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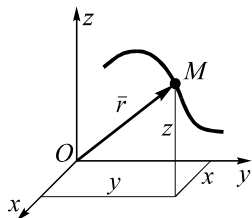
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\vec{r} ,

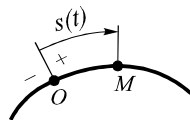
(1.1).

$$\vec{r} = \vec{r}(t),$$

$$, x = x(t), y = y(t).$$

1.2,

).



1.2

$$s = f(t).$$

$$\vec{v} = \frac{d\vec{r}}{dt}.$$

(/).

$$\vec{a} = \frac{d\vec{v}}{dt}.$$

/ ².

1.1.2

$$x = x(t), y = y(t), z = z(t) \quad (1.1)$$

$$z = z(t)$$

$$y = f(x).$$

$$x = at, \quad y = bt^2,$$

$$t = \frac{x}{a}; \quad y = b\left(\frac{x}{a}\right)^2.$$

$$v_x \quad v_y.$$

$$v_x = \frac{dx}{dt}; \quad v_y = \frac{dy}{dt}.$$

$$\bar{v} = \bar{v}_x + \bar{v}_y.$$

$$\bar{v}_x \quad \bar{v}_y$$

$$v = \sqrt{v_x^2 + v_y^2}. \quad (1.1)$$

$$v = \frac{ds}{dt}. \quad (1.2)$$

$$(1.2) \quad (1.1)$$

$$s = \int_0^t v dt = \int_0^t \sqrt{v_x^2 + v_y^2} dt .$$

$$\vec{a} = \vec{a}_x + \vec{a}_y .$$

$$a_x = \frac{dv_x}{dt} ; a_y = \frac{dv_y}{dt} .$$

$$a = \sqrt{a_x^2 + a_y^2} .$$

$$\vec{a}_\tau$$

$$a_\tau = \frac{dv}{dt} .$$

$$\vec{a}_\tau$$

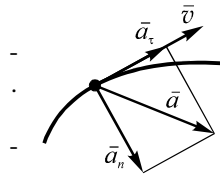
$$\vec{a}_n$$

$$a_n = \frac{v^2}{\rho} ,$$

$$a_n = 0 .$$

$$\vec{a}_n$$

$$1.3 \quad \vec{a} = \vec{a}_\tau + \vec{a}_n.$$



1.3

$$a = \sqrt{a_\tau^2 + a_n^2}.$$

1.2

$$x = 1 - 2 \cos^2 \frac{\pi t}{3}; \quad y = 2 \sin \frac{\pi t}{3} + 1.$$

$$t_1 = 1 \text{ c.}$$

$$\sin^2 \alpha + \cos^2 \alpha = 1.$$

$$\sin \frac{\pi t}{3} = \frac{y-1}{2}; \quad \cos^2 \frac{\pi t}{3} = \frac{1-x}{2}.$$

$$\alpha = \frac{\pi t}{3}, \quad \sin^2 \frac{\pi t}{3} + \cos^2 \frac{\pi t}{3} = 1.$$

$$\left(\frac{y-1}{2}\right)^2 + \frac{1-x}{2} = 1; \quad \frac{(y-1)^2}{2} - x - 1 = 0.$$

$$x = \frac{(y-1)^2}{2} - 1. \tag{1.3}$$

$$-1 \leq \sin \frac{\pi t}{3} \leq 1,$$

$$-1 \leq y \leq 3.$$

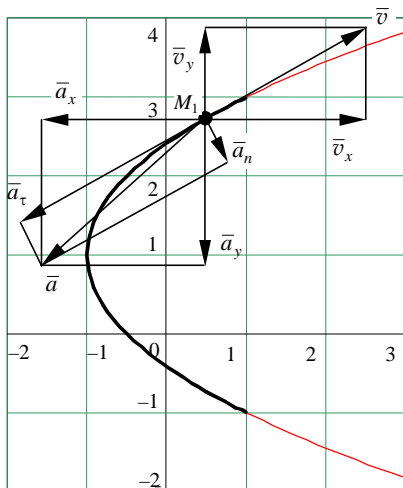
x y ,

(1.3) (2).

2 -

y	-1	0	1	2	3
x	1	-0,5	-1	-0,5	1

1.4



1.4

2

t_1 .

t_1

$$x_1 = 1 - 2 \cos^2 \frac{\pi}{3} = 0,5 \quad ; \quad y_1 = 2 \sin \frac{\pi}{3} + 1 = 2,73 \quad .$$

1

3

$$v_x = \frac{dx}{dt} = -\frac{4\pi}{3} \cos \frac{\pi t}{3} \left(-\sin \frac{\pi t}{3} \right) = \frac{2\pi}{3} \sin \frac{2\pi t}{3};$$

$$v_y = \frac{dy}{dt} = \frac{2\pi}{3} \cos \frac{\pi t}{3}.$$

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{\frac{4\pi^2}{9} \sin^2 \frac{2\pi t}{3} + \frac{4\pi^2}{9} \cos^2 \frac{\pi t}{3}} = \frac{2\pi}{3} \sqrt{\sin^2 \frac{2\pi t}{3} + \cos^2 \frac{\pi t}{3}}.$$

$$t_1 = 1 \quad :$$

$$v_{x_1} = \frac{2\pi}{3} \sin \frac{2\pi}{3} = 1,814 \quad / ; \quad v_{y_1} = \frac{2\pi}{3} \cos \frac{\pi}{3} = 1,047 \quad / ;$$

$$v_1 = \sqrt{1,81^2 + 1,05^2} = 2,094 \quad / .$$

1. , , 1 - 1 / ,
 \vec{v}_x \vec{v}_y . -
 \vec{v} . -

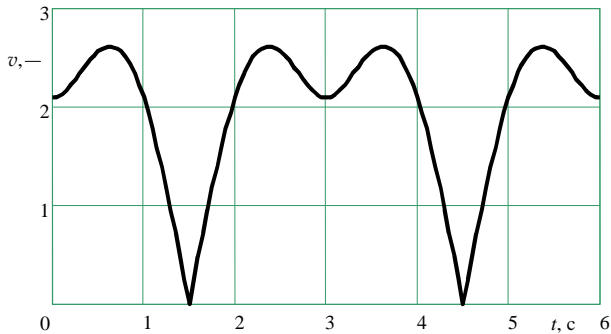
1.4.

2 .

4 $v = f(t)$ 1.5. -

$t = 0,63$ -

$t = 0,63$ $t = 1,57$ -



1.5

5

$$a_x = \frac{dv_x}{dt} = \frac{2\pi}{3} \cos \frac{2\pi t}{3} \frac{2\pi}{3} = \frac{4\pi^2}{9} \cos \frac{2\pi t}{3};$$

$$a_y = \frac{dv_y}{dt} = \frac{2\pi}{3} \left(-\sin \frac{\pi t}{3} \right) \frac{\pi}{3} = -\frac{2\pi^2}{9} \sin \frac{\pi t}{3}.$$

$$t_1 = 1$$

$$a_{x_1} = \frac{4\pi^2}{9} \cos \frac{2\pi}{3} = -2,19 \text{ / } ^2; \quad a_{y_1} = -\frac{2\pi^2}{9} \sin \frac{\pi}{3} = -1,90 \text{ / } ^2.$$

$$a = \sqrt{a_x^2 + a_y^2} :$$

$$a_1 = \sqrt{(-2,19)^2 + (-1,90)^2} = 2,90 \text{ / } ^2.$$

$$\vec{a}_x, \vec{a}_y, \vec{a}$$

$$1 \quad -2 \text{ / } ^2.$$

6

$$a_\tau = \frac{dv}{dt} = \frac{2\pi}{3} \frac{2 \sin \frac{2\pi t}{3} \cos \frac{2\pi t}{3} \frac{2\pi}{3} - 2 \cos \frac{\pi t}{3} \sin \frac{\pi t}{3} \frac{\pi}{3}}{2 \sqrt{\sin^2 \frac{2\pi t}{3} + \cos^2 \frac{\pi t}{3}}} = \frac{\pi^2}{9} \frac{2 \sin \frac{4\pi t}{3} - \sin \frac{2\pi t}{3}}{\sqrt{\sin^2 \frac{2\pi t}{3} + \cos^2 \frac{\pi t}{3}}}.$$

$$t_1 = 1 \text{ c} :$$

$$a_{\tau_1} = \frac{\pi^2}{9} \frac{2 \sin \frac{4\pi \cdot 1}{3} - \sin \frac{2\pi \cdot 1}{3}}{\sqrt{\sin^2 \frac{2\pi \cdot 1}{3} + \cos^2 \frac{\pi \cdot 1}{3}}} = -2,849 \text{ / } ^2.$$

« » , ,

$$a = \sqrt{a_\tau^2 + a_n^2} ,$$

$$a_{n_1} = \sqrt{a_1^2 - a_{\tau_1}^2} = \sqrt{2,9^2 - 2,849^2} = 0,541 \text{ / } ^2.$$

$$\vec{a}_{\tau_1}, \vec{a}_{n_1}$$

$$(1 \quad -2 \text{ / } ^2).$$

7

1.

$$a_n = \frac{v^2}{\rho}$$

$$\rho_1 = \frac{v_1^2}{a_{n_1}} = \frac{2,09^2}{0,541} = 8,07$$

x_1, y_1 ;
 v_1, v_{x_1} ;
 v_{y_1}, x_1, y_1 ;
 a_{x_1}, a_{y_1} ;
 a_{v_1}, a_{n_1} .

1.3 -1

3:

1)

$$x - y;$$

2)

$$x_1, y_1,$$

$t_1,$

;

3)

$$v_x(t), v_y(t);$$

$$v(t)$$

t_1

$$v_{x_1}, v_{y_1}, v_1;$$

;

4)

$$v = f(t)$$

;

5)

$$a_x(t);$$

t_1

$$a_x(t)$$

$$a_{x_1}, a_{y_1};$$

$$a_1;$$

;

6)

 a_τ a_n , - t_1 ;, a_{x_1} , a_{y_1} , a_1 ; a_{τ_1} a_{n_1} ;

7)

 t_1 .

