

## Theory



54<sup>th</sup> IChO 2022  
International Chemistry Olympiad  
TIANJIN, CHINA

# A1-1

Russian (Kazakhstan) (Kazakhstan)

## Быстрый и наглядный тест на COVID-19

Вес: 9 %						
Вопрос	1.1	1.2	1.3	1.4	1.5	Всего
Очки	1	1	4	4	4	<b>14</b>
Результат						

**1.1** (1.0 pt)

(a)

(b)

(c)

(d)

(e)

(f)

**1.2** (1.0 pt)

(a)

(b)

(c)

**1.3** (4.0 pt)

$N =$  \_\_\_\_\_

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# A1-2

Russian (Kazakhstan) (Kazakhstan)

1.4 (4.0 pt)

$\varepsilon =$  \_\_\_\_\_ л·моль<sup>-1</sup>·см<sup>-1</sup>

1.5 (4.0 pt)

$C_X =$  \_\_\_\_\_ μг·мл<sup>-1</sup>

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# A2-1

Russian (Kazakhstan) (Kazakhstan)

## Хром в прошлом и настоящем

Вес: 11 %										
Вопрос	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	Всего
Очки	2	1	6	1	2	1	1	5	2	21
Результат										

2.1 (2.0 pt)

A: \_\_\_\_\_ B: \_\_\_\_\_

2.2 (1.0 pt)

2.3 (6.0 pt)

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# A2-2

Russian (Kazakhstan) (Kazakhstan)

2.4 (1.0 pt)

2.5 (2.0 pt)

2.6 (1.0 pt)

(A)       (B)       (C)       (D)

2.7 (1.0 pt)

(A)       (B)       (C)       (D)

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# A2-3

Russian (Kazakhstan) (Kazakhstan)

2.8 (5.0 pt)

$\tilde{\nu}_{\text{CKП}} = \text{_____ cm}^{-1}$

2.9 (2.0 pt)

$\mu = \text{_____ } \mu_{\text{B}}$

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# A3-1

Russian (Kazakhstan) (Kazakhstan)

## Улавливание и конверсия углекислого газа

Вес: 14 %													
Вопрос	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	Всего
Очки	2	5	2	3	2	8	2	2	5	7	2	2	42
Результат													

3.1 (2.0 pt)

A: \_\_\_\_\_

B: \_\_\_\_\_

3.2 (5.0 pt)

стадия 1:

стадия 2:

стадия 3:

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# A3-2

Russian (Kazakhstan) (Kazakhstan)

**3.3** (2.0 pt)

A:

C:

**3.4** (3.0 pt)

реакция 1:

реакция 2:

реакция 3:

**3.5** (2.0 pt)

[ ] (a)

[ ] (b)

[ ] (c)

[ ] (d)

[ ] (e)



3.6 (8.0 pt)

$r(\text{CO}_2) = \underline{\hspace{2cm}}$  ммоль · мин<sup>-1</sup>

3.7 (2.0 pt)

3.8 (2.0 pt)



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# A3-4

Russian (Kazakhstan) (Kazakhstan)

3.9 (5.0 pt)

$$S = \text{_____} \text{M}^2$$

3.10 (7.0 pt)

$$R = \text{_____}; V_p = \text{_____} \text{cm}^3$$

3.11 (2.0 pt)

I: [ ] (a)      [ ] (b)      [ ] (c)      [ ] (d)  
II: [ ] (a)      [ ] (b)      [ ] (c)      [ ] (d)

3.12 (2.0 pt)

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# A4-1

Russian (Kazakhstan) (Kazakhstan)

## Новая жизнь античной серы

Вес: 16 %													
Вопрос	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	4.12	Всего
Очки	2	4	4	3	1	5	2	4	5	4	6	5	45
Результат													

4.1 (2.0 pt)

4.2 (4.0 pt)

4.3 (4.0 pt)

\_\_\_\_\_ %

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# A4-2

Russian (Kazakhstan) (Kazakhstan)

**4.4** (3.0 pt)

(a)

(b)

**4.5** (1.0 pt)

отношение масс: \_\_\_\_\_

**4.6** (5.0 pt)

\_\_\_\_\_ ч

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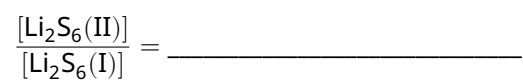
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# A4-3

Russian (Kazakhstan) (Kazakhstan)

4.7 (2.0 pt)

4.8 (4.0 pt)



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# A4-4

Russian (Kazakhstan) (Kazakhstan)

4.9 (5.0 pt)



4.10 (4.0 pt)

(1) \_\_\_\_\_ > (2) \_\_\_\_\_ > (3) \_\_\_\_\_ > (4) \_\_\_\_\_

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# A4-5

Russian (Kazakhstan) (Kazakhstan)

4.11 (6.0 pt)

$$E^{\ominus}(\text{Li}^+(\text{DMЭ})/\text{Li}) = \text{_____} \text{ В}$$

4.12 (5.0 pt)

$$m(\text{Li}_2\text{S}) = \text{_____} \text{ МГ}$$

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# A5-1

Russian (Kazakhstan) (Kazakhstan)

