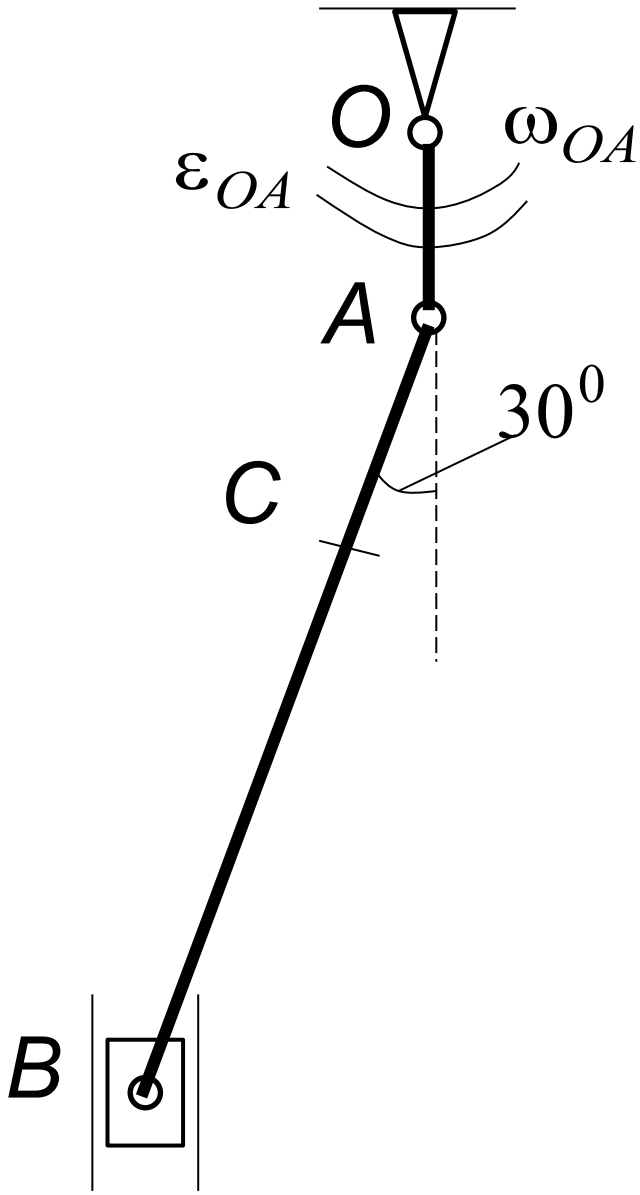
Определение скоростей и ускорений точек АТТ при плоском движении

