

«

»

'M1\\_j' ^ Zx

-

«09»

2021 .

**JZ[hqZy ijh]jZffZ ^bkpbiebgu**  
;1.H.21 L\_hjby nmgdabc dhfie\_dkgh]h i\_j\_f\_ggh]h

: 11.03.0JZ ^bhl\_ogbdZ

( ): JZ ^bhwe\_dljhggu\_ kbkl\_fu b dhfie\_dku

:

-2  
-3

-3, -108

: -3

: - , . .

«02»

2021 .,

1

2021

1. F\_klh ^ bkpbiebgu \ kljmdlmj\_ HHI

« »

11.03.01

« »

, « », « »  
 « ».  
 »  
 , « ».  
 « »

2. IeZgbjm\_fu\_j\_amevlZlu h[mq\_gby ih ^ bkpbiebg

<p>HII-1.</p>	<p>AgZ:                  Mf_lv                  &lt;eZ ^ :lv</p>
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3. Kh^\_j'Zgb\_ ^ bkpbiebgu

1. Dhfie\_dkgZy iehk@hklv
2. Ij^\_e, g\_ij\_ju\ghklv,a\h'jghZy.
3. We\_f\_glZjgu\_ nmgd@pbb gZ
4. Bgl\_]jZe hl nmgdpbb dhfie\_dkgh]h i\_j\_f\_ggh]h  
( )
5. Kl\_i\_ggu\_ jy^u, l\_hj\_fZ \_^bgkl\\_gghklb  
( ).
6. Jy^ EhjZgZ. Hkh[u\_ lhqdb. <uq\_lu

#### 4. L\_fZlbq\_kdbc ieZg

/					
1	$C$	16	2	4	10
2	,	18	2	6	10
3	$C$	16	2	4	10
4		20	4	6	10
5	,	18	2	6	10
6	.	20	4	6	10
<b>BLH = H</b>		<b>108</b>	<b>16</b>	<b>32</b>	<b>60</b>

#### 5. < b ^ m [ j Z a h \ Z l \_ e v g h k l b A Z g y l b y e \_ d p b h g g h ] h l b i Z

**E\_dpbH** . Комплексная плоскость  $C$ .

- 1.
- 2.
- 3.
- 4.

**E\_dpbZ** . Предел, непрерывность. Производная комплексной функции.

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

$$w = |z| \quad w = \arg z.$$

**E\_dpyb 3** . Элементарные функции.

- 1.
- 2.
- 3.
- 4.

**E\_dpy 4** . Интеграл.

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

**Е\_дпбу 6** Степенные ряды.

1. ( ).
2. .
3. .
4. .
5. .
6. .

**Е\_дпбу 8.** Особые точки. Вычеты.

1. .
2. , .
3. .
4. ( ).
5. .

**AZgylby k\_fbgZjkdh]h lbiZ b kZfhklhyl\_evgy jZ[h1Z**

**IjZdlbq\_kdZgyhb\_ .Dhfie\_dkgu\_qbkeZ b ^\_ckl\by gZ^ gfbf  
L\_hj\_lbq\_kdb\_ \hijk**

1. ?
2. ?
3. ?
4. ?
5. , ?
6. ?
7.  $z = a + bi$ .
8. ?
9. ?
10. ?
11. ?
12. ?
13. ?
14.  $n$ - ?

**AZ^Zqb b mijZ'gy gZy^blhjhgc jZ[hlu**

1.  $z_1 = 1 + i, z_2 = 2 - i$ .  
:  $z_3 = z_1 + z_2, z_4 = z_1 \cdot z_3, z_5 = \frac{z_2}{z_4}, z_6 = z_4 - z_5$ .
2.  $z$ , :  
)  $z = 3$ ; )  $z = -2$ ; )  $z = 3i$ ; )  $z = -2i$ ;  
)  $z = 1 - i$ ; )  $z = -1 + \sqrt{3}i$ ; )  $z = -\sqrt{3} - i$ ; )  $z = \sin \alpha + i \cos \alpha$ .
3. ,  $|z_1 - z_2|$   $z_1 z_2$
4. :  
)  $z \cdot \bar{z} = |z|^2$ ; )  $|z| = |\bar{z}|$ ; )  $Arg(z_1 \cdot z_2) = Arg z_1 + Arg z_2$ .

5. )  $z^2 + 25 = 0$ ; )  $z^2 + 4z + 13 = 0$ ; )  $z^3 - 2i = 0$ .

**A Z ^ Z g b \_ ^ e y k Z f h k l h y l \_ e v g h c j Z [ h l u**

1.  $z_1 = i, z_2 = 1 - 2i$ . :  $z_3 = z_1 - z_2, z_4 = z_2 \cdot z_3, z_5 = \frac{z_2}{z_4}$ .

2. )  $z = -1 + i$ ; )  $z = \sqrt{3} - i$ ; )  $z = \sin \alpha - i \cos \alpha$ .

3. )  $z + \bar{z} = 2 \operatorname{Re} z$ ; )  $z^2 = \bar{z}^2$ ; )  $\operatorname{Arg}(z^2) = 2 \operatorname{Arg} z$ .

4. )  $|z - i| = |2 - i|$ ; )  $|iz - 1| = |z - 1|$ ; )  $\arg(iz + 1) = \frac{\pi}{2}$ .

5. )  $z^3 + 27 = 0$ ; )  $z^2 + 2z + 2 = 0$ ; )  $z^4 - 16i = 0$ .

**I j Z d l b q \_ k d h \_ a Z g y D h j b \ u 2 \_ b h [ e Z k l b g Z d h f i e \_ d k g h c i e h k d h k L \_ h j \_ l b q \_ k d b \_ \ h i j h k u**

1. ?

2.  $z_1 = x_1 + iy_1$   $z_2 = x_2 + iy_2$ .

3.  $z = x + iy$ .

4.  $z_0 = x_0 + iy_0$

5. ?

6.  $z, \bar{z}, -z$ .

7. ( )

**A Z ^ Z q b b m i j Z ' g \_ g b y ^ e y Z m ^ b l h j g h c j Z [ h l u**

1. :

)  $|z + 1 + i| = 2$ ; )  $\operatorname{Im} \frac{z}{1+i} = 0$ ; )  $|z + i| + |z - i| = 2$ ;

)  $\left| \frac{z-1}{z+1} \right| = 2$ ; )  $\operatorname{Re} z^2 = 1$ ; )  $\arg(2iz - 4) = 0$ .

