



# CHEMICAL ANALYSIS SERVICE

**INDUSTRIAL BLOCK**





WorldSkills Russia organization in accordance with Constitution of WorldSkills Russia, Standing Order and Rules of the competition, has adopted the following minimum requirements to the professional skill of “Chemical Analysis Service” for the “WorldSkills” competition.

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Effective date: \_\_\_\_\_

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(signature)

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# 1 INTRODUCTION

## 1.1 NAME AND DESCRIPTION OF THE PROFESSIONAL SKILLS COMPETITION

### 1.1.1 Name of the professional skills competition:

Chemical Analysis Service

### 1.1.2 Description of the relevant work function or activity.

The work of laboratory chemical analyst is the basis of the produced products quality in many industries. The chemical analysis is necessary to control the compliance of the properties of raw materials, intermediates of the technological process and finished products with current standards.

The laboratory chemical analyst performs the laboratory analyses, tests, measurements aimed at determining the qualitative chemical composition of a substance and the quantitative ratio of chemical elements and compounds in it, processing of the obtained data, reporting results of analyses and other types of laboratory work according with the requirements of standards and specifications. The scope and complexity of the performing tests depend on the type of the tasks set by the employer.

The skill includes knowledge of the following objects of professional activity:

- Natural and industrial materials;
- Pharmaceuticals (Russian, European and United States pharmacopoeias);
- Equipment and instruments;
- Regulatory and technical documents.

Laboratory chemical analysts should be ready to determine the optimal tools and methods for the analysis of various natural and synthetic materials, to perform qualitative and quantitative tests using modern chemical and physicochemical analytical methods. They should be able to act logically and systematically, complying with sanitary and hygienic requirements and occupational safety and health standards.

Usually, laboratory chemical analysts work in chemical laboratories of quality control department on plants in various industries: chemical, petrochemical, pharmaceutical, construction materials, paint and varnish, polymeric, defense and many others, as well as in research and environmental laboratories in companies attracting extra-budgetary and budgetary investments.



## 1.2 ACTUALITY AND IMPORTANCE OF THIS DOCUMENT

This document contains information on the standards *required* to participate in this professional skills competition, as well as principles, methods and evaluation procedures that regulate running the competition.

Each expert and competitor should know and understand this technical description.

In case of any inconsistencies between the versions of the technical description in different languages, the English text should prevail.

## 1.3 RELATED DOCUMENTS

Since the technical description contains only specific information on professional skills, it should be used in conjunction with the following documents:

- WSI — The Competition rules
- WorldSkills International — The WorldSkills standard specifications
- WorldSkills International — Internet resources of the WorldSkills marking strategy, as outlined in this document
- Policies and procedures for WorldSkills safety, health and environment areas.



## 2 WORLDSKILLS STANDARD SPECIFICATIONS (WSSS)

### 2.1 GENERAL NOTES ON THE WORLDSKILLS STANDARD SPECIFICATIONS (WSSS)

The WorldSkills standard specifications specify the knowledge, understanding and specific skills that underpin the international best practice in technical and vocational performance. It should reflect a shared global understanding of what the corresponding trade or profession represents for industry and business ([www.worldskills.org/WSSS](http://www.worldskills.org/WSSS)).

The skills competition is intended to reflect as far as possible the international best practice described by the WorldSkills standard specifications. Therefore these specifications represent a guideline on the required training and preparation for the skills competition.

Knowledge and comprehension are estimated during the skills competition through practical performance. Additional tests of knowledge and comprehension are not provided.

The WorldSkills standard specifications consist of sections with headings and reference numbers.

Each section is assigned a percentage of the total mark to indicate its relative importance within the standard specifications. The sum of all percentages is 100.

The marking scheme and competition task assess only those skills that are described in the standard specifications. They should reflect the standard specifications as comprehensively as possible within the skills competition.

The marking scheme and competitive task should correspond to the assessment within the framework of standard specifications to the extent practicable. Variance of 5 (five) percent is allowed, provided that this does not distort the ratios specified in the standard specifications.



