if we used identical amount of the water samples, but different amount of indictors for the experiments that you have just described? **Why?**

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CD

……………………………………………………………………………………………………………………………………………………………

d) Would you get a different result in the experiments that you described, if we replaced (as a model) the water sample “**B**” by 0.1 mol/dm3 acetic acid that has got a pH 2.7? **Why?**...................

CE

……………………………………………………………………………………………………………………………………………………………

 Please, give us the following information! The end-of-semester grade you got in chemistry:

CF

* The larger the number you circle, the more you like chemistry:

CG

(0: you did not like it at all, 4: you really liked it): 0 1 2 3 4

* The bigger the number, the more you consider it is important to test ideas in sciences by experiments (0: not important at all; 4: very important):

CH

0 1 2 3 4

* The bigger the number, the more you agree with the following statement:

“I prefer the step-by-step experiments to the ones that I have to design.”

CI

0 1 2 3 4

Instructions given to the teachers to mark the students’ answers of the Test 3

Teachers correcting the test can judge whether the particular answer is accepted, since that should be determined by the meaning of the answer.

Please fill in the columns of the Excel spreadsheet with the marks obtained from following the instructions below. A student’s marks should be written in the appropriate row of the Excel spreadsheet.

Columns ‘BN’-‘CE’ contain marks for students’ answers.

Columns ‘CF’ contains the student’s end-of-semester grade in chemistry.

Columns ‘CG’-‘CI’ contain students’ attitude responses.

Column ‘BN’ (task 1.a)

Alternative answer I.: Gain of electron(s).

Alternative answer II.: Loss of oxygen (or gain of hydrogen).

Alternative answer III.: Decrease of oxidation number.

Marks: 1

In any other case. Marks: 0

1 item: recall (disciplinary content knowledge task: DCK task)

Column ‘BO’ (task 1.b)

Alternative answer I.: They are reducing agents, since they give off electrons easily (while their reaction partner gains electrons and therefore it is reduced).

Alternative answer II.: They are reducing agents, since they give off electrons easily, while they are oxidised (and therefore they reduce their reaction partner).

Marks: 1

In any other case. Marks: 0

1 item: understanding (DCK task)

Column ‘BP’ (task 2.)

Alternative answer I.: Yes, because it accelerates the reaction (or increases the rate of reaction) by opening a new reaction route (or decreasing the activation energy).

Alternative answer II.: Yes, because that is how it starts the reaction.

Marks: 1

In any other case. Marks: 0

1 item: understanding (DCK task)

Column ‘BQ’ (task 3.a)

Alternative answer I.: 2 beakers, 1 measuring cylinder and a stopwatch.

Alternative answer II.: 2 beakers, 1 Pasteur pipette and a stopwatch.

Alternative answer III.: 2 beakers, 2 measuring cylinders.

Alternative answer IV.: 2 beakers, 2 Pasteur pipettes.

Alternative answer V.: 3 beakers, 1 measuring cylinder and a stopwatch, etc.

*(Note: Any combination is good that the student correctly uses later while describing a fair test.)*

Marks: 1

In any other case. Marks: 0

1 item: higher order cognitive skills (EDS task)

Column ‘BR’ (task 3.b)

The same volume, but different concentration of one of the solutions (the formic acid or the bromine water).

Marks: 1

In any other case. Marks: 0

1 item: higher order cognitive skills (EDS task)

Column ‘BS’ (task 3.c)

By adding one type of the solutions to the other type of solutions (or adding one of the solutions to the other solution and starting the stopwatch, if the experiments are not done in parallel with the solutions that have different concentrations).

Marks: 1

In any other case. Marks: 0

1 item: higher order cognitive skills (EDS task)

Column ‘BT’ (task 3.d)

Alternative answer I.: One of the solutions get colourless earlier than the other(s).

Alternative answer II.: It becomes colourless (and/or it gets fizzy).