2. )  $2 - i$  4;

)  $1 + i$ ,  $\frac{\pi}{3}$ ;

)  $2i - 2$ ,  $\varepsilon = 2$ .

3. :

)  $|z + 1 + 2i| > 2$ ; )  $-\frac{\pi}{4} < \operatorname{Arg}(z - 1) < \frac{\pi}{3}$ ; )  $|z + \bar{z}| < 4$ ;

)  $\operatorname{Re} z^2 < 2$ ; )  $\left| \frac{z-1}{z+i} \right| < 2$ ; )  $\arg z < 0$ .

4.  $z(t) = x(t) + i \cdot y(t)$ ,  $L$ , :

- )  $z(t) = 2 - 3it, t \in R$ ;
- )  $z(t) = 2t + 1 + (t - 2)i, t \in [-1; 2]$ ;
- )  $z(t) = 2 \sin t + i3 \cos t, 0 < t < \pi$ .

5.  $L$ , :

- )  $L - z = i, \text{Im} z = -1$ ;
- )  $L -$  ;
- )  $L - -1 + i, 2 - 3i$ .

**A Z ^ Z g b \_ ^ e y k Z f h k l h y l \_ e v g h c j Z [ h l u**

1. ,

:

- )  $|z + 1 + i| = |iz + 1 + i|$ ; )  $\text{Re} \frac{z+1}{1-i} = 0$ ; )  $|iz + 1| + |iz - 1| = 2$ ;
- )  $|z - 2| + |z + i| = 4$ .

2. :

- )  $1 + i, 2$ ;
- ) ,  $1 - i, |z - 1| = |z - i|$ ;
- )  $i - 2, \varepsilon = 0,5$ .

3. ,

:

- )  $|z + 1| > |iz - 2|$ ; )  $\arg(-i) < \arg(z - i) < \arg(i - 1)$ ;
- )  $|z - \bar{z}| \geq 1$ ; )  $\text{Re}(z \cdot \bar{z}) < 2$ .

4.  $L$ ,

$z(t) = x(t) + i \cdot y(t)$ , :

- )  $z(t) = 3t + 4it, t \in R$ ;
- )  $z(t) = 2t + 1 + (t + 1)^2 i, t \in [-1; 2]$ ;
- )  $z(t) = e^t + ie^{-t}, -1 < t < 1$ .

5.  $L$ , :

- )  $L - z = i, z = -2i, a = 4$ ;
- )  $L - xy = 1$ ;
- )  $L - , 1 + 2i, 3 - 4i$ .

**I j Z d l b q \_ k d h \_ a Z g y l b k e 3 ^ h \ Z l \_ e v g h k l b b j y ^ u u d b h f i l e k \_ d d g**  
**L \_ h j \_ l b q \_ k d b \_ \ h i j h k u**

1.

.

2.  $z = x + iy$

?

3.

4.

5. ?

6.

7. ?

8. ?

9.

10.

11.

**A Z ^ Z q b b m i j Z ' g \_ g b y ^ e y Z m ^ b l h j g h c j Z [ h l u**

1.  $z_n = \frac{n-1+(2n+3)i}{n}$

$a = 1 + 2i.$

2.  $\lim_{n \rightarrow \infty} z_n = 0, \quad \lim_{n \rightarrow \infty} |z_n| = 0.$

3.  $z_n, \quad :$

)  $z_n = \frac{n^2+1+in}{1+in^2};$  )  $z_n = \left(\frac{2+3i}{5}\right)^n.$

4.  $:$

)  $\sum_{n=1}^{\infty} \frac{i^n}{i+n^2};$  )  $\sum_{n=1}^{\infty} \frac{(3i)^n}{n!};$  )  $\sum_{n=1}^{\infty} \frac{n+1}{(1+i)^n}.$

**A Z ^ Z g b \_ ^ e y k Z f h k l h y l \_ e v g h c j Z [ h l u**

1.  $z_n = \frac{n^2-1+(n^2+1)i}{n^2+in-1}$

$a = 1 + i.$

2.  $z_n, \quad :$

)  $z_n = \left(1 + \frac{i}{n}\right)^n;$  )  $z_n = \arg\left(-1 + \frac{i^n}{n}\right).$

3.  $:$

)  $\sum_{n=1}^{\infty} \frac{n}{(3i)^n};$  )  $\sum_{n=1}^{\infty} \frac{n!}{(in)^n};$  )  $\sum_{n=1}^{\infty} \frac{(2i)^n}{n!}.$

**I j Z d l b q \_ k d h \_ a Z g y l H h g y 4 . b \_ n m g d p b b d h f i e ] h i \_ j \_ f \_ g g h ] h**  
**I j \_ ^ \_ e b g \_ i j \_ j u \ g h k l v n m g d p b b d h f i e \_ d k g h ] h i \_ j \_ f \_ g g h ] h**  
**L \_ h j \_ l b q \_ k d b \_ \ h i j h k u**

1.  $?$

2.  $w = f(z) \quad ( \quad )?$

3.  $W = z^3 \quad : )$   
 $z = x + iy; )$

4.  $w = f(z) \quad z_0$   
 « $\varepsilon - \delta$ » ( ).

5.  $.$

6.  $w = f(z) \quad z_0.$   
 $z = 0$

**A Z ^ Z q b b m i j Z ' g \_ g b y ^ e y Z m ^ b l h j g h c j Z [ h l u**

1.  $:$

)  $w = \frac{\operatorname{Re} z^2}{z};$  )  $w = \frac{\operatorname{Re} z}{\operatorname{Im} z};$  )  $w = \frac{z+i}{z-i};$  )  $w = \overline{z^2} + |z^2|.$

2.  $L = \{z : |z|=1\} \quad w = \frac{1}{2} \left( z + \frac{1}{\bar{z}} \right).$

3.  $w = \frac{1}{z}$   $z =$

$) x^2 + y^2 = 4;$   $) y = x;$   $) x = 1;$   $) (x-1)^2 + y^2 = 1?$

4.  $T = \{z : |z| < 1\}$

$) w = |z|;$   $) w = z - \bar{z}?$

5.  $w = f(z)$   $z_0,$   $:$

$) w = \frac{\operatorname{Re} z^2}{z}, z_0 = 0;$   $) w = \frac{\operatorname{Re} z}{\operatorname{Im} z}, z_0 = 1 + i.$

6.  $,$   $,$   $,$

$) \lim_{z \rightarrow a} f(z) = b;$   $) \lim_{z \rightarrow a} f(z) = \infty;$   $) \lim_{z \rightarrow \infty} f(z) = b;$

$) \lim_{z \rightarrow +\infty} f(z) = b;$   $) \lim_{z \rightarrow \infty} f(z) = \infty;$   $) \lim_{z \rightarrow \infty} f(z) = 0.$

7.  $f(z) = z^2 + \bar{z} \cdot (z+1)$

**A Z ^ Z g b \_ ^ e y k Z f h k l h y l \_ e v g h c j Z [ h l u**

1.  $:$

$) w = z^2 - \frac{1}{z^2};$   $) w = z^4 + 5;$   $) w = z^2 + az + b$  ( $a$   $b$  -

).