3 -

-1

		t_1 ,			t_1 ,
1	$x = 3 \sin \frac{\pi t}{3} + 2$ $y = 3 \cos \frac{\pi t}{3} - 1$	4	7	$x = \frac{4}{t+3}$ $y = 6 + 2t$	0
2	$x = -3t^2 + 2$ $y = 2t$	1	8	$x = 2 \sin^2 \frac{\pi t}{6} - 3$ $y = 3 \cos^2 \frac{\pi t}{6} - 8$	7
3	$x = 4 + 3 \sin \frac{\pi t^2}{3}$ $y = 3 \cos \frac{\pi t^2}{3} - 2$	2	9	$x = 4 \cos \pi t - 3$ $y = 4 \sin \pi t + 2$	$\frac{3}{4}$
4	$x = 3 - 2t^3$ $y = t^3 + 1$	1	10	$x = 2 \cos \frac{\pi t}{4} - 4$ $y = 4 \sin \frac{\pi t}{4} - 2$	7
5	$x = 2t^2 + 1$ $y = 3t$	1	11	$x = 1 - 5 \sin \frac{\pi t^2}{6}$ $y = 5 \cos \frac{\pi t^2}{6} + 3$	2
6	$x = 5 \cos \frac{\pi t^2}{4}$ $y = 2 \sin \frac{\pi t^2}{4} + 3$	1	12	$x = e^{2t} - 1$ $y = 2e^t$	0,4

		t_1			t_1
13	$x = 2t^4 - 3$ $y = 2t^2$	0,5	22	$x = 3 - 2 \cos 2t$ $y = 1 - 3 \sin 2t$	$\frac{\pi}{16}$
14	$x = 1,5e^{-t}$ $y = 2 - 2e^{-2t}$	0,3	23	$x = 5t$ $y = 3 - 9t^2$	0,5
15	$x = 2 \cos^2 \frac{\pi t}{3} - 4$ $y = 3 - \sin^2 \frac{\pi t}{3}$	3,5	24	$x = 2e^t$ $y = 5e^{2t} - 2$	0,2
16	$x = 5 \sin \frac{\pi t}{6} + 3$ $y = 3 \cos \frac{\pi t}{6} - 2$	1,5	25	$x = 3e^{2t}$ $y = -2e^{-2t}$	0,1
17	$x = 4 \cos \frac{\pi t^2}{3} - 1$ $y = 2 - 4 \sin \frac{\pi t^2}{3}$	2	26	$x = 6 \cos \frac{\pi t^2}{4} - 3$ $y = 6 \sin \frac{\pi t^2}{4} - 4$	1
18	$x = 4 \sin \frac{\pi t}{3} - 4$ $y = 3 \cos \frac{\pi t}{3} + 2$	4	27	$x = 3e^{-2t} + 1$ $y = 2e^{-2t} - 2$	0,2
19	$x = -3t$ $y = 2 - 7t^2$	0,3	28	$x = 6t + 4$ $y = -\frac{2}{3t + 2}$	0
20	$x = 2 - 5 \sin \frac{\pi t^2}{6}$ $y = 5 \cos \frac{\pi t^2}{6} + 1$	2	29	$x = 2e^t$ $y = 4e^{-t}$	0,5
21	$x = 2 - 3e^{-t}$ $y = -2e^{-0,5t}$	0,5	30	$x = 2t$ $y = 3t^2 + 1$	0,5

2
2.1

φ . (). $\varphi = \varphi(t)$,

$$\omega = \frac{d\varphi}{dt}.$$

ω ,

$$\varepsilon = \frac{d\omega}{dt} = \frac{d^2\varphi}{dt^2}.$$

h -

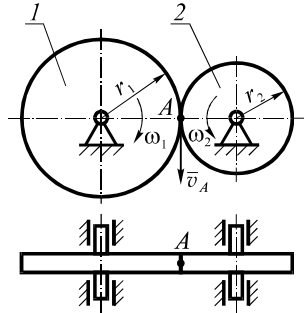
$$v = \omega h,$$

$$\vec{a} = \vec{a}_\tau + \vec{a}_n.$$

$$a_\tau = \varepsilon h, \quad a_n = \omega^2 h.$$

$$a = \sqrt{a_\tau^2 + a_n^2} = h\sqrt{\varepsilon^2 + \omega^4}.$$

(2.1)

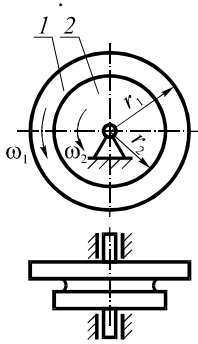


2.1

$$v_{A_1} = v_{A_2}.$$

$$v_{A_1} = \omega_1 r_1, \quad v_{A_2} = \omega_2 r_2, \quad \omega_1 r_1 = \omega_2 r_2.$$

()

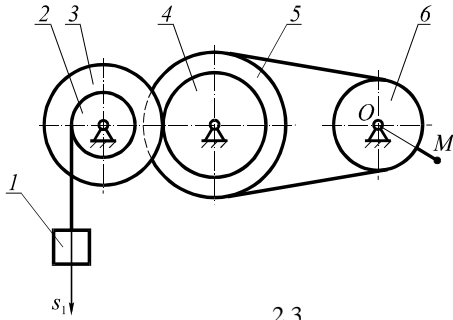


2.2

2.2,

$$\omega_1 = \omega_2.$$

2.2



2.3

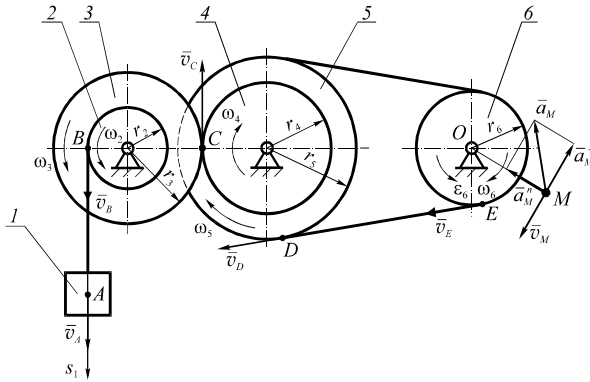
2.3
 $r_3 = 15$, $r_4 = 13$, $r_5 = 18$,
 $r_6 = 11$.
 $r_2 = 8$,
 $= 16$.

() $s_1 = 5 - 1,5 \cos 4t$.

$t_1 = 0,4$.

1

2.4.



2.4

2

1,

A

$$v_{A_1} = \frac{ds_1}{dt} = 6 \sin 4t \quad (/) .$$

$$v_{B_2} = \omega_2 r_2 .$$

$$6 \sin 4t = \omega_2 r_2 ; \quad \omega_2 = \frac{6 \sin 4t}{r_2} .$$

2 3

$$\omega_3 = \omega_2, \omega_3 = \frac{6 \sin 4t}{r_2} .$$

3 4 C. ,

$$v_{C_3} = v_{C_4}; v_{C_3} = \omega_3 r_3; v_{C_4} = \omega_4 r_4; \omega_3 r_3 = \omega_4 r_4; \omega_4 = \frac{\omega_3 r_3}{r_4} = \frac{6 \sin 4t}{r_2} \cdot \frac{r_3}{r_4} .$$

4 5 ,

$$\omega_5 = \omega_4, \omega_5 = \frac{6 r_3 \sin 4t}{r_2 r_4} .$$

5

6 .

$$v_{D_5} = v_{E_6}; v_{D_5} = \omega_5 r_5; v_{E_6} = \omega_6 r_6; \omega_5 r_5 = \omega_6 r_6; \omega_6 = \frac{\omega_5 r_5}{r_6} = \frac{6 r_3 \sin 4t}{r_2 r_4} \cdot \frac{r_5}{r_6} .$$

3

6. , -

$$v_M = \omega_6 \cdot OM .$$

$$t_1 = 0,4 \text{ c}$$

$$\omega_6 = \frac{6 r_3 r_5 \sin 4t_1}{r_2 r_4 r_6} = \frac{6 \cdot 15 \cdot 18 \cdot \sin(4 \cdot 0,4)}{8 \cdot 13 \cdot 11} = 0,629 \quad / ;$$

$$v_M = 0,629 \cdot 16 = 10,1 \quad / .$$

,

6, -

$$a_M = OM \sqrt{\varepsilon_6^2 + \omega_6^4} .$$

6

$$\varepsilon_6 = \frac{d\omega_6}{dt} = \frac{6 r_3 r_5}{r_2 r_4 r_6} \cdot 4 \cos 4t .$$

$$t_1 = 0,4 \text{ c}$$

$$\varepsilon_6 = \frac{24 r_3 r_5}{r_2 r_4 r_6} \cos(4 \cdot 0,4) = -0,0735 \quad / ^2 ;$$

$$a_M = 16 \cdot \sqrt{(0,629)^4 + (-0,0735)^2} = 6,44 \quad / ^2 .$$

(. 2.4) -

,

6, -

2.3

-2.

2.5

1.

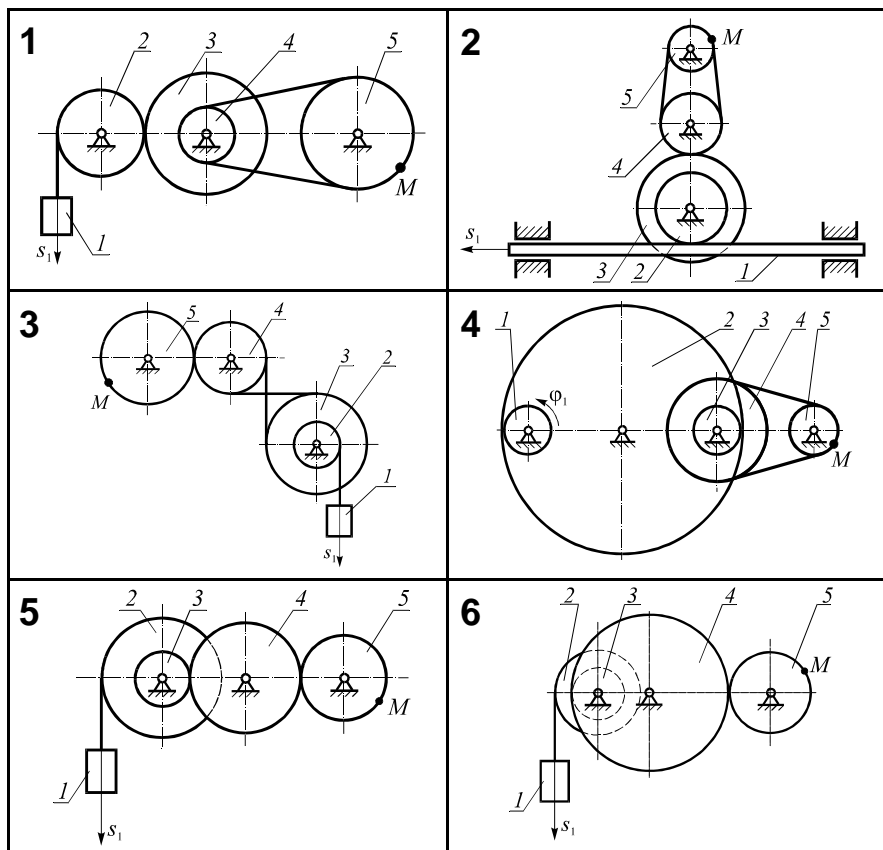
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1)