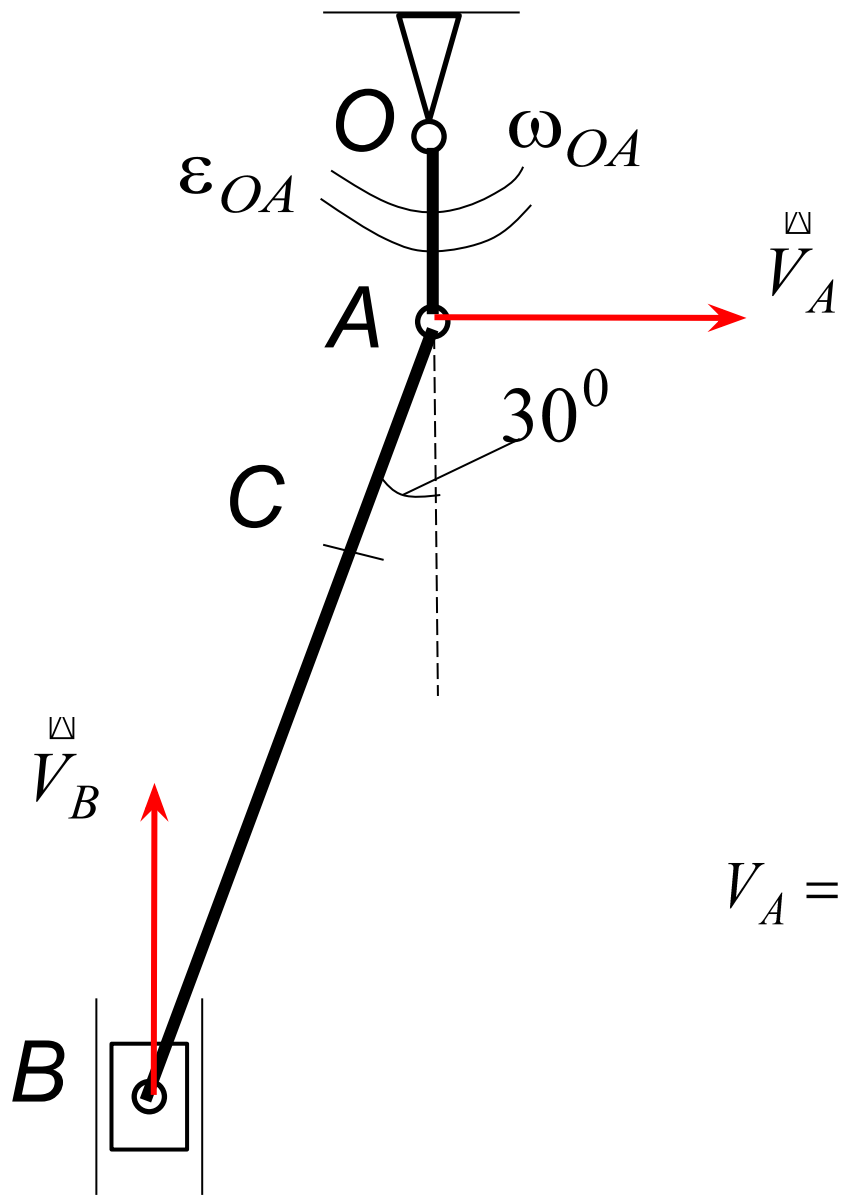
Пример

Для заданного положения механизма найти
скорости и ускорения точек *B* и *C*.