2.  $L = \{z : |z| = 1\}$   $w = \frac{1}{2} \left( z + \frac{1}{z} \right).$

3.  $w = \frac{1}{z}$   $z =$

$) x^2 + y^2 = 1;$   $) y = -x;$   $) y = 1;$   $) (x+1)^2 + y^2 = 1?$

4.  $T = \{z : |z| < 1\}$

$) w = |z-1|;$   $) w = \frac{1}{2} |z - \bar{z}|?$

5.  $,$   $,$   $:$

$) w = \frac{\bar{z}}{z};$   $) w = \frac{|z+i|^2}{z+i};$   $) w = i \arg(z-1).$

6.  $w = f(z)$   $z_0,$

$) w = \frac{\operatorname{Re} z^2}{z}, z_0 = 0;$   $) w = \frac{(z-1) \cdot \operatorname{Im}(z-1)}{|z-1|}, z_0 = 1.$

**I j Z d l b q \_ k d Z g y a b \_ 5 j h b a \ h ^ g Z y n m g d p b b d h f i e \_ d k g h ] h i \_ j \_ M k e h \ b y D - H b b Z g Z . g y h b \_ Z g Z e b l b q \_ k d h c n m g d p b b L \_ h j \_ l b q \_ k d b \_ \ h i j h k u**

1.  $w = f(z)$   $z_0.$



2. , .  
 3.  $z_0 = x_0 + iy_0$  .

4. ?  
 5. ?  
 6.  $f(z) = z^2 + (z-1) \cdot \bar{z}$  -

1.  $w = f(z)$   $z_0$ ,  
 :

)  $f(z) = z^3 - 3z^2 + 1, z_0 = 1 - i$ ; )  $f(z) = \frac{z+i}{z-i}, z_0 = -i$ .

2. )  $w = (\bar{z} - z)^2$ ; )  $w = \overline{z + \operatorname{Re} z}$ ; )  $w = (z+i)^3 - 2\bar{z}$ ;  
 )  $w = |z-i|^2 + (z-i)^2$ ; )  $w = iz^2 - 3z$ ; )  $w = \operatorname{Im} z + i \operatorname{Re} z$ .

3.  $w = \bar{z}$  ,  $a, b, c$  .

4.  $w = ax + by + i(cx + y)$

5. )  $f(z) = z^3 - z + 1$ ; )  $g(z) = z^2 - \bar{z}$ ; )  $q(z) = \frac{5}{z^2 - z}$ ?

1.  $w = f(z)$   $z_0$ ,  
 :

)  $f(z) = z^2 + 2z, z_0 = 3 + 2i$ ; )  $f(z) = \frac{z+1}{z-1}, z_0 = -1$ .

2.  $w = |z-a|^2$  ,  $a$  .

3. )  $w = (\operatorname{Re} z + i \operatorname{Im} \bar{z})^2$ ; )  $w = \operatorname{Im}(z + \operatorname{Re} z)$ ; )  $w = z^3 - 2|z-1|^2$ ;  
 )  $w = \overline{z-i} + (z-i)^2$ ; )  $w = z^2 + 2iz$ ; )

4.  $w = \operatorname{Re}^2 z - i \operatorname{Im}^2 z$  .

)  $f(z) = z^2 + \bar{z} - z$ ; )  $g(z) = z^{2015} - 2015$ ; )  $q(z) = \frac{z}{z^2 - 4}$ ?

**I j Z d l b q \_ k d H Z g y h b \_ 6 = \_ h f \_ l j b q \_ k d b c k f u k e f h ^ m e y b Z j ]**  
**i j h b a \ h ^ g h c n m g d p b b d h f i e \_ d k g h ] h i I j h g y l g h ] h . d h g n h j f g h f**  
**h l h [ j Z ' \_ g b b .**

1.  $f(z)$   
 $z_0$ ?

2.  $f(z)$   
 $z_0?$

3.  $z_0?$

4.  $D?$

5. ?

6.  $D = \{z \mid 0 < \text{Im} z < \pi\}$

7.  $W = e^z?$

1.  $C?$

1.  $w = f(z)$

$z_0, :$

)  $f(z) = z^3 - 3z^2 + 1, z_0 = 1 - i;$       )  $f(z) = \frac{z+i}{z-i}, z_0 = -i.$

2.  $\gamma_1: |z-1|=2 \quad \gamma_2: |z+1|=2$

3.  $w = iz^2 + z - \blacksquare.$

1.  $w = \frac{z+i}{z-i}$

4.  $w = \frac{iz+1}{iz-1}$

5.  $\text{Re} z = a \quad \text{Im} z = b \quad (a, b \in \mathbb{R})$

6.  $w = z^2.$

7.  $D = \left\{ z \mid -\frac{\pi}{4} < \text{Re} z < \frac{\pi}{4} \right\} \quad E = \{w \mid |w| < 1\}.$

1.  $w = f(z)$

$z_0, :$

)  $f(z) = (z-3)^2, z_0 = 2+i;$       )  $f(z) = \frac{iz+1}{z-1}, z_0 = -1.$

2. |

5.  $w = \frac{1}{z}$   $|z| = R, \arg z = \alpha$   
 ( $R > 0, 0 \leq \alpha < 2\pi$ ).  
 6.

**I j Z d l b q \_ k d h Z g y h b \_ . 7 E b g \_ c g Z y b ^ j l b g g h c g Z y n m g d p b b**  
**d h f i e \_ d k g h ] h i \_ j \_ f \_ g g h ] h b b o k \ h c k l \ Z**  
**L \_ h j \_ l b q \_ k d b \_ \ h i j h k u**

1.

2.

?