## 2.2 WORLDSKILLS STANDARD SPECIFICATIONS

SECTION		RELATIVE IMPORTANCE (%)
<b>1</b>	<b>Occupational safety and health</b>	<b>5</b>
	<p>A specialist should know and understand:</p> <ul style="list-style-type: none"><li>• Occupational Health and safety regulations and fire protection rules in the chemical laboratory</li><li>• Principles of safe work with chemical reagents, glassware and laboratory equipment</li><li>• Principles of ecological safety for working with chemical reagents</li><li>• Rules for the proper usage of personal protective equipment, as well as the proper care for them</li></ul>	
	<p>A specialist should:</p> <ul style="list-style-type: none"><li>• Follow the occupational health and safety regulations and fire protection rules in a chemical laboratory</li><li>• Comply with the principles of safe work with chemical reagents, glassware and laboratory equipment</li><li>• Be able to properly use personal protective equipment, as well as treat them properly</li><li>• Properly handle and dispose of environmentally hazardous substances</li><li>• Use protective garment for working in the laboratory</li></ul>	
<b>2</b>	<b>Work organization</b>	<b>5</b>
	<p>A specialist should know and understand:</p> <ul style="list-style-type: none"><li>• Main application, principles of usage and storage of necessary laboratory glassware, equipment and materials</li><li>• Main chemical properties and application of the tested or synthesized substances and reagents</li><li>• Basic principles of experiment planning, ways to organize effective work and working time management</li><li>• Analytical methods of the required analysis</li><li>• Importance of keeping the workplace clean and tidy</li><li>• Procedures of disposal of waste reagents, solutions and materials</li></ul>	
	<p>A specialist should be able to:</p> <ul style="list-style-type: none"><li>• Correctly select, apply, wash and store laboratory glassware</li><li>• Competently and accurately handle the equipment of chemical analytical laboratories according to the instruction</li><li>• Prepare reagents and materials required for analysis</li><li>• Organize a work place for maximum efficiency</li><li>• Manage time</li><li>• Follow the procedure of the analysis</li><li>• Keep a work place clean and tidy</li><li>• Dispose waste reagents, solutions and materials according to the instructions</li></ul>	



3	Determination of optimal analytical methods, sample preparation	5
	<p>A specialist should know and understand:</p> <ul style="list-style-type: none"><li>• Technical documentation necessary for the analysis</li><li>• Optimal materials and methods of analysis to effectively perform the tasks during the minimum period of time</li><li>• Correspondence between the procedure and the analysis tasks for the range of measured values and accuracy</li><li>• Economic feasibility of used analytical methods and measuring instruments</li><li>• Rules of sampling for analysis by chemical and instrumental methods</li></ul>	
	<p>A specialist should be able to:</p> <ul style="list-style-type: none"><li>• Find, analyze and apply technical documentation, such as state regulations, GOSTs, guidelines, instructions, manufacturers' specifications, diagrams, etc., necessary for the carrying-out of the analysis</li><li>• Select and substantiate the most optimal materials and methods of testing the chemical object</li><li>• Carry out experimental work on the certification of procedures for testing reference standards</li><li>• Select for work measuring glassware and laboratory equipment of the required accuracy class</li><li>• Select the most cost-effective methods of analysis for the performance of assigned tasks</li><li>• Follow the rules of sampling for analysis by chemical and instrumental methods</li></ul>	
4	Technique of working with laboratory glassware and equipment	25
	<p>A specialist should know and understand:</p> <ul style="list-style-type: none"><li>• Rules of operation, maintenance and adjustment of used laboratory equipment, apparatus and control instruments</li><li>• Construction and operating principle of the used analytical equipment</li><li>• Proper rules for the use of measuring and chemical glassware in accordance with state standards and specifications</li><li>• Rules for the use of analytical and technical balances, established by the manufacturer and regulatory documents</li><li>• Rules for working with thermometers of various types</li><li>• Methods for the calibration of used measuring glassware, instruments and equipment</li></ul>	
	<p>A specialist should be able to:</p> <ul style="list-style-type: none"><li>• Properly assemble the laboratory equipment for a given type of analysis</li><li>• Work on the provided laboratory equipment, carry out its maintenance and adjustment</li><li>• Properly use measuring and chemical glassware in accordance with state standards and specifications</li><li>• Correctly measure the specified volumes of liquid using the measuring glassware</li><li>• Correctly weigh the analyzed materials using analytical and technical balances, handle the balances carefully</li><li>• Work with thermometers of various types</li><li>• Calibrate the measuring glassware, instruments and equipment used in accordance with the instructions</li><li>• Correctly take and record readings of instruments, and values of liquid volumes in measuring glassware</li></ul>	



5	Preparation and performing the analysis	30
	<p>A specialist should know and understand:</p> <ul style="list-style-type: none"><li>• Normative documentation related to the control of the composition and properties of materials using chemical and physicochemical analytical methods</li><li>• Qualitative and quantitative analysis of inorganic and organic substances by chemical and physicochemical methods</li><li>• Fundamentals of general, analytical, physical chemistry and physicochemical methods of analysis</li><li>• Analysis of natural, pharmaceutical and industrial materials by chemical and instrumental methods</li><li>• Determination of physical properties and constants of substances, such as density, viscosity, refractive index, conductivity, etc.</li><li>• Processes of dissolution, mixing and filtration</li><li>• Properties of acids, alkalis, indicators and other reagents used</li><li>• Methods for preparing solutions of reagents with a given concentration</li><li>• Principles of detecting and testing the concentration of solutions</li><li>• Methods for calculating molar and normal concentrations, mass fraction, titer and other types of expression of the substance concentration in solution</li><li>• Principles of quantitative sample transfer</li><li>• Requirements for the quality of samples and analyses being performed</li><li>• Methods of determining the mass and volume of chemicals</li></ul>	
	<p>A specialist should be able to:</p> <ul style="list-style-type: none"><li>• Correctly carry out the analytical procedure specified in the normative documentation, fulfill the requirements consistently and deliberately</li><li>• Make a work plan in accordance with the given procedure and follow it</li><li>• Conduct an analysis of natural, pharmaceutical and industrial materials by chemical and instrumental methods</li><li>• Conduct qualitative and quantitative analysis of inorganic and organic substances by chemical and physicochemical methods</li><li>• Determine the percentage of the substance in the analyzed materials by different methods</li><li>• Prepare solutions of reagents with a given concentration</li><li>• Detect and test the concentration of solutions, determine the correction coefficients</li><li>• Calculate molar, normal concentration, mass fraction, titer and other types of concentrations of substances in solution, convert the concentrations from one type to another</li><li>• Carry out synthesis according to a given procedure in the laboratory conditions</li><li>• Determine physical properties and constants of substances, such as density, viscosity, refractive index, conductivity, etc.</li><li>• Follow the principles of quantitative transfer of samples</li></ul>	





