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2020
(III)

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4. ,
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5. .

6. , , ,
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7. , ( ),
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- (1 .);
- (5 .).

11.1

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2,0   ,   ,   ,
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1.   .

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,   ,
,   ,
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1.1
. .

1.2	ε r
.

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2.   .

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0   4. (.

1)

«0»

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$\varphi_0 = 0$

Рис. 1

2.1	φ_n .
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(   )   .   .
,   .

2.2	, , .
.

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3.   .

,   .1,
                                    2   8.
(. 2) .

Рис. 2

3.1 φ_n .
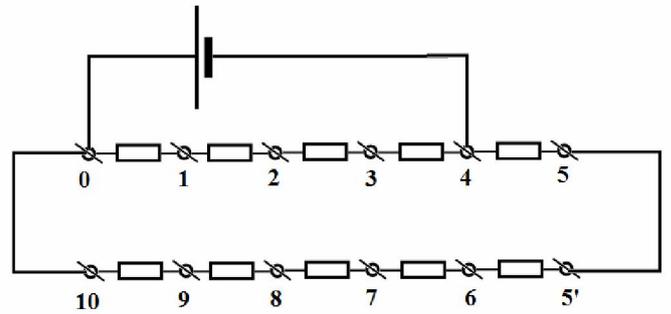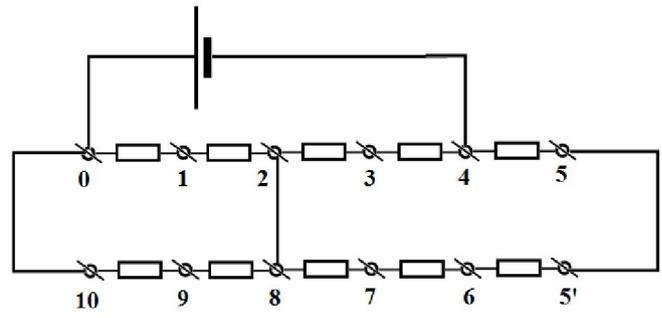
                   .

3.2   ,   ,
                             .   .

4.

4.1   R .

                                             ,

                             .

2

                        R

                             n = 4,5,...10 .

Рис. 3

                   .

4.2   R
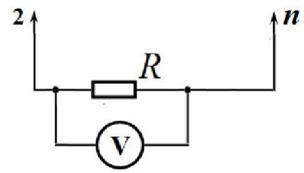   n .   .
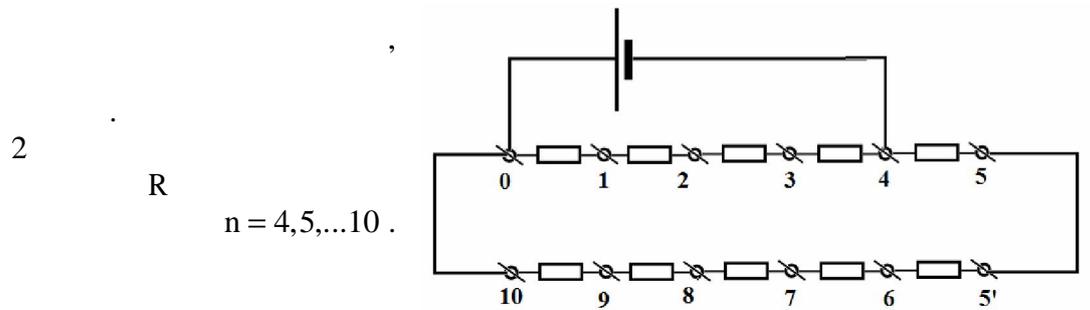
4.3   ,   ,
                             .   ,   ,
                   .

11-2.

_____ .

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. 1

2.

a

. L .

3,

r .

4 (

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(. 1).

5, m .

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, .

$$T = F(m, L, a, r),$$

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(–)

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,

:

$$E_k(\omega) + U(\varphi) = E_0.$$ (1)

$U(\varphi)$ -   ,

.

$$U(\varphi) \approx K\varphi^2, \tag{2}$$

K -   ,   .

$E_k(\omega)$ -   ,

ω .

$$E_k(\omega) \approx M\omega^2, \tag{3}$$

M -   ,   .
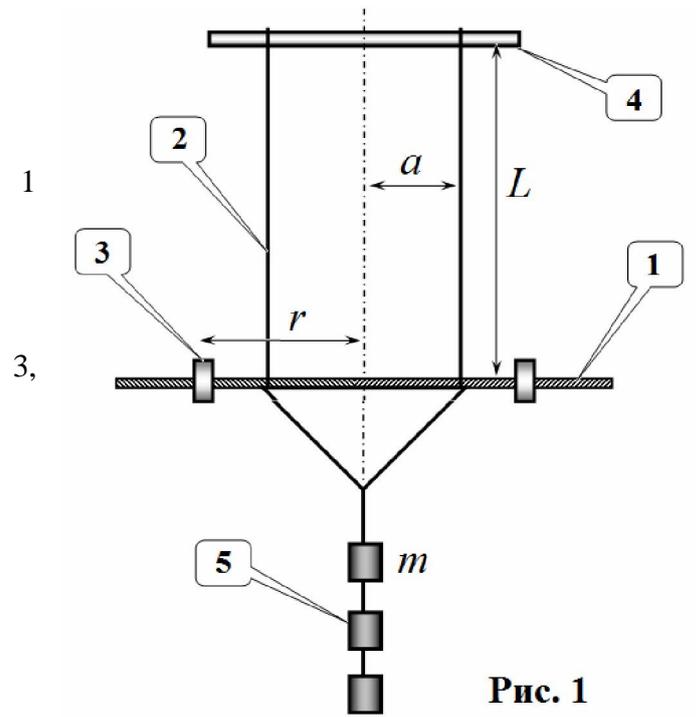
(2)-(3)

$$T = 2\pi\sqrt{\frac{M}{K}} \ . \tag{4}$$

1.   .

:

$L_0 = 30$;

$a_0 = 2,0$;

$r_0 \approx 0$;

$m_0 = 0$;

«   ».

,   ,

.

1.1	T_0	.
	.	

.

T , T_0 .

$$z = \frac{T}{T_0}$$

2. $T(n)$

2.1			K		M		
	?					.	
2.2				z			n .
2.3	,					.	(
	)						.

2.4

.

2.5   .
2.6   .

,

.

–   .

3. $T(r)$

3.1   K   M   r ?

.

3.2   z   r .
3.3   ,   .
3.4   .

?

4. $\eta = \dfrac{L}{a}$.

$$\eta = \frac{L}{a}$$

$$z(\eta) = \frac{T}{T_0} = \eta^\gamma \sqrt{\frac{L_0}{L}} \qquad (5)$$

.

4.1   ,   .

, γ .

4.2 $\eta = \dfrac{L}{a}$

4.3   ,

γ .

4.4 γ .