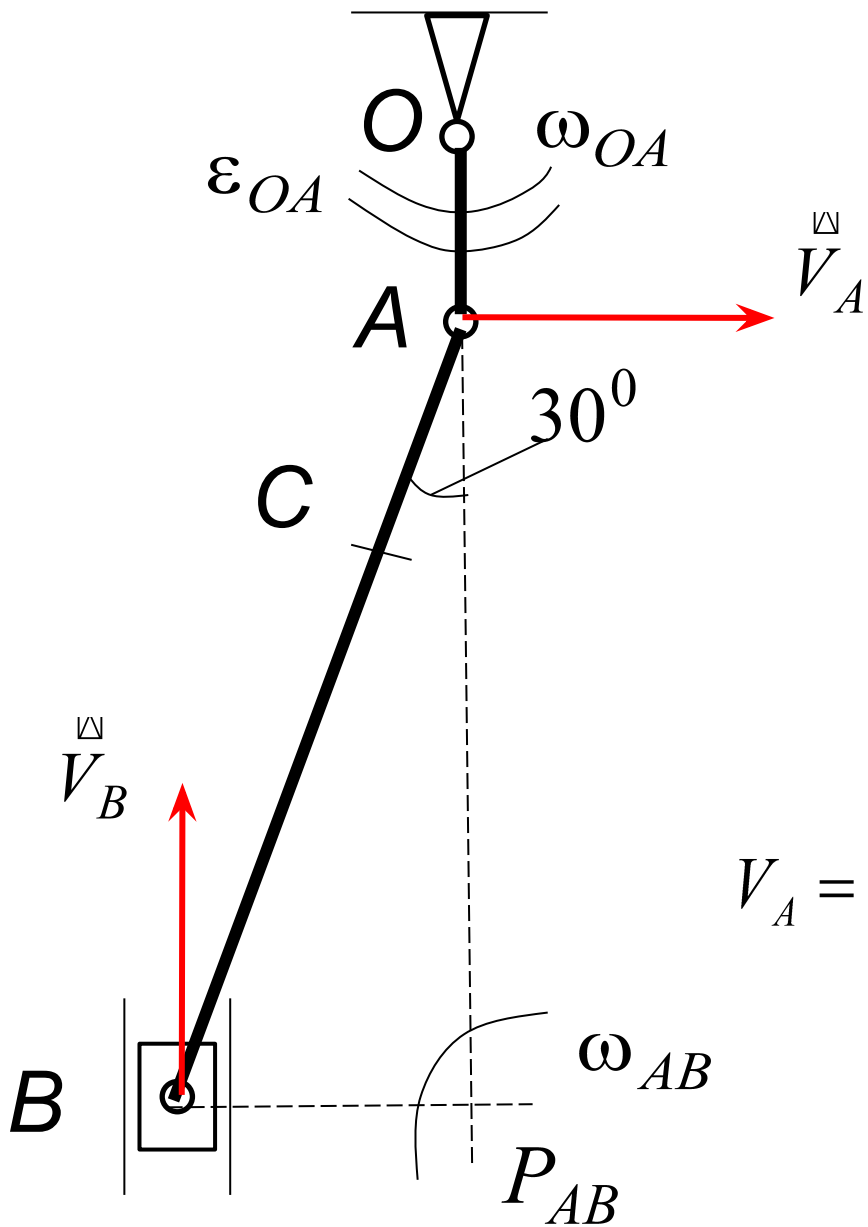
OA =10 см, *AB* =60 см *AC*=20см

$$\omega_{OA} = 1{,}5c^{-1}, \qquad \varepsilon_{OA} = 2c^{-2}$$


O
ω_{OA}
ε_{OA}
A
30^0
C
B



$$V_A = \omega_{OA} \cdot OA = 15 см/с$$



$$V_A = \omega_{OA} \cdot OA = 15 см/с$$

$$\omega_{AB} = \frac{V_A}{PA} = \frac{V_A}{AB\cos 30^0} = \frac{15}{60\cos 30^0} = 0{,}29c^{-1}$$

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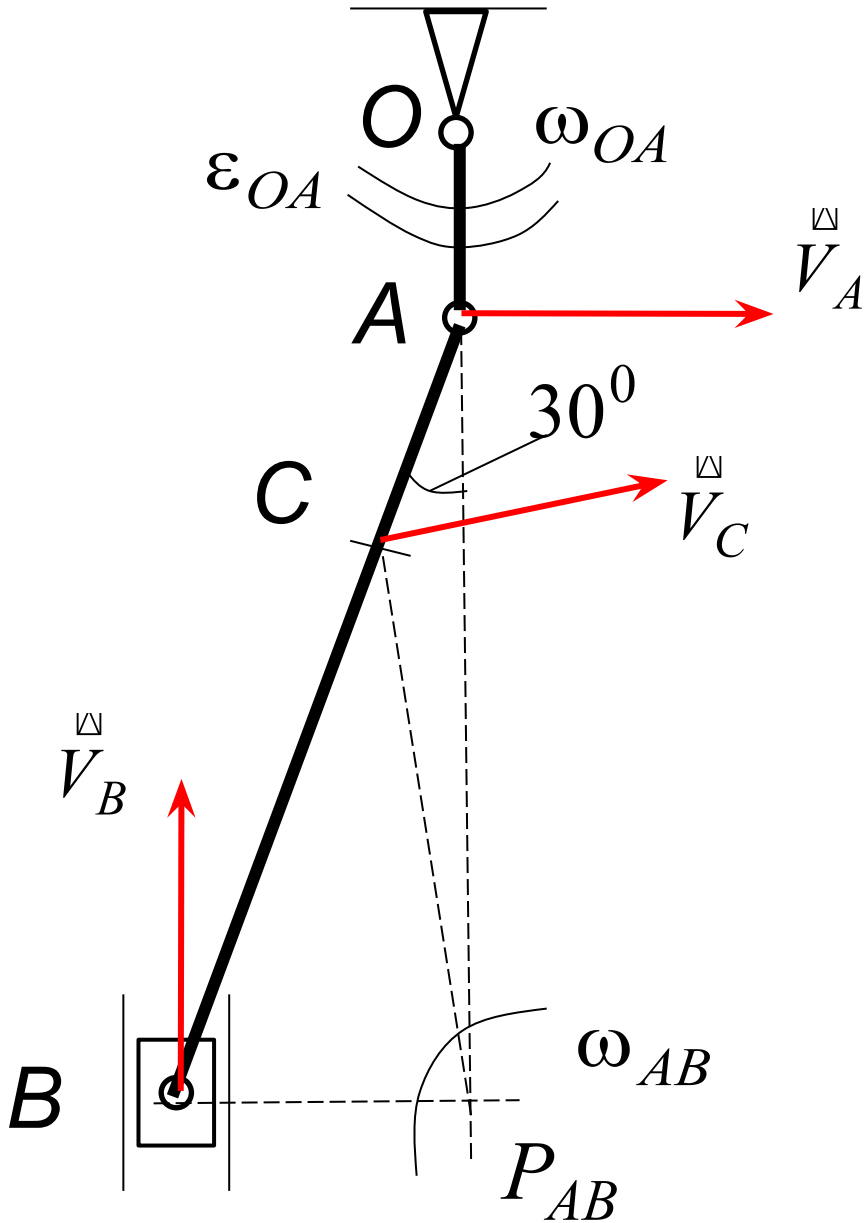
$$V_B = \omega_{AB} \cdot BP = \omega_{AB} \cdot AB\sin 30^0 = 8{,}7см/c$$