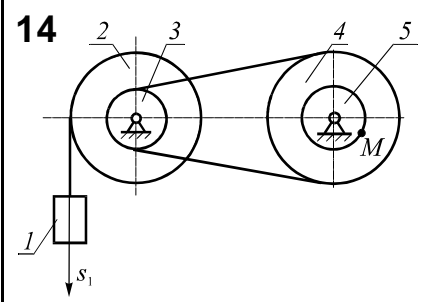
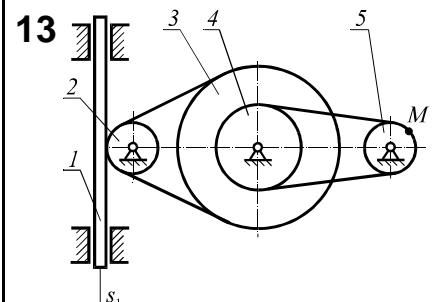
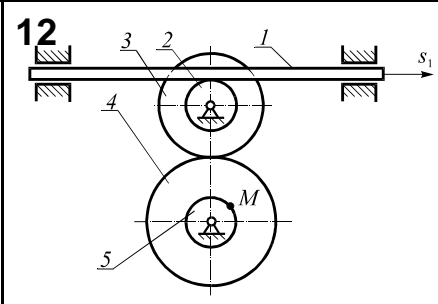
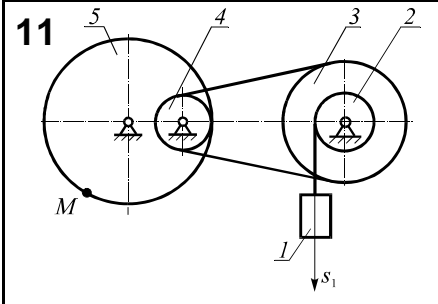
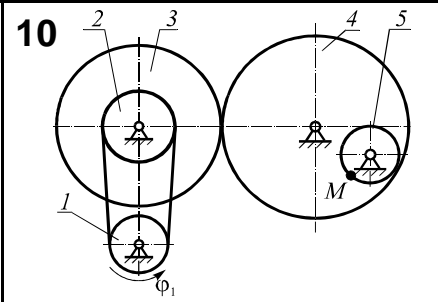
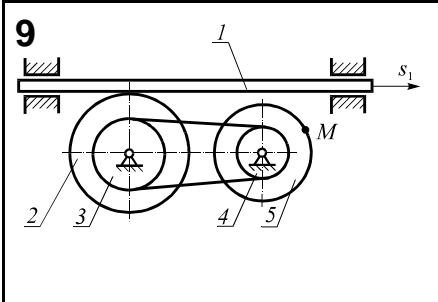
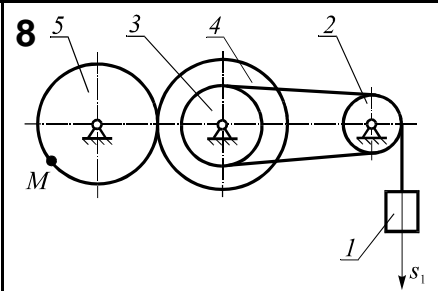
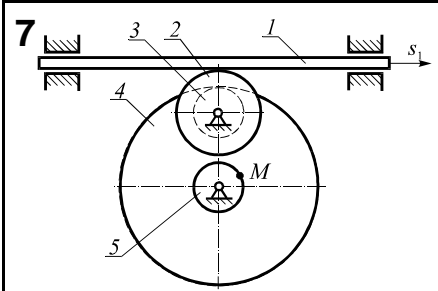
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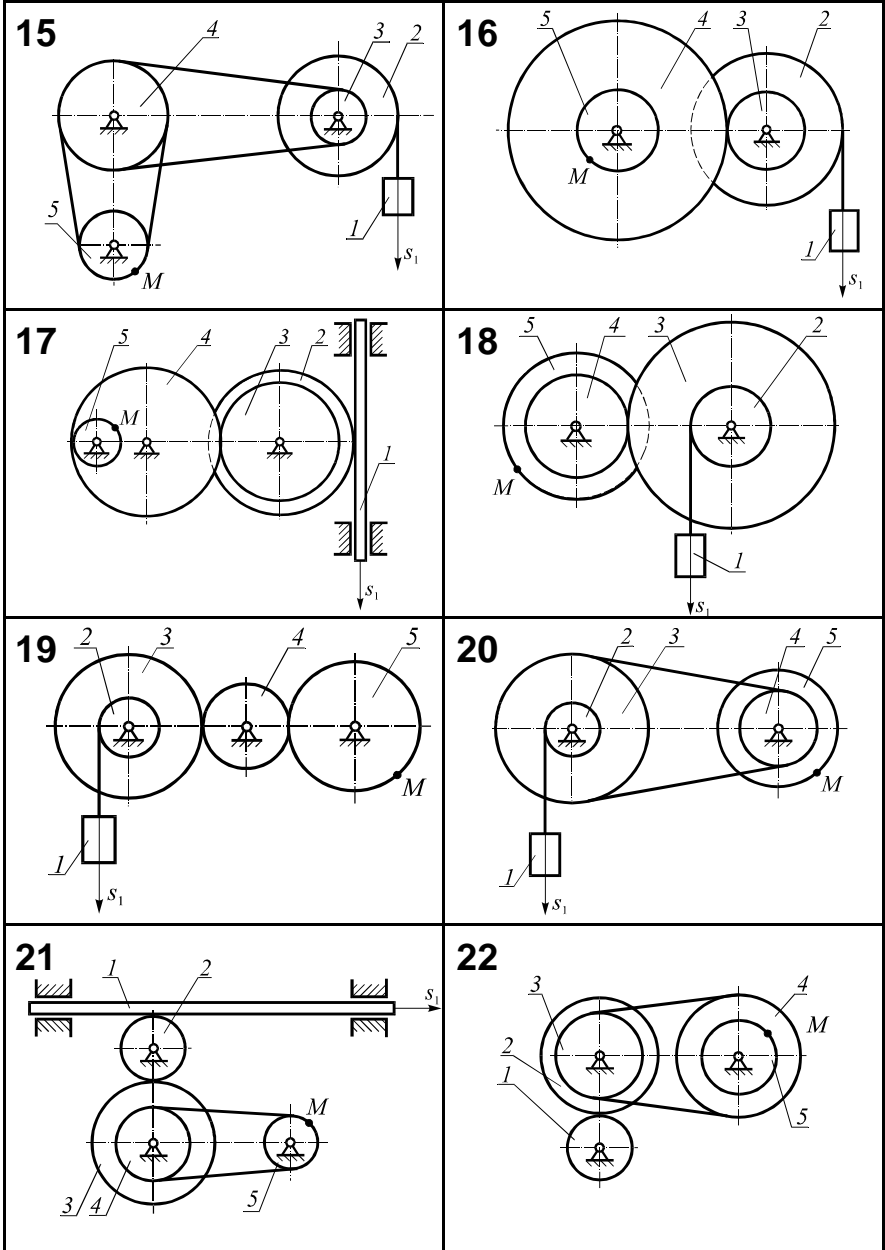
3)



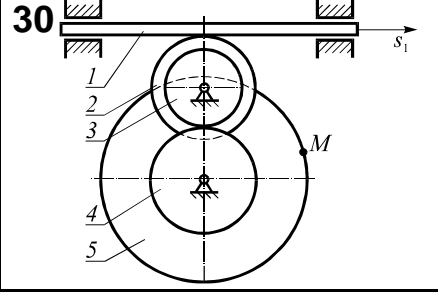
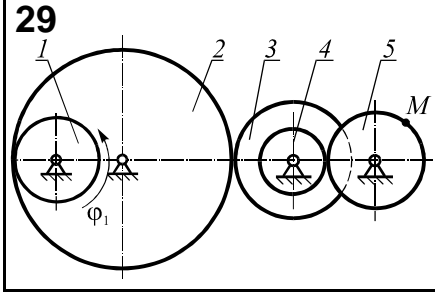
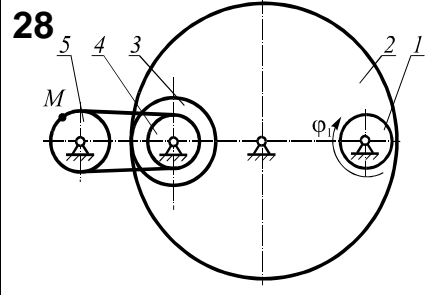
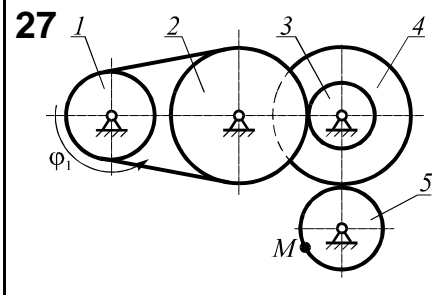
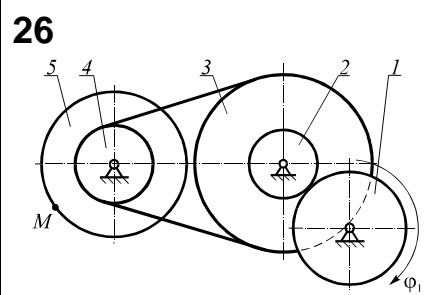
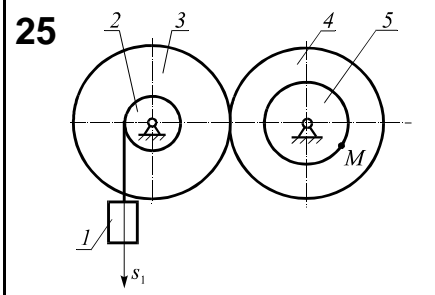
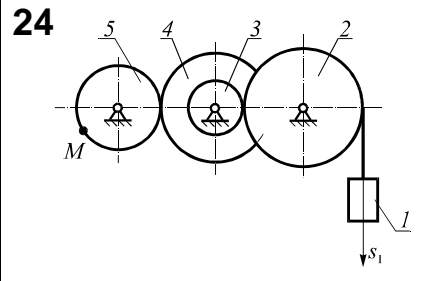
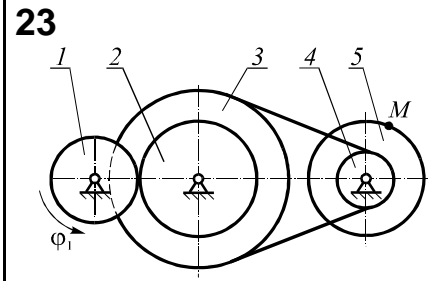
2.5