Marks: 1

In any other case. Marks: 0

1 item: higher order cognitive skills (EDS task)

Column ‘BU’ (task 3.e)

Alternative answer I.: If the more concentrated solution gets colourless earlier (than the more dilute), then the rate of reaction increases by the increase of the concentration.

Alternative answer II.: If the more dilute solution gets colourless later (than the more concentrated), then the rate of reaction decreases by the decrease of the concentration.

In any other case. Marks: 0

1 item: higher order cognitive skills (EDS task)

Column ‘BV’ (task 4.a)

Alternative answer I.: The system gets heat from its environment.

Alternative answer II.: The environment gives of heat to the system.

Marks: 1

In any other case. Marks: 0

1 item: recall (DCK task)

Column ‘BW’ (task 4.b)

Alternative answer I.: Whether the reaction enthalpy (of the oxidation of aluminium) is plus or minus.

Alternative answer II.: Whether the reaction (i.e. the oxidation of aluminium) is exothermic or endothermic.

Marks: 1

In any other case. Marks: 0

1 item: application (DCK task)

Column ‘BX’ (task 5)

That of the potassium, because the energy of the photons of the violet light is higher (since the wavelength of the violet light is shorter).

Marks: 1

0: If the calculation is not correct.

1 item: application (DCK task)

Column ‘BY’ (task 6.a)

In the case of the liquid that has got the bigger drops, because it has got a higher surface tension (since the surface tension is higher, if there are stronger interactions among the particles).

Marks: 1

In any other case. Marks: 0

1 item: application (DCK task)

Column ‘BZ’ (task 6.b)

Alternative answer I.: Because the particles on the surface of the liquide are attracted to the center of the drop by the same size forces (as an avarage).

Alternative answer II.: Because the resultant force points into the inner part of the liquid (and the spherical shape has got the smallest surface, if the volume of the liquid remains the same).

Marks: 1

In any other case. Marks: 0

1 item: understanding (DCK task)

Column ‘CA’ (task 7)

Alternative answer I.: Substances that give of proton/hydrogen ion/H+.

Alternative answer II.: Substances that increase the concentration of hydrogen ion/H+/oxoniumion/H3O+ (in the solution).

Marks: 1

In any other case. Marks: 0

1 item: recall (DCK task)

Column ‘CB’ (task 8.a)

Alternative answer I.: With litmus and if it is red, then the sample is **B)**, if it is blue, then the sample is **C)**, if it shows a transition colour (lilac) than the sample is **A)**.

Alternative answer II.: With methyl orange, and if it is red, then the sample is **B)**, if it is orange, then the sample is **A)** or **C)**.

Alternative answer III.: With bromothymol blue, and if it is blue, then the sample is **C)**, if it is yellow, then the sample is **A)** or **B)**.

Marks: 1

In any other case. Marks: 0

1 item: higher order cognitive skills (EDS task)

Column ‘CC’ (task 8.b)

Alternative answer I.: See above (at task 8.a).

Alternative answer II.: With methyl orange, and if it is red, then the sample is **B)**.

Alternative answer III.: With bromothymol blue, and if it is blue, then the sample is **C)**.

Marks: 1

In any other case. Marks: 0

1 item: higher order cognitive skills (EDS task)

Column ‘CD’ (task 8.c)

No, because the intensity of the colour of the indicator does not influence the result in this case (only its colour is important).

Marks: 1

In any other case. Marks: 0

1 item: higher order cognitive skills (EDS task)

Column ‘CE’ (task 8.d)

No (i.e. we could get to the same conclusion), because there is not any indicator among the listed ones that changes colour between pH 2.8 and 2.7.

Marks: 1

In any other case. Marks: 0

1 item: higher order cognitive skills (EDS task)

Column ‘CF’

The student’s end-of-semester grade in chemistry.

Column ‘CG’

Insert the number circled by the student.

Column ‘CH’

Insert the number circled by the student.

Column ‘CI’

Insert the number circled by the student.

END OF EVALUATION OF THE TEST 3.