6	Processing, Interpreting and recording analytical results	30
	<p>A specialist should know and understand:</p> <ul style="list-style-type: none"><li>• Rules of maintenance and registration of technical documentation for the execution of a given type of analysis, reporting</li><li>• Methods of calculating the given values presented in the procedure</li><li>• Rules of mathematical processing of the results of the analyses</li><li>• Rules of statistical processing of the results of the analyses</li><li>• Principles of calculating quality control parameters of the measurements</li><li>• Methods of automated information processing using computer technology</li><li>• Correct reporting the experimental results</li></ul>	
	<ul style="list-style-type: none"><li>• A specialist should be able to:</li><li>• Accurately keep records in the report, clearly and unambiguously formulate the conclusions</li><li>• Be familiar with specialized terminology typical for work in chemical analytical laboratories</li><li>• Correctly choose the formulas for calculating the specified values given in the procedure, use in the calculations the values of the quantities having the required units</li><li>• Use the generally accepted alphabetic abbreviation of physical quantities</li><li>• Correctly specify the dimension of all physical quantities</li><li>• Correctly perform mathematical calculations and rounding</li><li>• Carry out a statistical analysis of the results, determine the errors in measurements in accordance with the formulas proposed in the normative documentation</li><li>• Use interpolation and extrapolation methods</li><li>• Control the quality parameters of analyses, draw conclusion on the acceptability of the results</li><li>• Carry out mathematical processing of analytical results using modern computers and software</li><li>• Evaluate and interpret results, draw relevant conclusions</li><li>• Point out the obtained result from the general text of the report in the form of a conclusion or summary</li><li>• Record the results with the accuracy specified in the normative documentation</li><li>• Record the results with an indication of error and confidential probability in accordance with the requirements of the normative documentation</li></ul>	



## 3 EVALUATION STRATEGY AND STANDARDS

### 3.1 GENERAL GUIDANCE

Evaluations are implemented according to the WorldSkills evaluation strategy. The strategy establishes the principles and methods to which WorldSkills evaluation and classification should conform.

An expert evaluation is based on the WorldSkills competition. Therefore, the evaluation process itself is a subject of continuous professional development and thorough study. The evaluation experience of the competitors will be subsequently considered in using and improving the main evaluation tools used in the WorldSkills competitions: marking scheme, competition task and competition information system (CIS).

There are two types of marks at the WorldSkills Competition: judging and evaluation by measurable parameters. In both cases, it is necessary to use precise benchmarks for comparison, according to which each aspect is evaluated. This approach ensures adequate evaluation.

The marking scheme should correspond to the percentage ratios specified in standard specifications. The competition task is a competitor assessment tool in the professional skills competition, and it is also regulated by standard specifications. The competition information system (CIS) allows to keep a timely and accurate record of marks, which supports a proper organization of the competition.

The marking scheme allows to manage the process of a competitive task development. After that, marking scheme and competition task are developed in such a way as to guarantee their optimal interrelation with standard specifications and evaluation strategy. They are agreed by experts and submitted for approval by the WorldSkills International organization to demonstrate their quality and compliance with standard specifications.

Prior to submission for the WSI approval, marking scheme and competition task are agreed by the WSI professional skills consultants in order to take advantage of all the capabilities of the competition information system (CIS).



## 4 MARKING SCHEME

### 4.1 GENERAL GUIDANCE

This section describes role and place of the marking scheme (classification scheme), how the experts assess the work of a competitor during the competition task performing, and the procedures and requirements for evaluation.

The marking scheme is a key instrument of the WorldSkills competition, directly related to the skill's standards. This scheme is intended for evaluation of each aspect of the competition work according to the percentage ratios specified in the standard specifications.

The marking scheme reflects the percentage ratios specified in the standard specifications, and determines the parameters for the development of the competition task. Depending on the type of the professional skills and the features of their evaluation, it may be rational to develop a more detailed marking scheme as a guide in the development of a competitive task. As an alternative, the development of a competitive task may be based on a common marking scheme. From this point on, marking scheme and competition task should be developed together.

The section 2.1 above it specifies to what extent, in the absence of a real alternative, marking scheme and competition task may deviate from the percentages ratios provided by the standard specifications.