2.5 ()



2.5 ()



2.5 ()

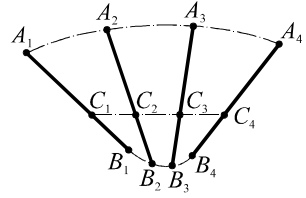
	$1(s, \dots)$	r_i					t_1, c
		r_1	r_2	r_3	r_4	r_5	
1	$s_1 = 6t^3 - 2t$	-	6	8	4	7	1
2	$s_1 = 2 - 15t^2$	-	5	8	4	3	0,5
3	$s_1 = 4t^3 - t^2$	-	3	8	6	8	1
4	$s_1 = 2 - t^3$	4	18	4	8	4	1
5	$s_1 = \frac{2}{3}t^3 + 6t$	-	8	3,5	7	6	2
6	$s_1 = 6t^2 - 4$	-	6	3,5	11	6	1,5
7	$s_1 = 3,5t^4$	-	6	3	14	5	1
8	$s_1 = 6t^2 - 6$	-	3	5	8	7	1,5
9	$s_1 = \frac{2}{3}t^3 + 1$	-	8	5	3	7	4
10	$s_1 = 5t - 0,5t^2$	4	5	11	12	4	2
11	$s_1 = 2,5t^2 + 0,2$	-	4	8	4	11	2,5
12	$s_1 = 2t^4 - 3t^2$	-	4	7	9	4	1,5
13	$s_1 = 15t^2 - t^3$	-	3,5	11	5,5	3,5	0,5
14	$s_1 = 2 - 4,5t^2$	-	8	3,5	8	3,5	3
15	$s_1 = 2,5t^4 - 6$	-	8	4	7,5	4,5	1
16	$s_1 = 24t^2 - t^4$	-	11	6	15	6	0,5
17	$s_1 = \frac{2}{3}t^3 - 1$	-	11	9	11	3	4
18	$s_1 = 4t^2 - 4$	-	6	14	7	10	3
19	$s_1 = -6t^3 + t^2$	-	4	9	5	8	1
20	$s_1 = 2t^4 - 3t$	-	3,5	10	5	8	1
21	$s_1 = \frac{3}{4}t^2 + 2t$	-	4	8	5	3,5	6
22	$s_1 = 0,75t^4 - 3$	4	8	6	8	5	1
23	$s_1 = 0,5t^4 - 2t$	5	7	11	4	7	0,5
24	$s_1 = 3t^3 - 1$	-	8	3	7	5,5	2
25	$s_1 = 5t^3 - 2t$	-	4	11	10	6	1
26	$s_1 = 1,5t^2 - 3$	5,5	8,5	13	6	11	2
27	$s_1 = 0,5t^3 + t^2$	5	8	4	8	5	0,5
28	$s_1 = 4 - 0,5t^4$	3	18	5	3	4	1,5
29	$s_1 = 5t - 2t^2$	5	13	7	4	6	2,5
30	$s_1 = 4t^4 - 3t^2$	-	7	5	7	13	1

3

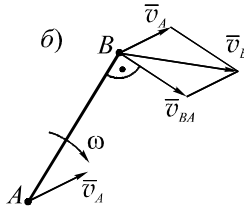
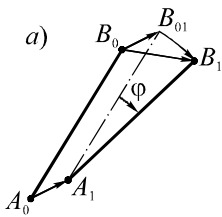
3.1

3.1.1

AB,



3.1



3.2

3.2,

A_0B_0

AB

A_1B_1

A

(3.2,): (3.1)

$$\vec{v}_B = \vec{v}_A + \vec{v}_{BA}$$

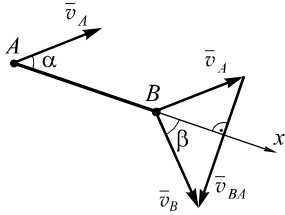
AB,

\vec{v}_{BA}

$$v_{BA} = \omega \cdot BA$$

$$c \quad \vec{v}_A, \vec{v}_{BA}, \vec{v}_B \quad (3.1)$$

$$\vec{v}_A, \vec{v}_{BA}, \vec{v}_B \quad (3.1)$$



3.3

$$(3.1)$$

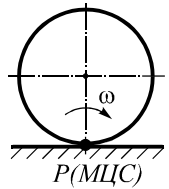
3.3

$$v_A \cos \alpha = v_B \cos \beta$$

3.1.2

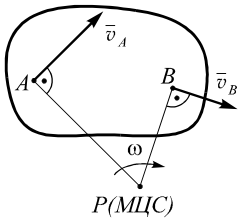
()

1



3.4

3.4.

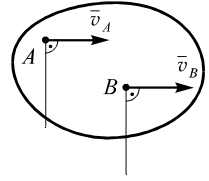


3.5

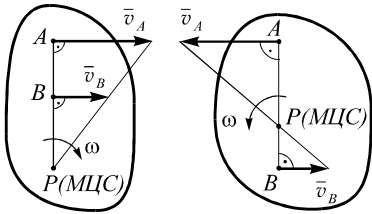
2

$$(3.5);$$

)
(3.6).



3.6



3.7

$$v_A = \omega \cdot AP,$$

3.1.3

$$\vec{a}_B = \vec{a}_A + \vec{a}_{BA}^\tau + \vec{a}_{BA}^n, \quad (3.2)$$

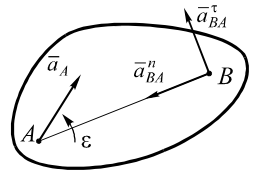
\vec{a}_A —
 $\vec{a}_{BA}^\tau, \vec{a}_{BA}^n$ —

$$a_{BA}^\tau = \varepsilon \cdot AB; \quad a_{BA}^n = \omega^2 \cdot AB.$$

\vec{a}_{BA}^τ

B A,

$$\vec{a}_{BA}^n \quad 3.8.$$



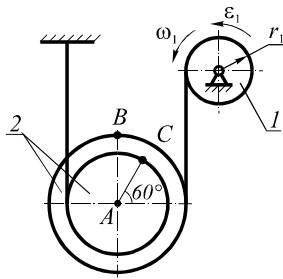
3.8

(3.2).

-3.

[1-3].

3.2



3.9

1

(3.9):
 $\omega_1 = 1$ / ; $\varepsilon_1 = 3$ / 2 ; $r_1 = 10$;
 $AC = 15$, $AB = 20$.

:
 2,

2

PD,

3.10.

2.

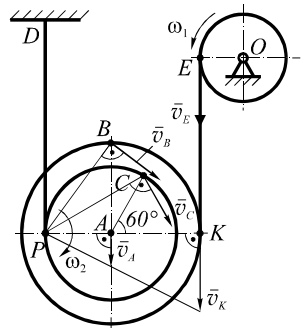
1

2

2

1,

$$v_E = \omega_1 r_1 .$$



3.10

$$v_K = v_E = \omega_1 r_1 .$$

$$v_K = \omega_2 \cdot KP .$$

$$\omega_2 = \frac{v_K}{KP} = \frac{\omega_1 r_1}{AK + AP} = \frac{\omega_1 r_1}{AB + AC} .$$

$$\omega_2 = \frac{1 \cdot 10}{20 + 15} = 0,286 \quad / .$$

$$v_B = \omega_2 BP = \omega_2 \sqrt{PA^2 + AB^2} = 0,286 \sqrt{15^2 + 20^2} = 7,15 \quad / ;$$

$$\begin{aligned} v_C &= \omega_2 CP = \omega_2 \sqrt{PA^2 + AC^2 - 2 \cdot PA \cdot AC \cos 120^\circ} = \\ &= 0,286 \sqrt{15^2 + 15^2 - 2 \cdot 15 \cdot 15 \cdot (-0,5)} = 7,43 \quad / . \end{aligned}$$

3

2

v_A

$$v_A = \omega_2 \cdot AP = \frac{\omega_1 r_1}{KP} AP .$$

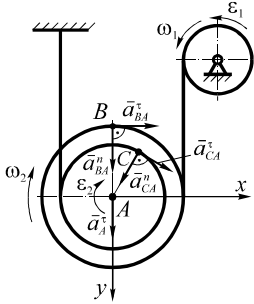
$$a_A^\tau = \frac{dv_A}{dt} = \frac{r_1 \cdot AP}{KP} \frac{d\omega_1}{dt} = \frac{r_1 \cdot AP}{KP} \varepsilon_1 = \frac{10 \cdot 15}{35} \cdot 3 = 12,86 \quad / ^2 .$$

$$\vec{a}_B = \vec{a}_A^\tau + \vec{a}_{BA}^\tau + \vec{a}_{BA}^n . \quad (3.3)$$

$$a_{BA}^n = \omega_2^2 \cdot AB = 0,286^2 \cdot 20 = 1,64 \quad / ^2 ,$$

$$a_{BA}^\tau = \varepsilon_2 \cdot AB .$$

$$\varepsilon_2 = \frac{d\omega_2}{dt} = \frac{d}{dt} \left(\frac{\omega_1 r_1}{KP} \right) = \frac{r_1}{KP} \frac{d\omega_1}{dt} = \frac{r_1}{KP} \varepsilon_1 = \frac{10}{35} \cdot 3 = 0,857 \quad / \text{ } ^2.$$



3.11

 \vec{a}_{BA}^n

$$a_{BA}^\tau = \varepsilon_2 AB = 0,857 \cdot 20 = 17,14 \quad / \text{ } ^2.$$

1

1 1),

2

 \vec{a}_{BA}^τ

3.11.