## Взаимные превращения оксидов азота

Вес: 15 %											
Вопрос	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	5.10	Всего
Очки	4	4	2	4	3	8	4	6	4	6	45
Результат											

5.1 (4.0 pt)

$r_+$  = \_\_\_\_\_

5.2 (4.0 pt)

$A_+$  = \_\_\_\_\_,  $E_{a^+}$  = \_\_\_\_\_

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# A5-2

Russian (Kazakhstan) (Kazakhstan)

5.3 (2.0 pt)

$$k_+(700\text{ K}) = \text{_____} \text{ л}^2 \text{ моль}^{-2} \text{ мин}^{-1}$$

5.4 (4.0 pt)

$$K_p^\ominus(600\text{ K}) = \text{_____}$$



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# A5-3

Russian (Kazakhstan) (Kazakhstan)

5.5 (3.0 pt)

$$\Delta_r U_m^\ominus = \text{_____} \text{ кДж моль}^{-1}$$

5.6 (8.0 pt)

$$r_- = \text{_____}, k_- (600 \text{ K}) = \text{_____}$$

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# A5-4

Russian (Kazakhstan) (Kazakhstan)

5.7 (4.0 pt)

$p_{\text{общ}} =$  \_\_\_\_\_ кПа

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# A5-5

Russian (Kazakhstan) (Kazakhstan)

5.8 (6.0 pt)

$\theta_v =$  \_\_\_\_\_

5.9 (4.0 pt)

(A)       (B)       (C)       (D)

5.10 (6.0 pt)

(A)       (B)       (C)

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# A6-1

Russian (Kazakhstan) (Kazakhstan)

## Фосфины открывают широкие возможности

Вес: 7 %								
Вопрос	6.1	6.2	6.3	6.4	6.5	6.6	6.7	Всего
Очки	3	6	8	5	6	3	5	<b>36</b>
Результат								

6.1 (3.0 pt)

\_\_\_\_\_

6.2 (6.0 pt)

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# A6-2

Russian (Kazakhstan) (Kazakhstan)

**6.3** (8.0 pt)

**B'** (4.0 pt)

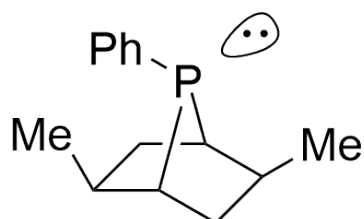
**C'** (4.0 pt)

**6.4** (5.0 pt)

**6**



6.5 (6.0 pt)



P2

6.6 (3.0 pt)

\_\_\_\_\_

6.7 (5.0 pt)

 (a) (b) (c) (d)

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# A7-1

Russian (Kazakhstan) (Kazakhstan)

## Органические молекулы и жизнь

Вес: 9 %				
Вопрос	7.1	7.2	7.3	<b>Всего</b>
Очки	12	8	12	<b>32</b>
Результат				

### 7.1 (12.0 pt)

7 (4.0 pt)

9 (4.0 pt)

12 (4.0 pt)

### 7.2 (8.0 pt)

15 (4.0 pt)

16 (4.0 pt)

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# A7-2

Russian (Kazakhstan) (Kazakhstan)

**7.3** (12.0 pt)

**21** (4.0 pt)

**24** (4.0 pt)

**25** (4.0 pt)





## Удивительный хиральный спиро-катализатор

Вес: 10 %									
Вопрос	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	Всего
Очки	16	2	2	2	2	8	2	2	36
Результат									

## Часть А

8.1 (16.0 pt)

1(4.0 pt)

2(4.0 pt)

4(4.0 pt)

5(4.0 pt)

8.2 (2.0 pt)

 (a) (b) (c) (d)

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# A8-2

Russian (Kazakhstan) (Kazakhstan)

**8.3** (2.0 pt)

(a)       (b)       (c)       (d)

### Часть В

**8.4** (2.0 pt)

\_\_\_\_\_

**8.5** (2.0 pt)

\_\_\_\_\_

**8.6** (8.0 pt)

**15**(4.0 pt)

**16**(4.0 pt)

**8.7** (2.0 pt)

(a)       (b)       (c)       (d)

**8.8** (2.0 pt)

(a)       (b)       (c)       (d)

## Theory



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# A9-1

Russian (Kazakhstan) (Kazakhstan)

## Полный синтез капитулактона

Вес: 9 %					
Вопрос	9.1	9.2	9.3	9.4	<b>Всего</b>
Очки	24	2	16	2	<b>44</b>
Результат					

### 9.1 (24.0 pt)

3 (4.0 pt)

4 (4.0 pt)

5 (4.0 pt)

8 (4.0 pt)

# Theory



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# A9-2

Russian (Kazakhstan) (Kazakhstan)

## 9.1 (cont.)

9 (4.0 pt)

11(4.0 pt)

## 9.2 (2.0 pt)

(a)

(b)

(c)

(d)

# Theory



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# A9-3

Russian (Kazakhstan) (Kazakhstan)

**9.3** (16.0 pt)

**15** (4.0 pt)

**16** (4.0 pt)

**18** (4.0 pt)

**19** (4.0 pt)

**9.4** (2.0 pt)

[ ] (a)

[ ] (b)

[ ] (c)

[ ] (d)