The marking scheme and competition task can be developed by one person, several or all experts. For the purpose of independent quality control, the detailed and final marking scheme and competition task should be approved by all expert juries prior to filing of an application. Exceptions are competitions of professional skills, in which the marking scheme and competition task are developed by a third party.

In addition, experts are advised to submit their marking schemes and competitive tasks for discussion and preliminary approval prior to the start of the competition in order to avoid disappointment or failure at the last moment. Furthermore, at this intermediate stage they are recommended to work with the CIS team in order to fully use the CIS capabilities.

In any case, a complete and approved marking scheme should be submitted to the CIS not later than eight weeks before the start of the competition using the standard CIS electronic spreadsheet or other agreed methods.

### 4.2 EVALUATION CRITERIA

The main sections of the marking scheme are the evaluation criteria. These sections are formed simultaneously with the competition task. Depending on the certain competition of professional skills, the names of the evaluations can either duplicate the titles of sections in standard specifications, or differ from them. Normally, five to nine evaluation criteria are used. Irrespective of the coincidence with the titles of the sections, the marking scheme should reflect the percentage ratios specified in the standard specifications.

Evaluation criteria are formed by the person (persons) developing the marking scheme. Such person (persons) may at own discretion determine criteria that, in his/her (their) opinion, are most suitable for evaluating a competitive task. Each evaluation criterion is indicated by a letter (A-I).

A consolidated evaluation form, prepared with the help of the CIS, includes a list of evaluation criteria.

Marks assigned according to each criterion are calculated by the CIS. This will be a total sum of points assigned to each competitor by this evaluation criterion.



### 4.3 SUBCRITERIA

Each evaluation criterion is divided into one or more subcriteria. Each subcriterion becomes the title of the WorldSkills evaluation form.

Each section of the evaluation form (subcriterion) is completed on a specific day.

Each section of the evaluation form (subcriterion) contains aspects that must be assessed by measurable parameters or judgement. Some subcriteria contain aspects that are assessed both by judgement and measurable parameters. In this case, a separate section of the evaluation form for each method is developed.

### 4.4 ASPECTS

Each aspect describes in detail one of the evaluated parameters, as well as possible points or instructions for marking. Aspects are assessed either by measurable parameters or judgement and recorded in a corresponding evaluation form.

The evaluation form describes in detail each assessed aspect, together with the number of points for its evaluation and a reference to a section on specific professional skills in the standard specification.

The sum of points intended for the evaluation of each aspect should fall within the range of points defined for this section on specific professional skills in the standard specification. This will be presented in the CIS distribution table, in the following format, when the marking scheme is considered for weeks C-8 (see section 4.1).

Tabulated form of the CIS distribution of points:

		CRITERIA								TOTAL SUM OF POINTS FOR EACH SECTION	WORLD SKILLS STANDARD SPECIFICATIONS FOR EACH SECTION	VARIANCE
		A	B	C	D	E	F	G	H			
SECTION OF STANDARD SPECIFICATIONS	1											
	2											
	3											
	4											
	5											
	6											
TOTAL MARK												

### 4.5 EVALUATION AND CLASSIFICATION BASED ON JUDGEMENT

A scale of 0-3 points is used for making a decision. For a clear and consistent application of the scale, the judgement should be made taking into account:



- benchmarks for comparison (criteria) for detailed guidance on each aspect
- scale 0-3, where:
  - 0: performance does not correspond with the industry standard;
  - 1: performance corresponds with the industry standard;
  - 2: performance corresponds with the industry standard and in some respects is superior to it;
  - 3: performance completely exceeds the industry standard and is evaluated as excellent

Each aspect is evaluated by three experts, and the fourth acts as a judge, when it is necessary to avoid evaluation of the competitor by his/her compatriot.

## 4.6 EVALUATION AND CLASSIFICATION BASED ON MEASURABLE PARAMETERS

Three experts evaluate each aspect. Unless otherwise stated, only maximum or zero point is displayed. If within any aspect it is possible to mark below the maximum, this should be explicitly stated.

## 4.7 EVALUATION OF JUDGEMENT AND MEASURABLE PARAMETERS

The decisions regarding the selection of evaluation criteria and methods are taken during the preparation of the competition by means of marking scheme and competition task.

## 4.8 PROCEDURE OF THE PROFESSIONAL SKILLS EVALUATION

### Module 1 — Photometric methods for determination of a metal ion content in a salt solution

The number of points for the module is 25 (max. 100 points)

The experts assess by the measurable parameters according to the following subcriteria:

Occupational safety at a work place;  
Selection of glassware and preparation of reagents;  
Organization of a work place;  
Carrying out the selected task;  
Interpretation and analysis of the obtained data;  
Waste disposal.

### Module 2 – Determination of the mass fraction of acid by potentiometric method. Calibration of pH-meter using buffer solutions (according to the instrument manual)

The number of points for the module is 20 (max. 100 points)

The experts assess by the measurable parameters according to the following subcriteria:

Occupational safety at a work place;  
Selection of the glassware;  
Organization of a work place;  
Carrying out the selected task;  
Interpretation and analysis of the obtained data;  
Waste disposal.