(3.3)

$$x: a_{Bx} = a_{BA}^\tau = 17,14 \quad / \text{ } ^2,$$

$$y: a_{By} = a_A^\tau + a_{BA}^n = 12,86 + 1,64 = 14,50 \quad / \text{ } ^2.$$

$$a_B = \sqrt{a_{Bx}^2 + a_{By}^2} = \sqrt{17,14^2 + 14,5^2} = 22,5 \quad / \text{ } ^2.$$

B

$$\vec{a}_C = \vec{a}_A + \vec{a}_{CA}^\tau + \vec{a}_{CA}^n = \vec{a}_A^\tau + \vec{a}_{CA}^\tau + \vec{a}_{CA}^n; \quad (3.4)$$

$$a_{CA}^\tau = \varepsilon_2 \cdot AC = 0,857 \cdot 15 = 12,86 \quad / \text{ } ^2;$$

$$a_{CA}^n = \omega_2^2 \cdot AC = 0,286^2 \cdot 15 = 1,23 \quad / \text{ } ^2.$$

 \vec{a}_{CA}^τ \vec{a}_{CA}^n \vec{a}_{BA}^τ \vec{a}_{BA}^n

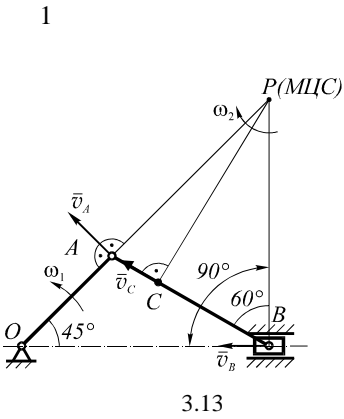
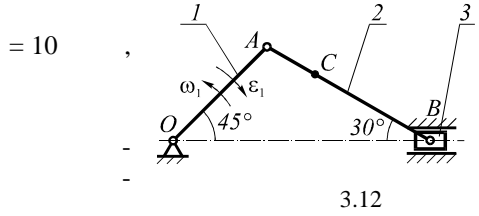
(3.4)

$$x: a_{Cx} = a_{CA}^\tau \cos 30^\circ - a_{CA}^n \cos 60^\circ = 12,86 \cdot 0,866 - 1,23 \cdot 0,5 = 10,52 \quad / \text{ } ^2;$$

$$y: a_{Cy} = a_A^\tau + a_{CA}^\tau \sin 30^\circ + a_{CA}^n \sin 60^\circ = 12,86 + 12,86 \cdot 0,5 + 1,23 \cdot 0,866 = 20,36 \quad / \text{ } ^2.$$

$$a_C = \sqrt{a_{Cx}^2 + a_{Cy}^2} = \sqrt{10,52^2 + 20,36^2} = 22,92 \quad / \text{ } ^2.$$

2
 3.12
 = 10
 $\omega_1 = 2$ / , $\varepsilon_1 = 5$ / ².
 2.



1.
 3.13.
 2.

2 () . 2.

$$v_A = \omega_1 \cdot OA = 20 \text{ / .}$$

$$v_A = \omega_2 \cdot AP . \tag{3.5}$$

$$\left(\dots \right) \tag{3.12},$$

$$\frac{OA}{\sin 30^\circ} = \frac{AB}{\sin 45^\circ} = \frac{OB}{\sin(180^\circ - 30^\circ - 45^\circ)} ;$$

$$AB = \frac{OA \cdot \sin 45^\circ}{\sin 30^\circ} = \frac{10 \cdot 0,707}{0,5} = 14,14 \quad ;$$

$$OB = \frac{OA \cdot \sin 105^\circ}{\sin 30^\circ} = \frac{10 \cdot 0,966}{0,5} = 19,32 \quad .$$

(. 3.13)

$$OP = \frac{OB}{\cos 45^\circ} = \frac{19,32}{0,707} = 27,33 \quad .$$

$$, AP = OP - OA = 27,33 - 10 = 17,33 \quad .$$

(3.5) ,

$$\omega_2 = \frac{v_A}{AP} = \frac{20}{17,33} = 1,15 \quad / .$$

, (3.5),

:

$$v_B = \omega_2 \cdot BP; \quad v_C = \omega_2 \cdot CP .$$

$$BP = OB = 19,32 \quad .$$

$$v_B = 1,15 \cdot 19,32 = 22,2 \quad / .$$

$$PC = \sqrt{CB^2 + BP^2 - 2 \cdot BC \cdot BP \cos 60^\circ} = \sqrt{10^2 + 19,32^2 - 2 \cdot 10 \cdot 19,32 \cdot 0,5} = 16,74 \quad .$$

$$v_C = 1,15 \cdot 16,74 = 19,3 \quad / .$$

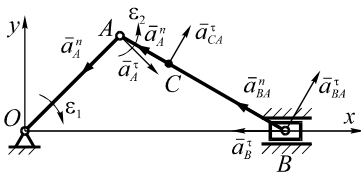
3

2.

1,

$$\vec{a}_A = \vec{a}_A^\tau + \vec{a}_A^n . \quad (3.6)$$

$$a_A^\tau = \varepsilon_1 \cdot OA = 5 \cdot 10 = 50 \quad / ^2 .$$



3.14

3.14.

$$a_A^n = \omega_1^2 \cdot OA = 2^2 \cdot 10 = 40 \quad / ^2$$

(. 3.14).

$$\vec{a}_B = \vec{a}_A + \vec{a}_{BA}^\tau + \vec{a}_{BA}^n.$$

$$\vec{a}_B = \vec{a}_A + \vec{a}_{BA}^\tau + \vec{a}_{BA}^n,$$

3.14.

(3.6)

$$\vec{a}_B^\tau = \vec{a}_A^\tau + \vec{a}_A^n + \vec{a}_{BA}^\tau + \vec{a}_{BA}^n. \quad (3.7)$$

\vec{a}_{BA}^τ

$$2 \left(\dots \right), \quad \vec{a}_{BA}^n =$$

$$a_{BA}^n = \omega_2^2 \cdot AB = 1,15^2 \cdot 14,14 = 18,7 \quad / \text{ }^2.$$

(3.7)

$$x: -a_B = -a_A^n \cos 45^\circ + a_A^\tau \sin 45^\circ - a_{BA}^n \cos 30^\circ + a_{BA}^\tau \cos 60^\circ; \quad (3.8)$$

$$y: 0 = -a_A^n \sin 45^\circ - a_A^\tau \cos 45^\circ + a_{BA}^n \sin 30^\circ + a_{BA}^\tau \sin 60^\circ. \quad (3.9)$$

$$(3.9) \quad a_{BA}^\tau:$$

$$a_{BA}^\tau = \frac{a_A^n \sin 45^\circ + a_A^\tau \cos 45^\circ - a_{BA}^n \sin 30^\circ}{\sin 60^\circ} =$$

$$= \frac{40 \cdot 0,707 + 50 \cdot 0,707 - 18,7 \cdot 0,5}{0,866} = 62,7 \quad / \text{ }^2.$$

$$(3.8) \quad a_B:$$

$$a_B = a_A^n \cos 45^\circ - a_A^\tau \sin 45^\circ + a_{BA}^n \cos 30^\circ - a_{BA}^\tau \cos 60^\circ =$$

$$= 40 \cdot 0,707 - 50 \cdot 0,707 + 18,7 \cdot 0,866 - 62,7 \cdot 0,5 = -22,2 \quad / \text{ }^2.$$

« »,

B,

3.14.

$$a_{BA}^\tau = \varepsilon_2 \cdot AB,$$

$$\varepsilon_2 = \frac{a_{BA}^\tau}{AB} = \frac{62,7}{14,14} = 4,43 \quad / \text{ } ^2.$$

$$\vec{a}_C = \vec{a}_A^\tau + \vec{a}_A^n + \vec{a}_{CA}^\tau + \vec{a}_{CA}^n. \quad (3.10)$$

$$a_{CA}^\tau = \varepsilon_2 AC = \varepsilon_2 (AB - CB) = 4,43 \cdot (14,14 - 10) = 18,34 \quad / \text{ } ^2;$$

$$a_{CA}^n = \omega_2^2 \cdot AC = 1,15^2 \cdot 4,14 = 5,48 \quad / \text{ } ^2.$$

$$\vec{a}_{CA}^\tau, \vec{a}_{CA}^n \qquad \vec{a}_{BA}^\tau, \vec{a}_{BA}^n.$$

$$(3.10)$$

$$Ox: a_{C_x} = -a_A^n \cos 45^\circ + a_A^\tau \sin 45^\circ - a_{CA}^n \cos 30^\circ + a_{CA}^\tau \cos 60^\circ =$$

$$= -40 \cdot 0,707 + 50 \cdot 0,707 - 5,48 \cdot 0,866 + 18,34 \cdot 0,5 = 2,65 \quad / \text{ } ^2;$$

$$Oy: a_{C_y} = -a_A^n \sin 45^\circ - a_A^\tau \cos 45^\circ + a_{CA}^n \sin 30^\circ + a_{CA}^\tau \sin 60^\circ =$$

$$= -40 \cdot 0,707 - 50 \cdot 0,707 + 5,48 \cdot 0,5 + 18,34 \cdot 0,866 = -45,0 \quad / \text{ } ^2.$$

$$a_C = \sqrt{a_{C_x}^2 + a_{C_y}^2} = \sqrt{2,65^2 + 45^2} = 45,1 \quad / \text{ } ^2.$$

3.3 -3.