3. : Всякое линейное отображение  $W = az + b, a \neq 0$ ,  
 получается в результате суперпозиции трех простейших отображений:

)  $t = |a|z$  (отображение подобия  $z = 0$   
 $|a|$ );

)  $\tau = e^{i \arg a} t$  (вращение  $t = 0$   $\arg a$ );

)  $W = \tau + b$  (параллельный перенос  $b$   $|b|$ );

4.

5.

?

6. : Всякое дробно-линейное отображение  
 $W = \frac{az + b}{cz + d}, bc - ad \neq 0, c \neq 0$ , получается в результате суперпозиции следующих трех  
 простейших отображений:

)  $t = \frac{c^2}{bc - ad} z + \frac{cd}{bc - ad}$ ; )  $\tau = \frac{1}{t}$ ; )  $W = \frac{a}{c} + \tau$ ?

7.

8.

**A Z ^ Z q b b m i j Z ' g \_ g b y ^ e y Z m ^ b l h j g h c j Z [ h l u**

1.

$0, -1, i$

$0, 2, 1+i$ .

2.

$T_2 = \{z : |z - i| \leq 2\}$

3.

$w = \frac{z+1}{z}$ :

)  $|z| = 2$ ;

)  $|z-1| = 1$ ;

)  $\operatorname{Re} z = 0$ ;

)  $\operatorname{Im} z = 1$ .

4.

$T_1 = \{z : |z - 2i| \leq 1\}$

$w = (1+i)z + 2$ .

5.

$\operatorname{Re} z > 0$

$T_2 = \{w : |w| < 2\}$ .

**A Z ^ Z g b \_ ^ e y k Z f h k l h y l \_ e v g h c j Z [ h l u**

1.

$i$

$-1$ .

$2 - i$ ,

2.

$|z + 1 - i| \leq 4$

3.  $\frac{\pi}{2}$ ,  $i, \infty, 1$ ,  $1, -i, 1-i$
4.  $w = \frac{z-i}{z+i}$ :  
 )  $|z|=1$ ; )  $|z+1|=1$ ; )  $\operatorname{Re} z = 1$ .
5.  $\operatorname{Re} w > 0$ ,  $|z| < 1$

**IjZdlbq\_kdZgylb\_Hkgh\gu\_ljZgkp\_g^\_glgu\_nmgdpbb dhfi**  
**i\_j\_f\_ggh]h b b o k\hckl\Z**  
**L\_hj\_l bq\_kdb\_ \hijkku**

- 1.
2.  $z = x + iy$ .  
 $\sin(5-3i) \cos(2i)$ .
- 3.
4.  $|\sin z| > 100$ ?  $z_1$ ,  
 $|\sin z_1| > 100$ .
5.  $z = x + iy$ .  
 $\operatorname{Ln} z$ ?
- 6.

**AZ^Zqb b mijZ'g\_gby ^ey Zm^blhjghc jZ[hlu**

1.  $e^{-1+i\frac{\pi}{2}}$ ;  $\sin(1+i)$ ;  $\cos(1-i)$ .
2.  $\sin^2 z + \cos^2 z = 1$   $z \in \mathbb{C}$ .
3.  $\sin z = 2$ ;  $\cos z = 1$ ;  $e^z = i$ .
4.  $\operatorname{Ln}(1-i\sqrt{3})$ .
5.  $U = \{z : |z| = e\}$ ,  
 $W = \ln z$ ,  $\ln z -$

**AZ^Zgb\_ ^ey kZfhklhyl\_evghc jZ[hlu**

1.  $e^{1+i}$ ;  $\sin i$ ;  $\cos(2-3i)$ .
2.  $\sin 2z = 2 \sin z \cos z$   $z \in \mathbb{C}$ .
3.  $\operatorname{Ln}(-i)$ .

**IjZdlbq\_kdZgylb\_ .9=Zjfhgbq\_kdb\_ nmgdpbb ^\mo ^\_ckl\**  
**i\_j\_f\_gguo b b o k\yav k ZgZebqb\_kdbfb nmgdpbyfb dhfie\_dkgh**  
**L\_hj\_l bq\_kdb\_ \hijkku**

1.  $M_0(x_0, y_0)$ .

2.  $U(x, y)$   $D$  ?

3. : если функция  $f(z) = U(x, y) + iV(x, y)$  является аналитической в точке  $z_0 = x_0 + iy_0$ , то функции  $U(x, y), V(x, y)$  являются гармоническими в точке  $M_0(x_0, y_0)$  ?

4.  $D$   $U(x, y)$   
 $( )$   $D$   $f(z)$ ?

5.  $G$   $U(x, y)$ .  
 $G$   $f(z)$ ,

$\text{Re } f(z) = U(x, y)$  ( $\text{Im } f(z) = U(x, y)$ )?

**A Z ^ Z q b b m i j Z ' g \_ g b y ^ e y Z m ^ b l h j g h c j Z [ h l u**

1. , :  
 )  $U(x, y) = \arctg \frac{y}{x}$ ; )  $\varphi(x, y) = \ln(x^2 + y^2)$ ; )  $V(x, y) = x^3 + y^3$ .

2.  $f(z)$ , :  
 )  $\text{Re } f(z) = x^2 - y^2$ ; )  $\text{Im } f(z) = xy^2$ ; )  $\text{Re } f(z) = \frac{x^2 - y^2}{(x^2 + y^2)^2}$  ?

3.  $f(z) = u(x, y) + iv(x, u)$   
 $u(x, y) = x^2 - y^2 + 5x + y - \frac{y}{x^2 + y^2}$ .

4.  $f(z) = u(x, y) + iv(x, u)$   
 $v(x, y) = e^{-2y} \cos 2x$ .

5.  $f(z)$  ,  $\text{Re } f(z) = x^2 - y^2 + x$   
 $f(0) = i$ .

**A Z ^ Z g b \_ ^ e y k Z f h k l h y l \_ e v g h c j Z [ h l u**

1. , :  
 )  $U(x, y) = e^x \sin y$ ; )  $\varphi(x, y) = x^3 - 3xy^2$ ; )  $V(x, y) = x^4 + y^4 + 1$ .

2.  $f(z)$ , :  
 )  $\text{Re } f(z) = x^2 + y^2$ ; )  $\text{Im } f(z) = 3xy^2 - x^3$ ; )  $\text{Re } f(z) = \frac{x^2 - x + y^2}{x^2 + y^2}$  ?