### **Module 3 — Analysis of pharmaceuticals by refractometric method**

The number of points for the module is 10 (max. 100 points)

The experts assess by the measurable parameters according to the following subcriteria:

- Occupational safety at a work place;
- Selection of glassware and preparation of reagents;
- Organization of a work place;
- Carrying out the selected task;
- Interpretation and analysis of the obtained data;
- Waste disposal.

### **Module 4 — Titration methods for the determination of individual metals ions and several ions in the joint presence**

The number of points for the module is 25 (max. 100 points)

The experts assess by the measurable parameters according to the following subcriteria:

- Occupational safety at a work place;
- Selection of glassware and preparation of reagents;
- Organization of a work place;
- Carrying out the selected task;
- Interpretation and analysis of the obtained data;
- Waste disposal.

### **Module 5 – Preparation of a volumetric solution for acid-base titration**

The number of points for the module is 20 (max. 100 points)

The experts assess by the measurable parameters according to the following subcriteria:

- Occupational safety at a work place;
- Selection of glassware and preparation of reagents;
- Organization of a work place;
- Carrying out the selected task;
- Interpretation and analysis of the obtained data;
- Waste disposal.

## **4.9 PROCEDURES OF THE PROFESSIONAL SKILLS EVALUATION**

Each module of the competition task is accompanied by the draft of marking scheme, based on the evaluation criteria defined in the section 4.8. All criteria are evaluated by the measurable parameters. The draft of marking scheme is developed by a person or persons engaged in the development of the competition task. A detailed final marking scheme is developed and approved by all experts at the competition.

Before the competition beginning, the senior expert explains the method of evaluation to all experts and ensures the plotting of an evaluation schedule.

In the process of each module evaluating one expert is assigned to a particular competitor and gives 100% of points according to the table of evaluation criteria. When performing tasks on a site, there are two or more independent experts, not assigned to a particular competitor. They freely move through the competition site and participate in the evaluation of the work of all competitors. Thus, the evaluation of each competitor is provided by a group of three experts.



## 5 COMPETITION TASK

### 5.1 GENERAL NOTES

The competition task is developed in accordance with sections 3 and 4. These notes are additional.

Regardless of whether the competition task is integral or set of separate or linked modules, it provides an evaluation of the professional skills for each section of the WorldSkills standard specifications (WSSS).

The purpose of the competition task is to provide full and balanced opportunities for the evaluation and award of points according to standard specifications in conjunction with the marking scheme. The relationship between competition task, marking scheme and standard specifications is a key indicator of quality.

The competition task should not concern areas that are not related to the standard specifications, or affect the balance of marks within standard specifications in a manner different from that specified in the section 2.

The competition task allows to evaluate knowledge and understanding exclusively in the conditions of a practical operation.

The competition task does not evaluate the knowledge of the WorldSkills rules and specifications.

This Technical Description identifies all the problems that could affect the ability of the competition task to provide an adequate evaluation process in relation to standard specifications. See Section 5.3.

### 5.2 COMPETITION TASK DESIGN/STRUCTURE

The competition task consists of at least three independent modules, which are evaluated separately.

During the performing of modules, the following areas of knowledge may be tested:

- occupational health and safety regulations and fire protection rules;
- main principles of experiment design;
- rules of the making up of technical documentation for analysis;
- construction of instruments for the analytical control and procedures of work on them;
- chemical and instrumental methods of substance analysis;
- chemical properties of tested and synthesized substances;
- work with chemicals in compliance with occupational and environmental safety;
- sampling for analysis;
- selection of optimal methods for the analysis of a chemical object;
- analysis of natural and industrial materials by chemical and instrumental methods;
- control of the quality parameters of measurements;
- recording of the experimental results.

### 5.3 REQUIREMENTS TO THE COMPETITION TASK STRUCTURE

The competition task consists of five independent modules:

**Module 1** (4 hours): Photometric methods for determination of a metal ion content in a salt solution

The competitor must make and implement an algorithm for performing the experimental task in accordance with the normative document (ND). Prepare the necessary reagents to determine the content of the metal



ion according to the ND. The state reference standard of the ion to be analyzed is proposed as the control. To obtain the necessary results, the use of QA 5300 PC software is suggested.

**Module 2** (3 hours): Determination of a mass fraction of an acid by potentiometric method. Calibration of pH-meter using buffer solutions (according to the instrument manual).

To execute this module an algorithm of performing the experimental task in accordance with the normative document is to be made and implemented. Prepare the equipment for the experiment. Perform instrument setup and calibration using buffer solutions. The determination according to GOST should be performed.

**Module 3** (2 hours): Analysis of pharmaceuticals by refractometric method.

The competitor must make and implement an algorithm for performing the experimental task in accordance with the analytical procedure. The glassware is to be prepared for the experiment.

**Module 4** (4 hours): Titration methods for the determination of individual metals ions and several ions in a joint presence.

Determine the main substance in crystalline hydrate by the complexometric method.