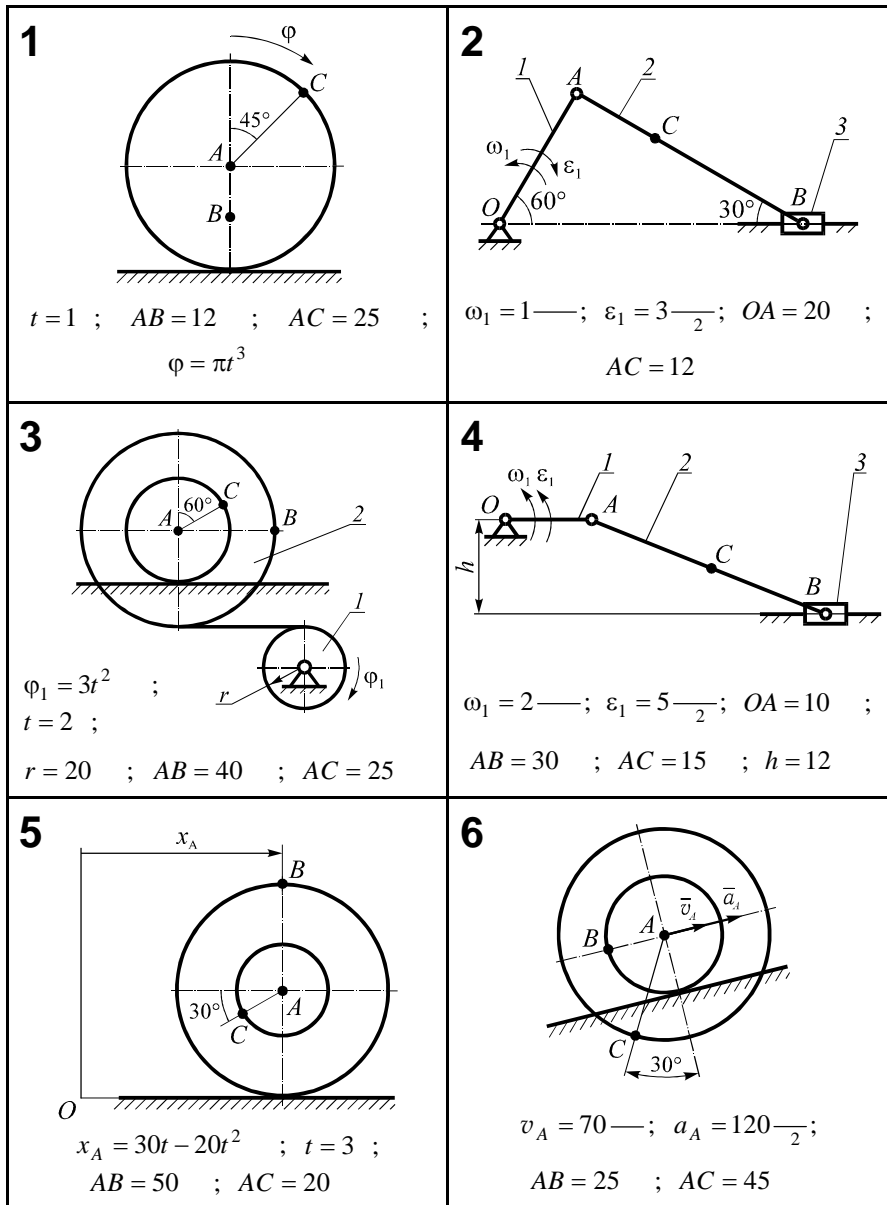
3.15

1

2

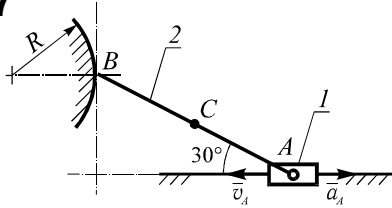
3

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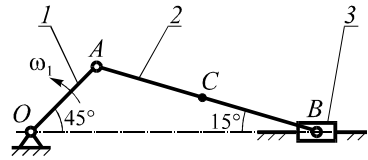
3.15 ()

7



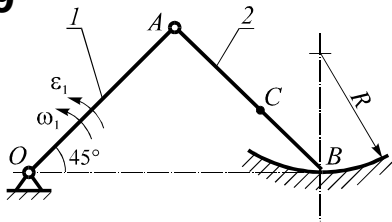
$v_A = 20$ — ; $a_A = 30$ —₂ ;
 $AB = 50$; $BC = 25$; $R = 40$

8



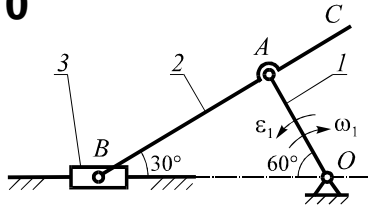
$\omega_1 = 4$ — ; $\epsilon_1 = 0$;
 $OA = 10$; $AC = BC$

9



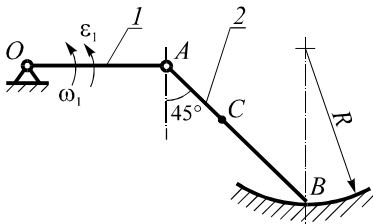
$\omega_1 = 3$ — ; $\epsilon_1 = 4$ —₂ ; $OB = 40$;
 $BC = 12$; $R = 20$

10



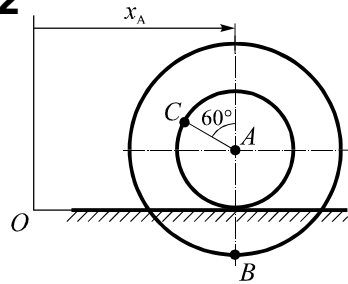
$\omega_1 = 1$ — ; $\epsilon_1 = 4$ —₂ ; $AB = 30$;
 $BC = 45$

11



$\omega_1 = 2$ — ; $\epsilon_1 = 2$ —₂ ; $OA = 25$;
 $AB = 35$; $BC = 20$; $R = 30$

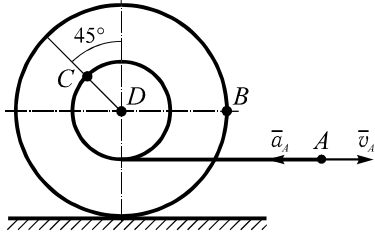
12



$x_A = 50t - 10t^2$; $t = 1$;
 $AB = 25$; $AC = 15$

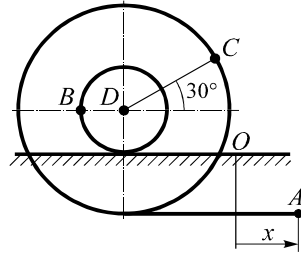
3.15 ()

13



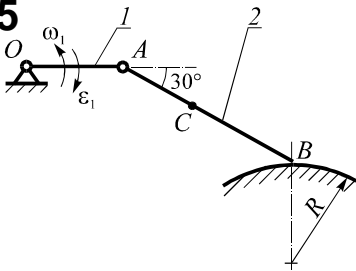
$v_A = 20$ — ; $a_A = 30 \frac{—}{2}$;
 $BD = 35$; $CD = 15$

14



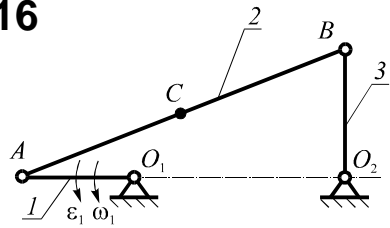
$x_A = 15t^2$; $t = 2$;
 $BD = 10$; $CD = 25$

15



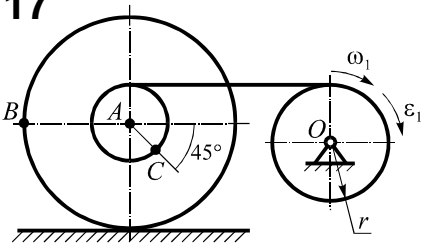
$\omega_1 = 3$ — ; $\epsilon_1 = 6 \frac{—}{2}$; $OA = 15$;
 $AB = 25$; $BC = 15$; $R = 20$

16



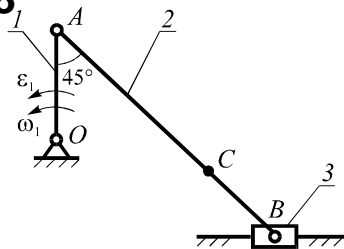
$\omega_1 = 3$ — ; $\epsilon_1 = 7 \frac{—}{2}$; $O_1A = 15$;
 $O_2B = 20$; $O_2A = 40$; $AC = BC$

17



$\omega_1 = 2$ — ; $\epsilon_1 = 5 \frac{—}{2}$; $r = 10$;
 $AB = 20$; $AC = 5$

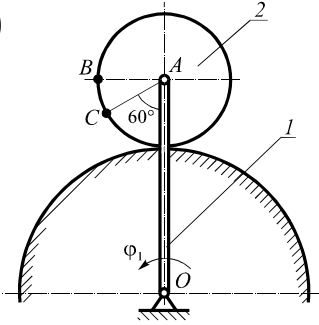
18



$\omega_1 = 2$ — ; $\epsilon_1 = 2 \frac{—}{2}$; $OA = 12$;
 $AB = 30$; $BC = 10$

3.15 ()

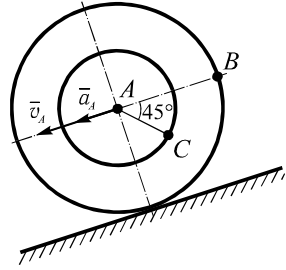
19



$$\varphi_1 = 8t - 2t^2 \quad ; \quad t = 1 \quad ;$$

$$OA = 50 \quad ; \quad AB = 15$$

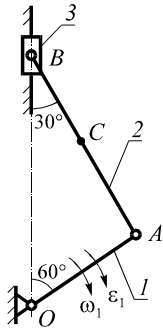
20



$$v_A = 120 \text{ —} ; \quad a_A = 150 \text{ —}_2 ;$$

$$AB = 55 \quad ; \quad AC = 30$$

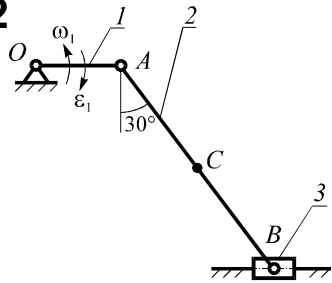
21



$$\omega_1 = 2 \text{ —} ; \quad \epsilon_1 = 1 \text{ —}_2 ; \quad OA = 20 \quad ;$$

$$BC = 15$$

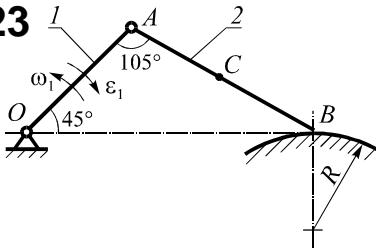
22



$$\omega_1 = 4 \text{ —} ; \quad \epsilon_1 = 6 \text{ —}_2 ; \quad OA = 10 \quad ;$$

$$AB = 30 \quad ; \quad BC = 15$$

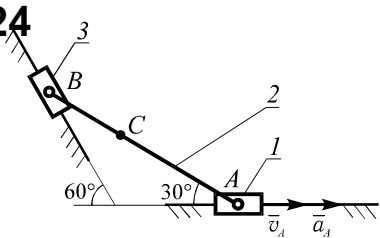
23



$$\omega_1 = 1 \text{ —} ; \quad \epsilon_1 = 2 \text{ —}_2 ; \quad OA = 25 \quad ;$$

$$AC = BC ; \quad R = 15$$

24

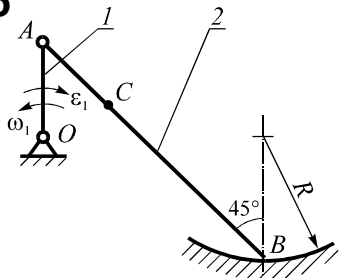


$$v_A = 30 \text{ —} ; \quad a_A = 10 \text{ —}_2 ;$$

$$AB = 25 \quad ; \quad AC = 15$$

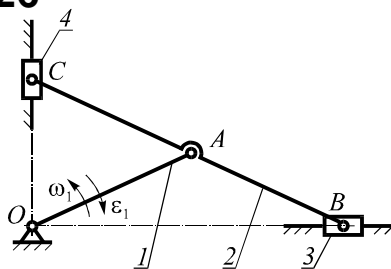
3.15 ()

25



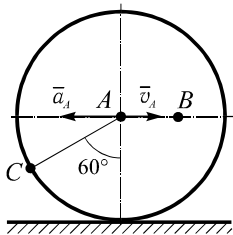
$\omega_1 = 2$ — ; $\varepsilon_1 = 5 \frac{—}{2}$; $AB = 35$;
 $OA = AC = 10$; $R = 20$