3.  $f(z) = u(x, y) + iv(x, u)$   
 $u(x, y) = e^y \cos x$ .

4.  $f(z) = u(x, y) + iv(x, y)$   
 $v(x, y) = \ln(x^2 + y^2) + x - 2y$ .

5.  $f(z)$  ,  $\text{Re } f(z) = 3x^2 y - y^3$   
 $f(0) = 0$ .

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i\_j\_f\_ggh]h

L\_hj\_lbq\_kdb\_ \hijhku

1.

2.

$$f(z) \quad L?$$

3.

$$f(z)$$

L.

4.

$$\int_L f(z) dz$$

$$\operatorname{Re} f(z) = u(x, y) \quad \operatorname{Im} f(z) = v(x, y)?$$

5.

6.

7.

$$\oint_L z^n dz, \quad L = \{z: |z| = \rho\}, \quad \rho > 0 \quad n -$$

AZ^Zqb b mijZ'g\_gby ^ey Zm^blhjghc jZ[hlu

1.

t, :

$$f(t)$$

$$) f(t) = (t+i)^3; \quad ) f(t) = \frac{t+i}{t-i}; \quad ) f(t) = e^{it}.$$

2.

:

$$) \int_{-1}^1 (t+i)^2 dt; \quad ) \int_0^1 \frac{dt}{t+i}; \quad ) \int_0^{2\pi} e^{it} dt.$$

3.

$$f(z) = z^2 \quad [-4; 4i],$$

4.

$$f(z)$$

L, :

$$) f(z) = \operatorname{Re} z, \quad L = [-1-i; 1+i]; \quad ) f(z) = \bar{z}, \quad L = [1; i];$$

$$) f(z) = (z+i)^2, \quad L = \{z \mid z = e^{it}, 0 \leq t \leq \pi\}; \quad ) f(z) = |z|, \quad L: |z| = 1;$$

$$) f(z) = z + (z+1)\bar{z}, \quad L - \quad 1, 1+i, i.$$

AZ^Zgb\_ ^ey kZfhklhyl\_evghc jZ[hlu

1.

t, :

$$f(t)$$

$$) f(t) = t^2 + t + i(t^2 - 1); \quad ) f(t) = \frac{t^2 + 1}{t^2 + i}; \quad ) f(t) = \cos t + i \sin t.$$

2.

:

$$) \int_{-\pi}^{\pi} \sin(t+i) dt; \quad ) \int_0^1 \frac{dt}{t^2 + i}; \quad ) \int_0^{\pi} e^{-2it} dt.$$

3.

$$f(z) = z + 2i \quad [2i; 2],$$

4.

$$f(z)$$

L, :

- )  $f(z) = \operatorname{Im} z$ ,  $L = [-i; 1+i]$ ;
- )  $f(z) = \bar{z}^2$ ,  $L = [1+i; 0]$ ;
- )  $f(z) = z \cdot \bar{z} - 1$ ,  $L = \{z \mid z = e^{it}, 0 \leq t \leq 2\pi\}$ ;
- )  $f(z) = \operatorname{Im}^2 z - i \operatorname{Re}^2 z$ ,  $L: |z| = 1$ ;
- )  $f(z) = \frac{z + \bar{z}}{2}$ ,  $L = \{1, i, -1, -i\}$ .

11.  $L = \{z \mid \operatorname{Re} z = 1, \operatorname{Im} z \geq 0\}$ .  $f(z) = z^2 + 1$ .  $D = \{z \mid \operatorname{Re} z > 1\}$ .

1.  $f(z)$  is analytic in  $D$ .
2.  $f(z)$  is analytic in  $D$ .
3.  $f(z)$  is analytic in  $D$ .
4.  $f(z)$  is analytic in  $D$ .
5.  $f(z)$  is analytic in  $D$ .

12.  $L = \{z \mid \operatorname{Re} z = 1, \operatorname{Im} z \geq 0\}$ .  $f(z) = z^2 + 1$ .  $D = \{z \mid \operatorname{Re} z > 1\}$ .

1.  $f(z)$  is analytic in  $D$ .
- )  $f(z) = (iz + 1)^2$ ,  $L = [-1+i; 2i]$ ;
- )  $f(z) = e^{iz}$ ,  $L = [0; \pi]$ ;
- )  $f(z) = z \cdot \cos z$ ,  $L = \{z \mid z = t + it^2, 0 \leq t \leq 1\}$ ;
- )  $f(z) = z^2 \cdot e^{-iz}$ ,  $L = \{z \mid |z| = 2\}$ ;
- )  $f(z) = \frac{z^3}{z-2}$ ,  $L = \{z \mid |z| = 1\}$ ;
- )  $f(z) = \frac{e^z}{z(z+2)}$ ,  $L = \{z \mid z = e^{it}, 0 \leq t \leq 2\pi\}$ ;
- )  $f(z) = \frac{z}{z^2 - 4z + 3}$ ,  $L = \{z \mid |z-1| = 1\}$ ;
- )  $f(z) = \frac{1}{z(z^2 + 1)}$ ,  $L = \{z \mid |\operatorname{Re} z| + |\operatorname{Im} z| = 2\}$ .

2.  $f(z) = \frac{dz}{z^2 + 9}$ ,  $a (a > 0)$ .

$$L = \{z \mid |z - i| = a\}.$$

3.  $f(z) = \frac{dz}{\prod_{k=1}^n (z - z_k)}$ ,

$$L = \{z \mid |z - \bar{z}_k| = a, k = 1, n\}.$$

**А Z ^ Z g b \_ ^ e y k Z f h k l h y l \_ e v g h c j Z [ h l u**

1.  $f(z)$   $L$ , :

)  $f(z) = (2iz - 1)^3, L = [i; 1 + 2i];$

)  $f(z) = e^{-2iz}, L = \left[-\frac{\pi}{2}; \frac{\pi}{2}\right];$

)  $f(z) = z \cdot \sin z, L = \{z : z = t + \pi i \sin t, 0 \leq t \leq \pi\};$

)  $f(z) = z \cdot e^z, L = \{z : |z| = 1\};$

)  $f(z) = \frac{z^2 + i}{z + 2i}, L = \{z : |z| = 1\};$

)  $f(z) = \frac{e^z}{(z - 2i)(z + 2)}, L = \{z : z = e^{it}, 0 \leq t \leq 2\pi\};$

)  $f(z) = \frac{z}{z^2 - 5iz - 6}, L = \{z : |z - 2i| = 2\};$

)  $f(z) = \frac{z^2 - iz}{z(z^2 - 1)}, L = \{2, -2 + 2i, -2 - 2i\}.$

2.  $a (a > 0)$

$$\int_L \frac{dz}{z^2 + a^2},$$

$$L = \{z : |z| = a + 1\}.$$

**12. B g l \_ ] j Z e l b i Z D h r b b i j h b a \ h ^ g u \_ i h j y ^ d h \ Z g Z e l b q \_ k d b o n m g d p b c**

**L \_ h j \_ l b q \_ k d i j h k h**

1.