In order to perform this module an algorithm of the experimental task in accordance with the normative document is to be compiled and implemented. Glassware is to be ready. The reagents are to be prepared. A work place is to be organized. A dry salt is provided for the test. The obtained data are to be analyzed in accordance with the ND.

**Module 5** (3 hours): Preparation of a volumetric solution for acid-base titration.

In order to perform this module an algorithm of the experimental task in accordance with the normative document is to be compiled and implemented. Glassware is to be ready for the experiment. A volumetric solution is to be prepared according to the proposed procedure. The concentrated solutions of acids and alkalis are provided for the experiment. A determination of the solution concentration is to be conducted in accordance with the interstate standard.

## 5.4 DEVELOPMENT OF THE COMPETITION TASK

The competition task should be MANDATORY submitted on the WorldSkills International templates ([www.worldskills.org/expertcentre](http://www.worldskills.org/expertcentre)).

### 5.4.1 Who develops the competition task and modules?

The competition tasks and modules are developed by experts in the competence of chemical analysis service, expressing interest in the development of these tasks and having obtained the agreement of the senior expert. The competition task can be developed by a third-party company.

### 5.4.2 How and where are the competition tasks and modules developed?

Development of the competition task is carried out by experts jointly or separately with the use of the expert's forum (<http://forum.worldskills.ru>). The experts compile five modules of the competition task. During the entire preparation period for the competition and the competition itself, the presence of the technology staff, developer of the competition task is necessary.

### 5.4.3 When a competition task is being developed?

The competition task is developed in the following terms:





TIME	ACTION
Not later than 2 (two) months before the competition	The experts develop modules of the competition task. The competition task is posted in the appropriate closed group on the discussion forum in the “Chemical Analysis Service” skill section
For 1.5 (one and a half) months before the competition	The competition task is selected by voting of the WSR experts on the discussion forum in the “Chemical Analysis Service” skill section
Not later than 1 (one) month before the competition	The competition task is approved by the WSR technical director
During the competition	Experts make 30% of changes in the modules of the competition task

## 5.5 JUSTIFICATION OF THE COMPETITION TASK

The WSR technical director of the competition should approve the concept and design of the competition task before posting on the forum for review by experts.

## 5.6 SELECTION OF THE COMPETITION TASK

Only modules that meet the specified requirements are allowed to be selected.

The competition task is selected by voting of the WSR experts on the discussion forum in the skill section “Chemical Analysis Service” for 1.5 months before the competition beginning.

A typical task is posted in an open forum for review by all WSR experts of this competition. Comments and discussions will be taken into account when developing the final version of the competition task modules.

All Experts are divided into groups at the competition. Each group is assigned to test feasibility of the tasks selected for the competition. The group will be required to:

- Check availability of all documents;
- Check the compliance of the competition task with the project criteria;
- Make sure of the competition task feasibility for the allotted time;
- Make sure of the adequacy of the proposed marking scheme;
- If, as a result, the competition task is considered incomplete or unfeasible, it is canceled and replaced by a alternate task.

## 5.7 DISTRIBUTION OF THE COMPETITION TASK

A typical competition task is announced in the forum <http://forum.worldskills.ru> two months before the competition beginning.

## 5.8 APPROVAL OF THE COMPETITION TASK (PREPARATION FOR COMPETITION)

The competition task is approved by the senior expert and the organizer of the competition.



## 5.9 CHANGE OF THE PROJECT DURING THE COMPETITION

Due to the distribution of the competition task among the competitors before the competition, it is necessary that competition task modules and corresponding marking schemes provide for at least 30% of unknown modules or unknown components.

## 5.10 MATERIAL OR MANUFACTURER SPECIFICATIONS

Certain material or manufacturer specifications required for the competition task performing by the competitor are provided by the competition organizer and will be available at [www.worldskills.org/infrastructure](http://www.worldskills.org/infrastructure) located in the Expert Center.

The competition organizer provides complete information about the equipment (brand, model, etc.) included in the infrastructure list so that the competitors could become acquainted with the manufacturer's instructions for the usage of this equipment. If necessary, during the review, the technical expert organizes the demonstration on-site.



## 6 PROFESSIONAL SKILLS MANAGEMENT AND COMMUNICATION

### 6.1 EXPERT FORUM

Prior to the competition, all discussions, communication, cooperation and making decisions regarding professional competition should be held at the Expert Forum on this skill (<http://forums.worldskills.org>). The decisions related to the professional skills and information exchange are only valid if they occur on the forum. The senior expert (or an expert appointed by the senior expert) is the moderator of this Forum. The communications schedule and requirements for the competition plan development are described in the competition rules.

### 6.2 INFORMATION FOR COMPETITORS

All information for registered competitors is available at the Competitor Center ([www.worldskills.org/competitorcentre](http://www.worldskills.org/competitorcentre)).

This information includes:

- Competition rules
- Technical descriptions
- Marking schemes
- Competition tasks
- Infrastructure list
- WorldSkills safety, health and environment policy and regulations
- Other information related to the championship

### 6.3 COMPETITION TASKS [AND MARKING SCHEME]

The distributed competition tasks will be available on the site [www.worldskills.org/testprojects](http://www.worldskills.org/testprojects) and in the Competitor Center ([www.worldskills.org/competitorcentre](http://www.worldskills.org/competitorcentre)).