26



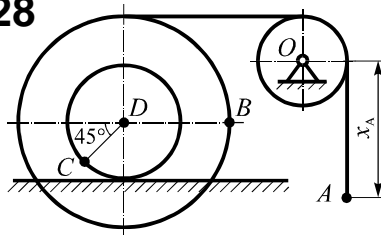
$\omega_1 = 2$ — ; $\varepsilon_1 = 3 \frac{—}{2}$; $OC = 20$;
 $OA = AB = AC = 25$

27



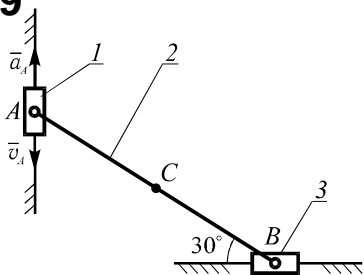
$v_A = 50$ — ; $a_A = 30 \frac{—}{2}$;
 $AB = 35$; $AC = 65$

28



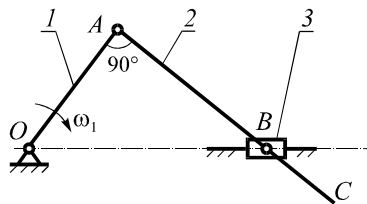
$x_A = 120t^2$; $t = 3$;
 $BD = 50$; $CD = 25$

29



$v_A = 40$ — ; $a_A = 20 \frac{—}{2}$;
 $AB = 30$; $AC = BC$

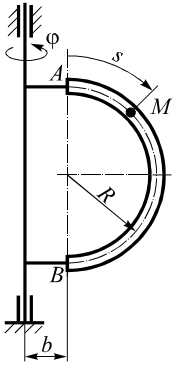
30



$\omega_1 = 2$ — ; $\varepsilon_1 = 0$; $OA = 15$;
 $AB = 20$; $BC = 10$

3.15 ()

4.2



4.1

AB.

$$\varphi = 0,3t^2 - 2t \quad (4.1)$$

$$s = 8\pi t^2 \quad ; R = 12 \quad , b = 6$$

$$M \quad t_1 = 1$$

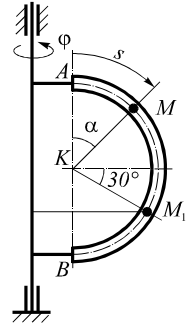
$$s(t) = 8\pi t^2 = 8\pi \cdot 1^2 = 8\pi$$

$$\alpha \quad (4.2) \quad s = R\alpha$$

$$\alpha = \frac{s}{R} = \frac{8\pi}{12} = \frac{2\pi}{3}$$

$$\alpha = 120^\circ, \quad 30^\circ \quad KM_1$$

(4.2).
2



4.2

$$M$$

$$s = s(t).$$

$$\varphi = \varphi(t),$$

$$\vec{v} = \vec{v}_{nep} + \vec{v}$$

4.3.

$$M_1$$

$$CM_1,$$

h -

$$v = \omega h,$$

$$h = CM_1 = b + KM_1 \cos 30^\circ = 6 + 12 \cdot 0,866 = 16,39$$

ω —

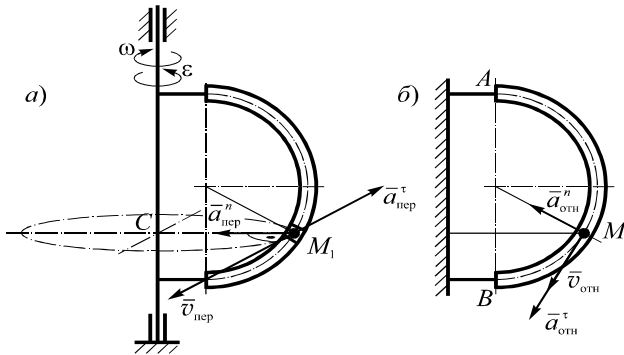
$$\omega = \frac{d\varphi}{dt} = 0,6t - 2, \quad t_1 = 1 \quad \omega_1 = 0,6 \cdot 1 - 2 = -1,4 \quad / .$$

φ .

$$v = 1,4 \cdot 16,39 = 22,95 \quad / .$$

1

(. 4.3,).



4.3

4.3, .

$$v = \frac{ds}{dt} = 16\pi t .$$

$$t_1 = 1$$

$$v = 16\pi t_1 = 16 \cdot 3,14 \cdot 1 = 50,24 \quad / .$$

s.

$$\bar{v} \quad \bar{v}$$

$$v = \sqrt{v^2 + v^2} = \sqrt{22,95^2 + 50,24^2} = 55,23 \quad / .$$

3

M.

$$\bar{a} = \bar{a}^n + \bar{a}^\tau + \bar{a}^n + \bar{a}^\tau + \bar{a} \quad . \quad (4.4)$$

$$a^\tau = \varepsilon \cdot h; a^n = \omega^2 \cdot h.$$

$$\varepsilon = \frac{d\omega}{dt} = 0,6 \text{ /}^2,$$

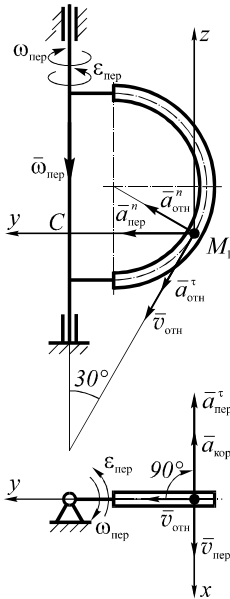
$$a^\tau = 0,6 \cdot 16,39 = 9,83 \text{ /}^2; a^n = 1,4^2 \cdot 16,39 = 32,12 \text{ /}^2.$$

4.3,

$$a^\tau = \frac{dv}{dt} = 16\pi = 16 \cdot 3,14 = 50,24 \text{ /}^2;$$

$$a^n = \frac{v^2}{\rho} = \frac{v^2}{R} = \frac{50,24^2}{12} = 210,34 \text{ /}^2.$$

4.3,



s (

$$a = 2\omega \cdot v \sin(\angle \vec{\omega}, \vec{v}).$$

4.4.

$$a = 2 \cdot 1,4 \cdot 50,24 \cdot \sin 30^\circ = 70,34 \text{ /}^2.$$

4.4

4.4. \bar{a}

(4.4),

$Ox: a_x = -a^\tau - a^n =$

$= -9,83 - 70,34 = -80,17 \text{ / } ^2;$

$Oy: a_y = a^n + a^\tau \sin 30^\circ + a^n \cos 30^\circ =$

$= 32,12 + 50,24 \cdot 0,5 + 210,34 \cdot 0,866 = 239,39 \text{ / } ^2;$

$Oz: a_z = -a^\tau \cos 30^\circ + a^n \sin 30^\circ =$

$= -50,24 \cdot 0,866 + 210,34 \cdot 0,5 = 61,66 \text{ / } ^2;$

$a = \sqrt{a_x^2 + a_y^2 + a_z^2} = \sqrt{80,17^2 + 239,39^2 + 61,66^2} = 259,88 \text{ / } ^2.$

4.3 -4.

(4.5).

1)

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2)

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3)

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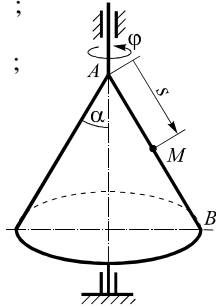
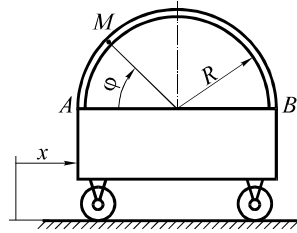
1

$$\varphi(t) = 3t^2 - 2t \quad ;$$

$$s(t) = 10 \cos \frac{\pi t}{3} \quad ;$$

$$t = 1 \quad ;$$

$$\alpha = 30^\circ$$

**2**

$$\varphi(t) = 3 t^2 \quad ; \quad x(t) = 2 \sin t \quad ;$$

$$t = \frac{1}{3} \quad ; \quad R = 15$$

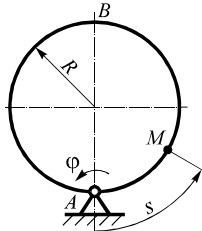
3

$$\varphi(t) = 8 \cos \frac{\pi t}{4} \quad ;$$

$$s(t) = \frac{5\pi t^2}{2} \quad ;$$

$$R = 5 \quad ;$$

$$t = 1$$

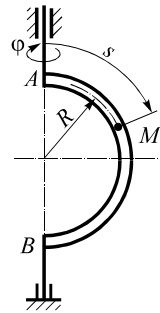
**4**

$$\varphi(t) = 10t - 5 \quad ;$$

$$s(t) = \frac{2\pi t^2}{3} \quad ;$$

$$t = 2 \quad ;$$

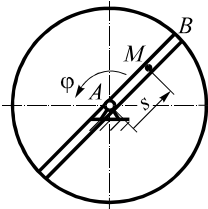
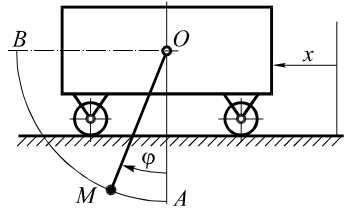
$$R = 4$$

**5**

$$\varphi(t) = 6t - 4t^2 \quad ;$$

$$s(t) = 10 \sin \frac{\pi t}{6} \quad ;$$

$$t = 1$$

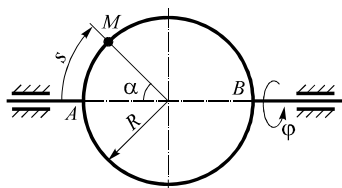
**6**

$$\varphi(t) = \frac{\pi t^2}{6} \quad ; \quad x(t) = 4t^2 - t$$

$$t = 1 \quad ; \quad l = 20$$

4.5 ()