2.

3.

?

4. : если  $f(z)$  - аналитическая функция в некоторой области  $D$ , то  $f'(z)$  также является аналитической в этой области?

5.

$$D \quad f(z)?$$

6.

7.

8.

9.

10.

11.

12.

$L$ .

$G$ ,

13.

?



14. : если функция  $f(z)$  является аналитической в односвязной области  $D$ , то для любой замкнутой простой кусочно-гладкой кривой  $\gamma \subset D$  имеет место формула

$$\frac{1}{2\pi i} \int_{\gamma} \frac{f(t)dt}{t-z} = \begin{cases} f(z), & \text{если } z \in G^+, \\ \frac{1}{2} f(z), & \text{если } z \in \gamma, \\ 0, & \text{если } z \in D \setminus (G^+ \cup \gamma), \end{cases}$$

где  $G^+$  - конечная область, ограниченная кривой  $\gamma$ .

**A Z ^ Z q b b m i j Z ' g \_ g b y ^ e y Z m ^ b l h j g h c j Z [ h l u**

1.

:

)  $\oint_L \frac{\cos z}{z^2} dz, \quad L = \{z : |z| = 1\};$

)  $\oint_L \frac{\sin z}{\left(z - \frac{\pi}{3}\right)^3} dz, \quad L = \{z : |z - i| = 4\}.$

2.

,  $a \ b-$  :

)  $e^{az};$

)  $\sin az;$

)  $e^{az} \cos bz.$

3.

$f(z)$

$r < |z - a| < R.$

,  $\int_{|z-a|=\rho} f(z) dz, \quad r < \rho < R, \quad \rho.$

**A Z ^ Z g b \_ ^ e y k Z f h k l h y l l u v g h c j Z [ h**

1.

:

)  $\oint_L \frac{\cos z}{(z-i)^3} dz, \quad L = \{z : |z - i| = 1\};$

)  $\oint_L \frac{e^z}{(z-1)^3} dz, \quad L = \{z : |z - 1| = 1\}.$

2.

,  $a-$  :

)  $\cos az;$  )  $ze^{az};$  )  $z \cos az.$

3.

$f(z)$

$r < |z - a| < R.$

$\int_{|\zeta-a|=\rho} \frac{f(\zeta)}{\zeta - z} d\zeta, \quad r < \rho < R, \quad \rho.$

**I j Z d l b q \_ k d Z h g y h b \_ 1 K l \_ i \_ g g u \_ j y ^ u \ d h f i e \_ d k g h c h [ e Z k l b**  
**L \_ h j \_ l b q \_ k d b \_ \ h i j h k u**

1.

2.

3.

4.

5.

**A Z ^ Z q b b m i j Z ^ g y g B m ^ b l h j g h c j Z [ h l u**

1.

$$) \sum_{n=0}^{\infty} \left( \frac{z-1+i}{3+4i} \right)^n ; \quad ) \sum_{n=0}^{\infty} \frac{z^n}{n!} \quad ) \sum_{n=0}^{\infty} \frac{(2iz-3)^n}{(1+i)^n}.$$

2.

$$\frac{z}{z^2+4} = \sum_{n=0}^{\infty} c_n (z+1-i)^n$$

$$c_0 \quad c_1.$$

3.

$$T_2 = \{z : |z-i| < 2\}.$$

$$z=1$$

$$z = -3 - i ?$$

4.

$$\sum_{n=0}^{\infty} c_n (z+i)^n$$

$$z_1 = 1 - 2i$$

$$z_2 = -3 - 5i.$$

$$z_3 = 0, \quad z_4 = -1,$$

$$z_5 = -2 + i, \quad z_6 = -4 + 6i ?$$

5.

$$f(z) \quad L, \quad :$$

$$) f(z) = \frac{z+2i}{(z^2+1)(z+1)^2}, \quad L = \{z : |z-1|=1\}; \quad ) f(z) = \frac{e^z}{(z-i)^3}, \quad L = \{z : |z-2|=10\}.$$

**A Z ^ Z g b \_ ^ e y k Z f h k l h y l \_ e v g h c j Z [ h l u**

1.

$$) \sum_{n=0}^{\infty} \left( \frac{z+i}{1+i} \right)^n ; \quad ) \sum_{n=0}^{\infty} \frac{(-1)^n z^n}{n} \quad ) \sum_{n=0}^{\infty} \frac{(iz-5)^n}{(3+4i)^n}.$$

2.

$$\frac{1}{z^2+1} = \sum_{n=0}^{\infty} c_n (z+2+i)^n$$

$$c_0 \quad c_1.$$

3.

$$|z+i| < 5.$$

$$z=1 \quad z = -3 + 10i ?$$

4.

$$\sum_{n=0}^{\infty} c_n (z-i)^n$$

$$z_1 = 2 + i$$

$$z_2 = -3 - i.$$

$$z_3 = 0, \quad z_4 = 3i,$$

$$z_5 = -2 + i, \quad z_6 = -1 + 6i ?$$

5.

$$f(z) \quad L, \quad :$$

$$) f(z) = \frac{z+i}{z^2+4}, \quad L : |z-i|=2; \quad ) f(z) = \frac{z^4+4z+1}{(z-i)^{2012}}, \quad L : |z-i|=1.$$

6.

$$a \in C$$

$$\int_L \frac{z^2+1}{(z-a)^2} dz,$$

$$L = \{z : |z|=1\}.$$

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 L\_c ehjZ.meb ZgZeb1bq\_kdhc nmgdpbb. L\_hj\_fZ \_^bgkl\\_gghkl  
 ijh^he'\_gb\_

L\_hj\_l bq\_kdb\_ \hijhku

1.  $f(z)$
- a.
2. ?
3.  $f(z)$ .
4. ( )  $f(z)$ ?
- 5.
6. ?
- 7.
8.  $D$   $f(z)$
9. ?  $F(z)$
10.  $f(z)$ .