### 6.4 DAILY MANAGEMENT

The daily management of the professional skills during the competition is defined in the Plan of skills management, which is developed by a team of professional skills management under the supervision of the senior expert. The team of the professional skills management includes the chairman of the jury, the senior expert and assistant senior expert. The Plan of professional skills management is developed within six months prior to the competition and is finally agreed in the competition by decision of experts. The plan of the professional skills competition can be viewed at the Expert Center ([www.worldskills.org/expertcentre](http://www.worldskills.org/expertcentre)).



## 7 SAFETY REQUIREMENTS FOR A SPECIFIC SKILL

See the rules of country or region of the organizer and WorldSkills healthy, safety and environment regulations.

Also, the following safety requirements are mandatory for professional skills presentation:

- Do not place cords of electrical appliances on the aisle, they must be attached to the floor and table with adhesive tape
- When in the work area, the competitors should use appropriate personal protective equipment, including protective garment, shoes, glasses and gloves
- When handling aggressive reagents, the competitors should work in a fume hood with the ventilation turned on
- When in the work area, the experts should wear protective garment and, and if necessary, use appropriate personal protective equipment
- If the competitor does not comply with safety requirements, endangers himself/herself or other competitors, he/she may be disqualified from the competition.



## 8 MATERIALS AND EQUIPMENT

### 8.1 INFRASTRUCTURE LIST

The infrastructure list specifies in detail all the equipment, materials and instruments provided by the competition organizer.

The infrastructure list is available on the website [www.worldskills.org/infrastructure](http://www.worldskills.org/infrastructure).

The infrastructure list specifies the items and quantity of materials requested by experts for the following competition. The competition organizer should constantly update the infrastructure list, specifying the actual quantity, type, brand and model of the items. The items provided by the competition organizer are listed in a separate column.

At each competition, in preparation for the next competition, experts should check and update the infrastructure list. The experts should advise the director of the professional skills competition for any changes in the area or quantity of equipment.

At each competition professional skill, a technical reviewer should check the infrastructure list that was used in this competition.

The infrastructure list does not include the items that competitors and (or) experts should bring, as well as items that are prohibited to be brought by the competitors - they are listed below.

### 8.2 COMPETITOR TOOLBOX

The competitors should bring with them their own tools that are not prohibited in the infrastructure list. In the context of the “Chemical Analysis Service” skill the competitor toolbox is a set of necessary tools that can be brought to the site in a small package, bag or without additional packaging.

### 8.3 MATERIALS, EQUIPMENT AND INSTRUMENTS OF THE COMPETITORS KEPT IN THE TOOLBOX

Personal protective equipment:

- medical rubber gloves
- safety glasses
- lab coat
- hair net

Supporting materials:

- rubber pipette fillers capacity 30 and 90 cm<sup>3</sup>
- cloth napkins
- magnifier
- laboratory hammer
- burette screen
- calculator
- pen
- pencil

The experts check the competitor toolbox every day before the start of the competition.



## 8.4 MATERIALS, EQUIPMENT AND INSTRUMENTS PROVIDED BY THE EXPERTS

Not applicable.

## 8.5 MATERIALS AND EQUIPMENT PROHIBITED AT THE COMPETITION SITE

Any materials and equipment available to the competitors should be presented to the experts. The jury has the right to prohibit the use of any items that are deemed not relevant to chemical analysis or which can give an unfair advantage to the competitor.

The competitors are prohibited from bringing into the work area:

- Books, notebooks, copybooks
- Portable PC
- Mobile phones, smart phones
- Tablet PC
- Other electronic personal communication devices

In case of such items finding, they will be confiscated with a return at the end of the competition.