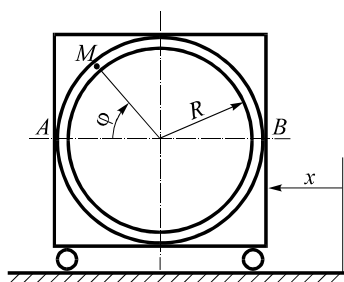
7



$$\varphi(t) = 5t + 3t^2 \quad ;$$

$$s(t) = \frac{5\pi t^2}{4} \quad ; t = 1 \text{ c}; R = 5$$

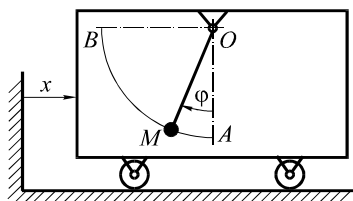
8



$$\varphi(t) = 4t^2 \quad ; x(t) = 16t^2 - 12t \quad ;$$

$$t = \frac{1}{4} \quad ; R = 8$$

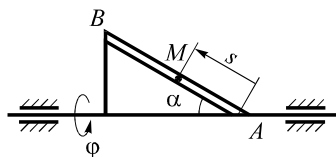
9



$$\varphi(t) = \frac{\pi t^2}{3} \quad ; x(t) = 12 \sin \frac{\pi t}{4} \quad ;$$

$$t = 1 \quad ; OM = l = 5$$

10

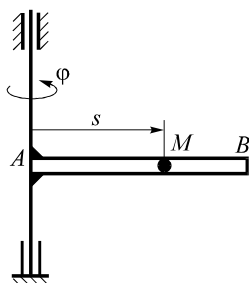


$$\varphi(t) = 6t - 2t^2 \quad ;$$

$$s(t) = 4 \sin \frac{\pi t}{6} + 2 \quad ;$$

$$t = 1 \text{ c}; \alpha = 30^\circ$$

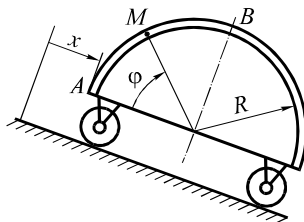
11



$$\varphi(t) = 4\pi t^2 \quad ; s(t) = 8t^2 + 3 \quad ;$$

$$t = 0,5$$

12

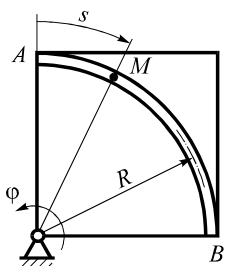


$$\varphi(t) = \frac{4}{3}t^2 \quad ; x(t) = 8 \cos \frac{t}{2} \quad ;$$

$$t = 0,5 \text{ c}; R = 15$$

4.5 ()

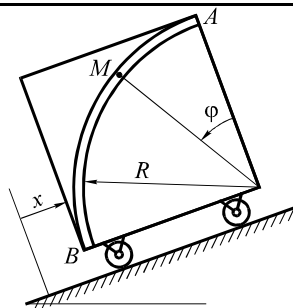
13



$$\varphi(t) = 4t^2 - 2t \quad ; \quad s(t) = 3\pi t^2 \quad ;$$

$$t = 1 \text{ c}; \quad R = 6$$

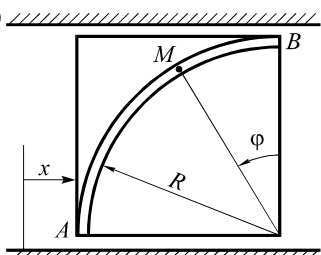
14



$$\varphi(t) = \frac{1}{6}t^2 \quad ; \quad x(t) = 16t^2 - 2t + 2 \quad ;$$

$$t = 1 \quad ; \quad R = 10$$

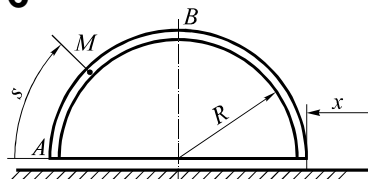
15



$$\varphi(t) = 3t^2 \quad ; \quad x(t) = 15 \sin t \quad ;$$

$$t = \frac{1}{3} \quad ; \quad R = 12$$

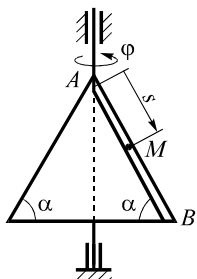
16



$$s(t) = \frac{10}{3}t^2 \quad ; \quad x(t) = 4 \sin \frac{t}{4} \quad ;$$

$$t = 1 \quad ; \quad R = 10$$

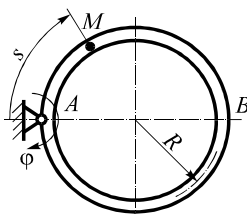
17



$$\varphi(t) = 5t - t^2 \quad ; \quad s(t) = 2t^2 - 4 \quad ;$$

$$t = 2 \text{ c}; \quad \alpha = 60^\circ$$

18

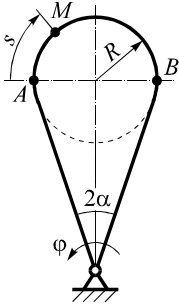


$$\varphi(t) = 7t^2 - 3 \quad ; \quad s(t) = 3\pi t^2 \quad ;$$

$$t = 1 \text{ c}; \quad R = 6$$

4.5 ()

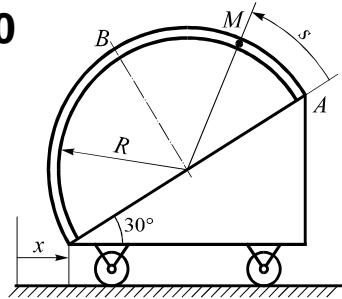
19



$$\varphi(t) = 6t^2 - 4t \quad ; \quad s(t) = 6\pi t^3 \quad ;$$

$$R = 6 \quad ; \quad t = 1 \text{ c} ; \quad \alpha = 30^\circ$$

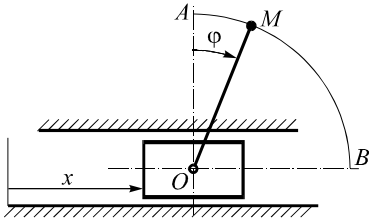
20



$$s(t) = \frac{16\pi t^2}{3} \quad ; \quad t = 0,5 \quad ;$$

$$x(t) = 12t^2 - 4t \quad ; \quad R = 8$$

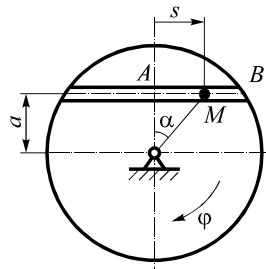
21



$$\varphi(t) = \frac{\pi t^2}{6} \quad ; \quad x(t) = 30 \sin \frac{\pi t}{3} \quad ;$$

$$t = 1 \quad ; \quad OM = l = 20$$

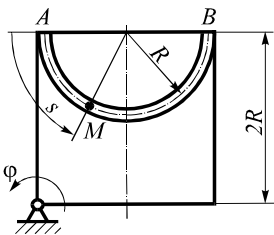
22



$$\varphi(t) = 4 \sin \frac{\pi t}{6} \quad ; \quad s(t) = 4t^2 + 6t \quad ;$$

$$t = 1 \text{ c} ; \quad a = 10\sqrt{3}$$

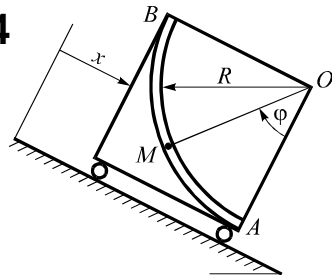
23



$$\varphi(t) = 4t - t^3 \quad ; \quad s(t) = 4\pi t^2 \quad ;$$

$$t = 1 \text{ c} ; \quad R = 8$$

24

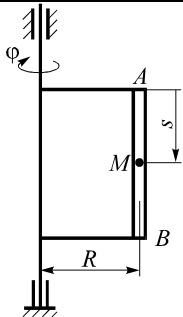


$$\varphi(t) = \frac{2}{3} t^2 \quad ; \quad x(t) = 15 \cos \frac{t}{2} \quad ;$$

$$t = \frac{1}{2} \quad ; \quad R = 10$$

4.5 ()

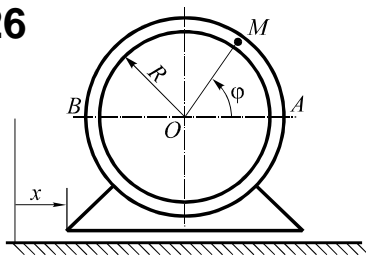
25



$$\varphi(t) = 2t^2 - 1 \quad ; \quad s(t) = 6 \sin \frac{\pi t}{6} \quad ;$$

$$t = 1 \quad ; \quad R = 4$$

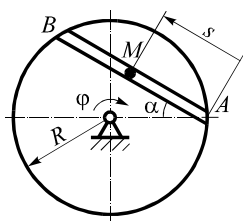
26



$$\varphi(t) = 2\pi t^3 \quad ; \quad x(t) = 20 \sin \pi t \quad ;$$

$$t = \frac{1}{2} \quad ; \quad R = 3$$

27

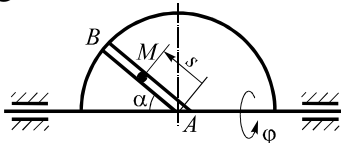


$$\varphi(t) = 2t^3 - t^2 \quad ;$$

$$s(t) = 10 \cos \frac{\pi t}{3} + 1 \quad ;$$

$$t = 1 \text{ c} \quad ; \quad R = 5 \quad ; \quad \alpha = 30^\circ$$

28

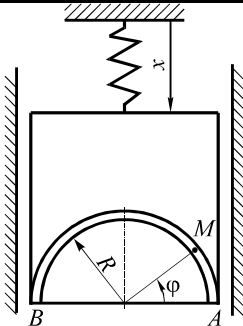


$$\varphi(t) = 6t - 4t^2 \quad ;$$

$$s(t) = 6 \sin \frac{\pi t}{6} + 3 \quad ;$$

$$t = 1 \text{ c} \quad ; \quad R = 6 \quad ; \quad \alpha = 60^\circ$$

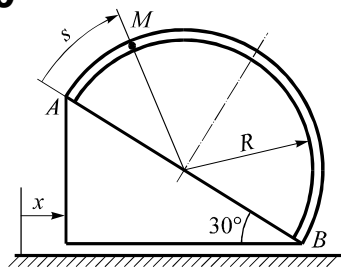
29



$$\varphi(t) = \frac{\pi t^2}{3} \quad ; \quad x(t) = 40 - 10 \sin \frac{\pi t}{4} \quad ;$$

$$t = 1 \quad ; \quad R = 6$$

30



$$s(t) = \frac{15\pi t^2}{6} \quad ; \quad x(t) = 4t^3 - t^2 \quad ;$$

$$t = 1 \quad ; \quad R = 15$$

4.5 ()

- 1 - « », 1998. - 736 . / , ,
- 2 , 1995. - 416 . / -
- 3 : 1. / , , - , 1990. - 670 .
- 4 / [.]; : , 1985. - 367 .
- 5 - : / « », 1998. - 448 .
- 6 : 1. / , - 6- : , 1984. - 343 .

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- 7 () . . . -
- 8 . . . -
- 9 . . . -

(« »)

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04.10.2006 . 60×84 ¹/₁₆.

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