AZ^Zqb b mijZ'g\_gby ^ey Zm^blhjghc jZ[hlu  
 $f(z)$   $z-a$

1. :  
 )  $f(z) = e^{iz}$ ,  $a = -1$ ; )  $f(z) = \sin^2 z$ ,  $a = 0$ ; )  $f(z) = \frac{z}{z^2 - 4}$ ,  $a = 2i$ .
2. :

1. )  $\int_{|z+1|=2} \frac{1}{(z+1)^2} dz$ ; )  $\int_{|z|=1} \frac{1}{z} dz$ .
3.  $f(z)$  , :

)  $f(z) = (z^2 - 9)(z^2 + 9)$ ; )  $f(z) = \frac{\sin^3 z}{z}$

$$) f\left(\frac{1}{n}\right) = \frac{1}{n^2}, n \in N; \quad ) f\left(\frac{1}{n}\right) = \frac{1}{n + \sin \frac{\pi n}{2}}, n \in N.$$

8.  $\sin^2 z + \cos^2 z = 1.$

9.  $\sin z = \cos z \quad z = \frac{\pi}{4} + 2\pi n, n \in Z.$

10.  $F(z) = \frac{1}{1-i} \sum_{n=0}^{\infty} \left(\frac{z-i}{1-i}\right)^n$

$$f(z) = \sum_{n=0}^{\infty} z^n.$$

1.  $f(z) = \frac{z-a}{z-a}$

)  $f(z) = ze^{-z}, a = -i;$       )  $f(z) = \frac{z+2}{z^2+4}, a = 2.$

2. :

)  $\int_{|z+i|=2} \frac{ze^{-z}}{(z+1)^3} dz;$       )  $\int_{|z-2|=1} \frac{z+2}{(z^2+4)(z-2)} dz.$

3.  $a=0$   $f(z),$  :

)  $f(z) = z \sin z - z^2;$       )  $f(z) = z(e^{z^2} - 1) - z^3.$

4.  $f(z) = \varphi(z).$   $a$  :

)  $f(z) - \varphi(z);$       )  $f^2(z) \cdot \varphi^3(z);$       )  $c_1 \cdot f(z) + c_2 \cdot \varphi(z), c_1, c_2 \in C.$

5.  $E,$  :

)  $E = \{z : |z| = 1\};$       )  $E = \left\{z : z = \frac{1}{n} + 2i, n \in N\right\}.$

6.  $f(z),$

)  $f\left(\frac{1}{n}\right) = -f\left(-\frac{1}{n}\right), n \in N;$       )  $f\left(\frac{1}{n}\right) = \frac{1}{n^2 + \cos^2 \pi n}, n \in N.$

7.  $\sin 2z = 2 \sin z \cos z.$

8.  $\cos z = \cos^2 z \quad z = 2\pi n, n \in Z.$

9.  $F(z) = \frac{1}{4} \sum_{n=0}^{\infty} (-1)^n \frac{z^n}{4^n}$

$$f(z) = \frac{1}{3} \sum_{n=0}^{\infty} (-1)^n \frac{(z+1)^n}{3^n}$$

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L\_hj1bq\_kdb\_ \hijhku

1.

2. ( ) ?
3. ?
4. .
5.  $f(z)$ .
6.  $f(z)$   $z_0$ ?
7.  $f(z)$ .
8.  $f(z)$ ?
9.  $f(z)$ .

10. **A Z ^ Z q b b m i j Z ' g \_ g b y ^ e y Z m ^ b l h j g h c j Z [ h l u**
1. :

1. )  $\sum_{n=-\infty}^{\infty} \frac{3^n z^n}{n^2 + 1}$ ; )  $\sum_{n=-\infty}^{\infty} \frac{(z+i)^n}{2^n}$ ; )  $\sum_{n=0}^{\infty} \left( \frac{z^n}{n!} + \frac{n}{z^{n+1}} \right)$ .

2.  $f(z)$   $z - z_0$ , :

1. )  $f(z) = \frac{z}{(z+i)(z-3)}$ ,  $z_0 = 0$ ; )  $f(z) = z^2 \sin \frac{1}{z-1}$ ,  $z_0 = 1$ .

3.  $f(z)$ , :

1. )  $f(z) = \frac{1}{\sin z}$ ; )  $f(z) = z^3 e^{\frac{1}{z^2}}$ ; )  $f(z) = \frac{1 - \cos 2z}{z^2}$ .

4.  $f(z)$   $\varphi(z)$   $z_0$   $m$   $n$  :

1. )  $f(z) \cdot \varphi(z)$ ; )  $\frac{f(z)}{\varphi(z)}$ ; )  $f(z) + \varphi(z)$ .

5.  $f(z)$   $\Gamma$ , :

1. )  $f(z) = \frac{1}{z^3 - z^5}$ ,  $\Gamma = \left\{ z: |z-1| = \frac{1}{2} \right\}$ ; )  $f(z) = z e^{\frac{1}{z}}$ ,  $L = \{z: |z|=1\}$ .

6.  $\sin \frac{1}{z}$ .

1. **A Z ^ Z g b \_ ^ e y k Z f h k l h y l \_ e v g h c j Z [ h l u**  
 $f(z)$   $z_0$ , :

1. )  $f(z) = \frac{z^2 + 1}{z^2 - 5z + 6}$ ,  $z_0 = 2$ ; )  $f(z) = (z^2 - 1) \cdot e^{\frac{1}{z^2}}$ ,  $z_0 = 0$ .

2.  $f(z)$ , :

1. )  $f(z) = \frac{z^2 - 1}{z^3 - 1}$ ; )  $f(z) = \frac{1 - e^{z^2}}{z^4 - z^2}$ ; )  $f(z) = \frac{e^{\frac{1}{z^2}}}{1 - \cos^2 z}$ .

3. :

1. ) ;

- )  $z = 0$  ;
- )  $z = i$   $\frac{c_{-3}}{(z-i)^3}$

4.  $f(z)$  ,  $D$

$f(z)$  ,  $\frac{f'(z)}{f(z)}$

$f(z)$  ,  $f(z) = 0$ .