## 8.6 PROPOSED WORK SITE AND WORK PLACE LAYOUTS

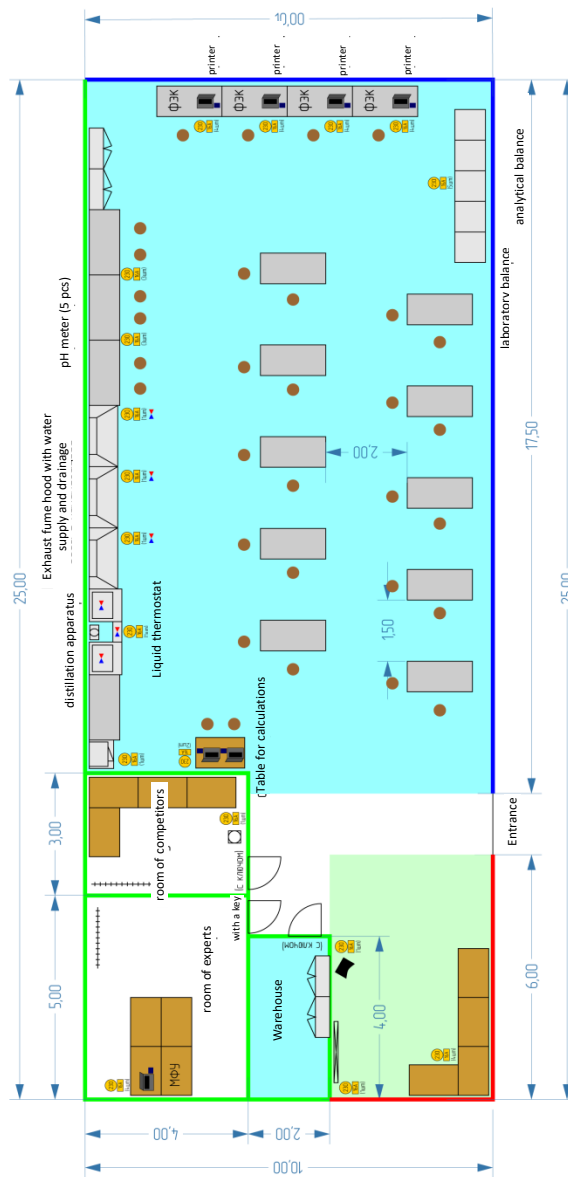
The layouts of the work sites of previous competitions are available on the website [www.worldskills.org/sitelayout](http://www.worldskills.org/sitelayout).

An approximate layout of the competition site within the skill:



# Chemical Analysis Service

- wall 1000 mm
- wall 2500 mm
- glasses
- Working area with a chemically resistant coating
- Presentation area
- Laboratory bench with chemically resistant coating 1600x750 mm
- Meeting table
- Sink-bench
- Exhaust fume hood
- Stool
- Shelf stand for reagents and glassware
- Drying oven with a base 60x70
- Distillation apparatus
- Liquid thermostat
- Antivibration table for balances
- Portable PC (laptop)
- Audio system on a stand
- LCD screen on a stand
- Water cooler
- Clothes hanger





## 9 SPECIAL RULES FOR CERTAIN PROFESSIONAL SKILLS

The rules of certain professional skills should not contradict the Competition Rules or have an advantage over them. They provide specific clarifications and details on those areas that can vary from one competition to another. Among others, they relate to personal computing equipment, storage devices, Internet access, procedures and sequence of work performing, and the maintenance and distribution of the documentation.

TOPIC/TASK	RULES FOR CERTAIN PROFESSIONAL SKILLS
Hardware - USB, memory sticks	The competitors are not allowed to bring memory ticks to the work site
The use of technologies - personal portable computers, tablets and mobile phones	The experts and translators are allowed to use personal portable computers, tablets and mobile phones exclusively in the room of experts; The competitors are not allowed to use personal portable computers, tablets, mobile phones
The use of technologies - personal devices for photo and video recording	The competitors, experts and translators are allowed to use personal devices for photo and video recording at the work site only after the end of the competition
Procedures of tasks performing, recording	The competitors, experts and translators are not allowed to take the procedures of performing the modules of the competition task from the work site
Templates, manuals, etc.	The competitors are not allowed to bring books and other reference materials to the work site
Equipment failure	In a case of a malfunction of the instrument or equipment provided by the competition organizer, the competitors are given additional time. The competitors should immediately contact the senior expert if a malfunction of the equipment is detected.
Health, safety and environment	It is necessary to read and understand the WorldSkills document "Safety, health and environment policy" and other guidance documents
Competition task	The competitor is not allowed to perform any part of the competition task or any materials outside the competition venue

## 10 PARTICIPATION OF VISITORS AND PRESS

The competition site of the "Chemical Analysis Service" skill should maximally involve visitors and journalists in the process. To achieve this goal, using of the following ideas should be considered:

- to invite visitors to try themselves in the profession: an interactive site where visitors and members of the press can try themselves as a chemist
- to use demonstration screens showing the work progress and information about the competitor, advertising career prospects
- to place on the stands text descriptions of competition tasks for public viewing





## 11 ENVIRONMENT SAFETY

The professional skills competition is conducted taking into account the listed principles of sustainable development:

- Recycling
- Usage of environment friendly reagents and materials
- Developers of tasks should emphasis on environmental issues in the preparation of a task
- A proper disposal of waste reagents and materials after the end of the competition;
- The competition tasks will be designed in such a way as to minimize the quantity of necessary materials, reagents, equipment and space.



## 12 LINKS FOR CONSULTATIONS WITH THE MARKET PLAYERS

WorldSkills is interested in *ensuring* that the WorldSkills standard specifications fully reflect the dynamics of applying globally best practices in industry and business. To achieve this, WorldSkills *collaborates* with a number of organizations around the world to find out their opinions on the draft document “Description of the Associated Role” and WorldSkills standard specifications for two years.

In addition, the databases of career research and analysis, O\*NET OnLine ([www.onetonline.org/](http://www.onetonline.org/)), is used as a reference to all professions presented in WorldSkills competitions.

The following table lists the organizations that expressed their opinions on the draft document “Description of the Associated Role” and standard specifications during the WorldSkills competition in Abu Dhabi in 2017.

ORGANIZATION	CONTACT PERSON