$$V_C = \omega_{AB} \cdot CP =$$

$$= \omega_{AB} \cdot \sqrt{BC^2 + BP^2 - 2BC \cdot BP\cos 30^0} = 36{,}1см/c$$


O
ω_{OA}
ε_{OA}
$\vec{V}_A$
A
30^0
C
$\vec{V}_C$
$\vec{V}_B$
B
ω_{AB}
P_{AB}

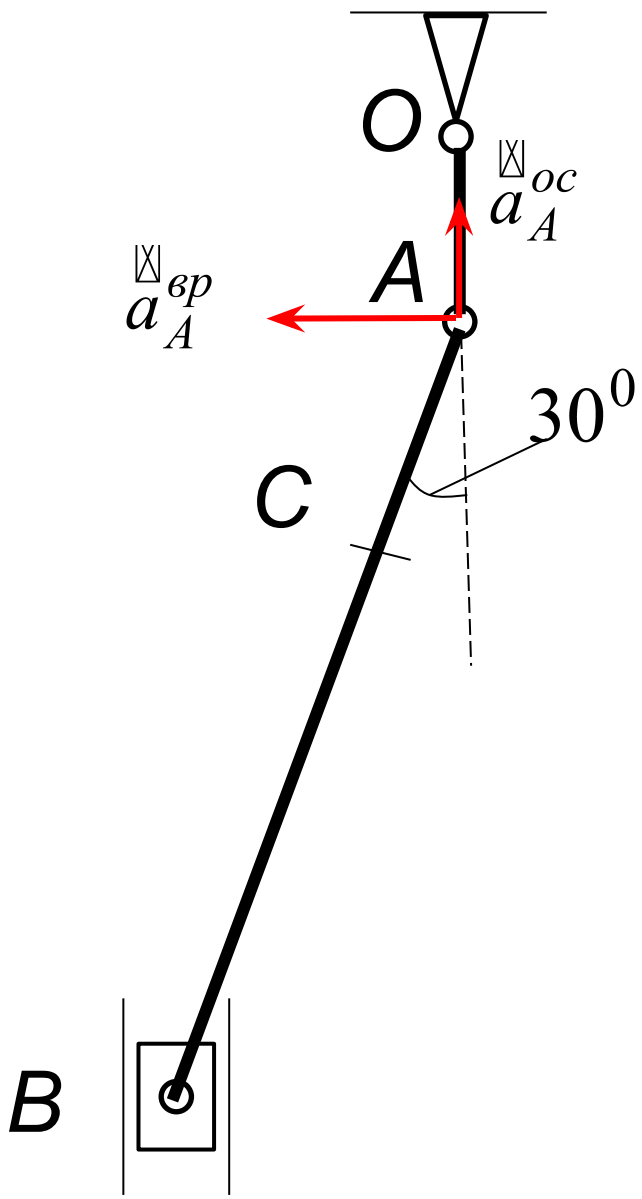
Определение ускорений точек

Ускорение точки *A*:

$$a_A^{вр} = \varepsilon_{OA} \cdot OA = 20 см/с^2$$

$$a_A^{ос} = \omega_{OA}^2 \cdot OA = 22{,}5 см/с^2$$

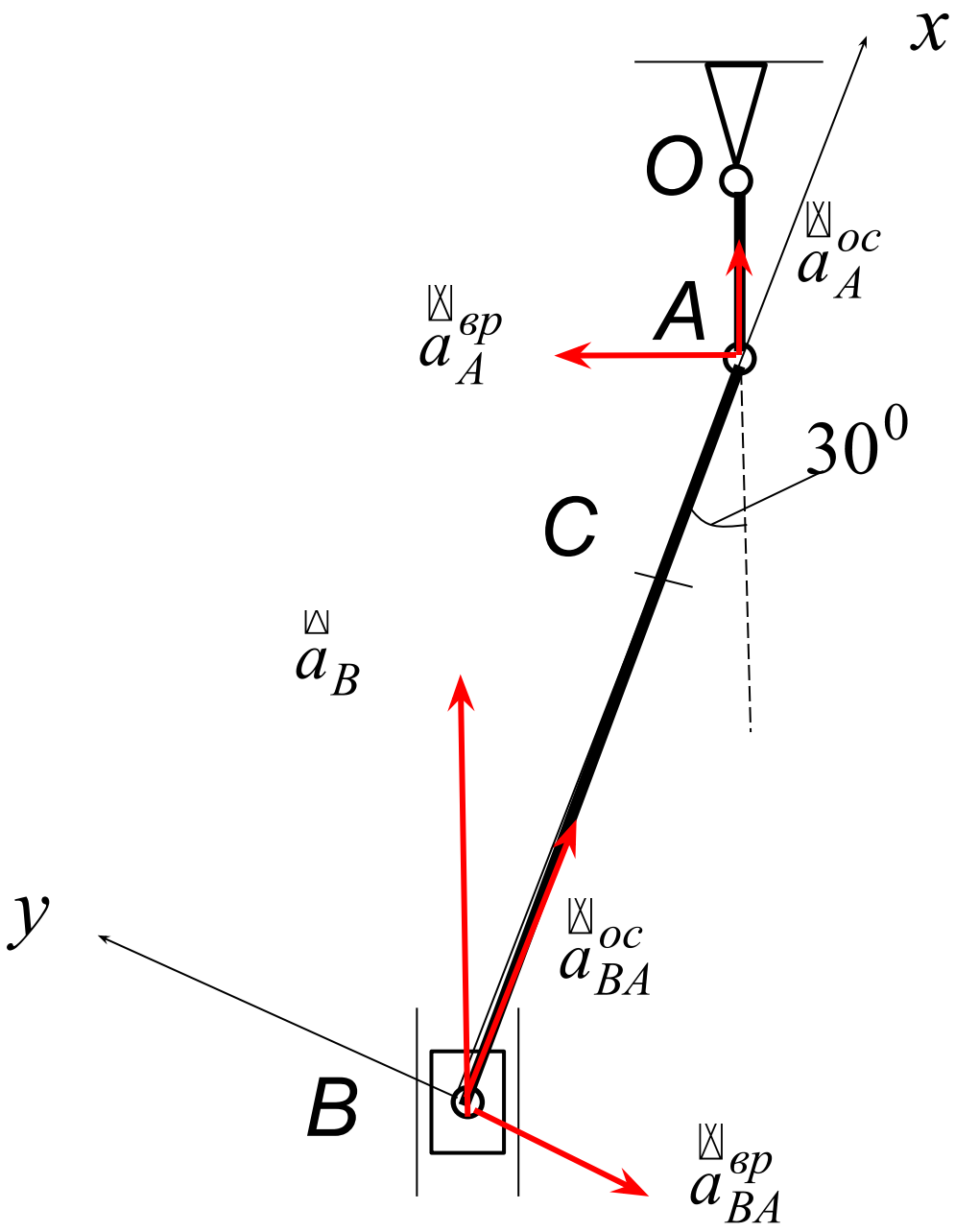
$$a_A = \sqrt{\left(a_A^{вр}\right)^2 + \left(a_A^{ос}\right)^2} = 30{,}1 см/с^2$$


O
$\vec{a}_A^{oc}$
A
$\vec{a}_A^{вр}$
30^0
C
B

Ускорение точки *B:*

$$\vec{a}_B = \vec{a}_A + \vec{a}_{BA}^{вр} + \vec{a}_{BA}^{ос} \qquad (1)$$

$$a_{BA}^{ос} = \omega_{AB}^2 \cdot AB = 5{,}05 см / с^2$$


x
O
$\vec{a}_A^{oc}$
A
$\vec{a}_A^{вр}$
30^0
C
$\vec{a}_B$
y
$\vec{a}_{BA}^{oc}$
B
$\vec{a}_{BA}^{вр}$

Проецируем уравнение (1) на ось *x:*

$$a_B \cos 30^0 = a_{BA}^{oc} + a_A^{oc} \cos 30^0 - a_A^{вр} \cos 60^0$$

$$a_B = \frac{a_{BA}^{oc} + a_A^{oc} \cos 30^0 - a_B^{вр} \cos 60^0}{\cos 30^0} = 16{,}7 см/с^2$$