**I j Z d l b q \_ k d Z g y h b \_ 1 6 < u q \_ l n m g d p b b h l g h k b l \_ e v g h b a h e b j**  
**h k h [ h c l h q h h y l b \_ e h ] Z j b n f b q \_ k d h ] h \ u q \_ l Z b i j b g p b i Z j ] m f \_ g l Z**  
**L \_ h j \_ l b q \_ k d b \_ \ h i j h k u**

- $f(z)$ .
- $f(z)$
- $f(z)$   $z_0?$
- $\text{Res}_{z_0} f(z)$ ,  $z_0$   $f(z)?$
- 
- 
- 
- $f(z)$ .
- ?
- 
- 
- 

**A Z ^ Z q b b m i j Z ' g \_ g b y ^ e y Z m ^ b l h j g h c j Z [ h l u**

- $f(z)$  , :
- )  $f(z) = \frac{z+2}{z^2-1}$ ;    )  $f(z) = \frac{e^{iz}}{z^2(z-\pi)}$ ;    )  $f(z) = \frac{\sin z}{z^4 \cos z}$ .
- )  $\int_L \frac{z+1}{(z-1)(z+5)^2} dz$ ,  $L = \{z: |z|=3\}$ ;

)  $\int_L \frac{e^{iz}}{(z+1)(z+2)^2}$ ,  $L = \{z: |\text{Re} z| + |\text{Im} z| = 3\}$ ;

)  $\int_L \frac{dz}{\sin z}$ ,  $L -$
- $z = \infty$  :
- )  $f(z) = \frac{z^4+1}{z^6-1}$ ;    )  $f(z) = \cos \frac{(z+2)\pi}{2z}$ .
- $f(z) = \frac{z^{2015}}{z-2016}$   $z_0$  , :

5. )  $z_0 = 0$ ; )  $z_0 = 2013$ ; )  $z_0 = 2014$ .

5. )  $z^4 - 3z + 1 = 0, |z| < 1$ ; )  $z^7 - 5z^4 + z^2 - 2 = 0, |z| < 1$ .

1.  $f(z) = \frac{z+1}{z^2+1}$ ;  $f(z) = \frac{\sin \pi z + 1}{z^2(z+1)}$ ;  $f(z) = \frac{\cos \pi z}{(z-1)^2 \sin \pi z}$ .

2. )  $\int_L \frac{z+3}{(z+1)(z-5)^2} dz, L = \{z: |z+1|=1\}$ ;

)  $\int_L \frac{\cos \pi z}{(z-1)(z-2)^2}, L = \{z: \operatorname{Re}^2 z + \operatorname{Im}^2 z = 5\}$ ;

)  $\int_L \frac{\cos 2z dz}{\sin z}, L - z = \infty$ ;

)  $f(z) = \frac{\sin \frac{1}{z}}{z-1}$ ; )  $f(z) = z \cos^2 \frac{\pi}{z}$ .

4.  $f(z) = \frac{z+i}{z^2+4} z_0$ ;

)  $z_0 = -i$ ; )  $z_0 = 2i$ ; )  $z_0 = -2i$ .

5. )  $2z^4 - 5z + 2 = 0, |z| < 1$ ; )  $z^8 - 4z^5 + z^2 - 1 = 0, |z| < 1$ .

6. **Djbl\_jbb hp\_gb\Zgby j\_amevlZlh\ hk\h\_gby ^bkpbiebg**

6.1. **Hp\_ghqgu\_kj\_^kl\Z b djbl\_jbb hp\_gb\Zgby ^ey l\_dms**

**DhgljhevgZy yZ[h**

**H[jZa\_p dhgljhevg hc jZ[hlu**

1.  $w = (\bar{z} + i)^2 - 2iz^4$  ?

2.  $\Gamma z_0 = 1 - i\sqrt{3} \frac{\pi}{6}$ .

$w = (2-z)^2 w_0 = -2 + 2i\sqrt{3}$ .

3.  $a = (\ln(-i) - \sin 2i)e^{1-i}$ .

4.  $w = \cos z$

?

5.  $f(z) = i - z + \operatorname{Re} z [1 - i; -1 + i]$ .

1.

/		(*)
1		1

(\*) 0,25

2.

/		
1		4,75-5
2		3,75-4,5
3		3-3,5
4		3

6.2. Hp\_ghqgu\_kj^kl\Z b djbl\_jbb hp\_gb\Zgby ^ey ijhf\_‘ml  
 Djbl\_jbb ihemq\_ϑblyZ aZ  
 AZql\_gh « »

G\_aZql\_gh « »

7. I\_j\_q\_gv hkgh\ghhegb\_l\_evghe mq\_[ghc ebl\_jZlmju

7.1.Hkgh\gZy ebl\_jZlmjZ

1.

2021. – 263 .– : // [ ]. – URL:  
<https://urait.ru/bcode/468277>.

2.

// , 2020. – 313 .– :  
 [ ]. – URL:  
<https://urait.ru/bcode/451868>.

7.2.>hihegb\_l\_evgZy ebl\_jZlmjZ

1.

, 2020. – 219 .– : // [ ]. – URL: <https://urait.ru/bcode/452425>.

2.

, 2021. – 143 .– : // [ ]. – URL: <https://urait.ru/bcode/472770>.

3.

, 2021. – 353 .– : // [ ]. – URL: <https://urait.ru/bcode/469117>.

4.

// , 2021. – 402 .– :  
 [ ]. – URL:  
<https://urait.ru/bcode/468294>.

7.3.I\_j\_q\_gv j\_kmjkh\ bgnhjZϑbdhfgfmgbdZpbhgghc k\_lb ‘Bgl

1.

<http://www.intuit.ru>

2.

<http://exponenta.ru>

3.

<http://www.mathnet.ru>



8. FZl\_jbZe~~gh~~q\_kdh\_ h[\_ki\_q\_gb\_  
Mq\_[gZy Zm^blhjby ^ey ijh\\_^\_gby aZgylbc e\_dpbhggh]h

Mq\_[gZy Zm^blhjby ^ey ijh\\_^\_gbgZjZgh]hclkiZb ]jmiih\uo  
bg^b\b^mZevguo dhgkmevlZpbc, l\_dms\_]h dhgljhey b ijhf\_‘ml

Ihf\_s\_gb\_ ^ey kZfhklhyl\_evghc jZ[hlu  
« »

9. Ijh]jZfgh\_ h[\_ki\_q\_gb\_

Microsoft Open License (Windows XP, 7, 8, 10, Server, Office 2003-2016),  
66975477 03.06.2016 ( ).

« »,

ДОКУМЕНТ ПОДПИСАН  
ЭЛЕКТРОННОЙ ПОДПИСЬЮ

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