Проецируем уравнение (1) на ось *y:*

$$a_B \cos 60^0 = -a_{BA}^{вр} + a_A^{вр} \cos 30^0 + a_A^{ос} \cos 60^0$$

$$a_{BA}^{вр} = -a_B \cos 60^0 + a_A^{вр} \cos 30^0 + a_A^{ос} \cos 60^0 = 20{,}2 см / с^2$$

$$\varepsilon_{BA} = \frac{a_{BA}^{вр}}{BA} = 0{,}34 с^{-2}$$

Ускорение точки C:

$$\vec{a}_C = \vec{a}_A + \vec{a}_{CA}^{вр} + \vec{a}_{CA}^{ос}$$

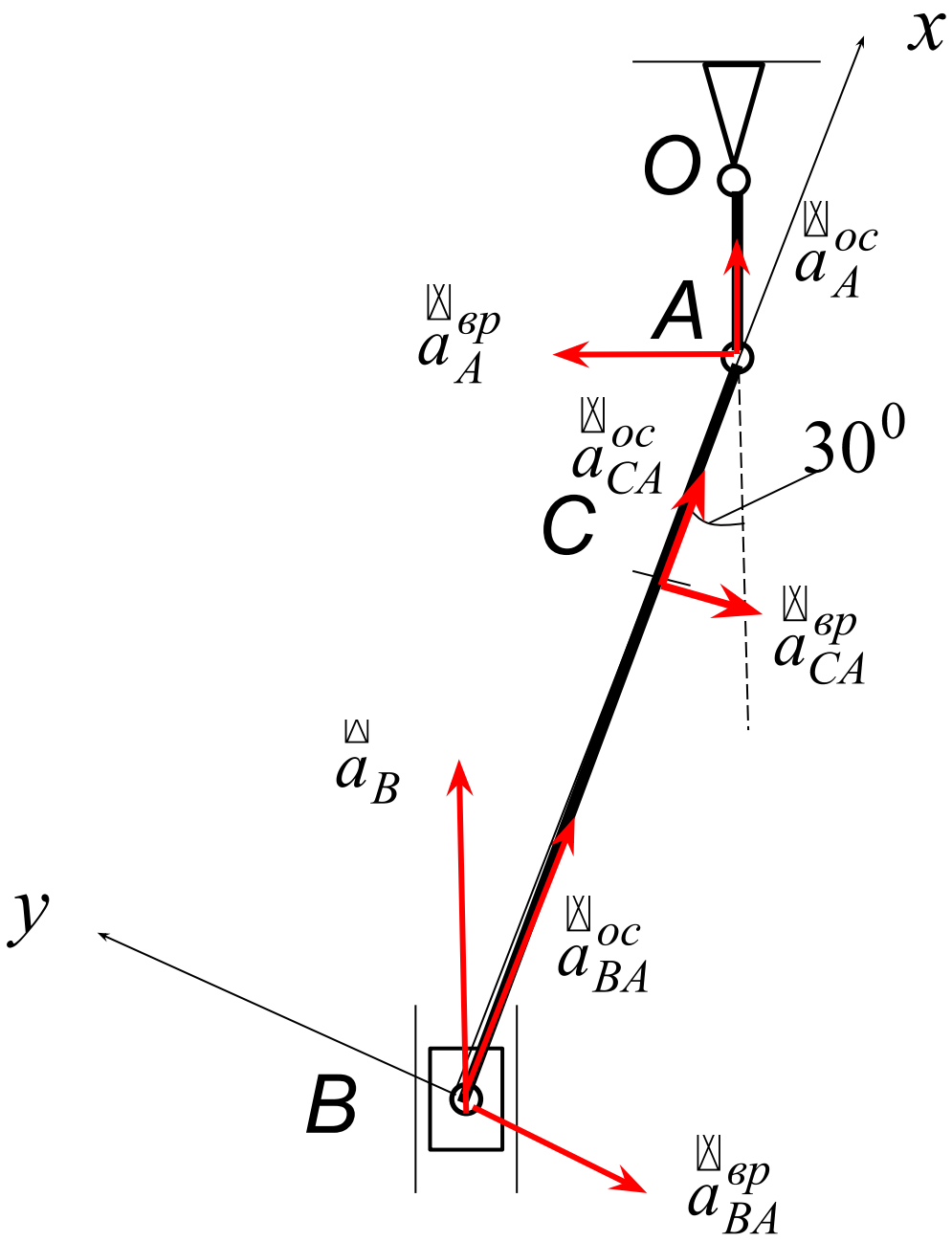
$$a_{CA}^{вр} = \varepsilon_{AB} \cdot AC = 6{,}8 см / с^2$$

$$a_{CA}^{ос} = \omega_{AB}^2 \cdot AC = 1{,}7 см / с^2$$

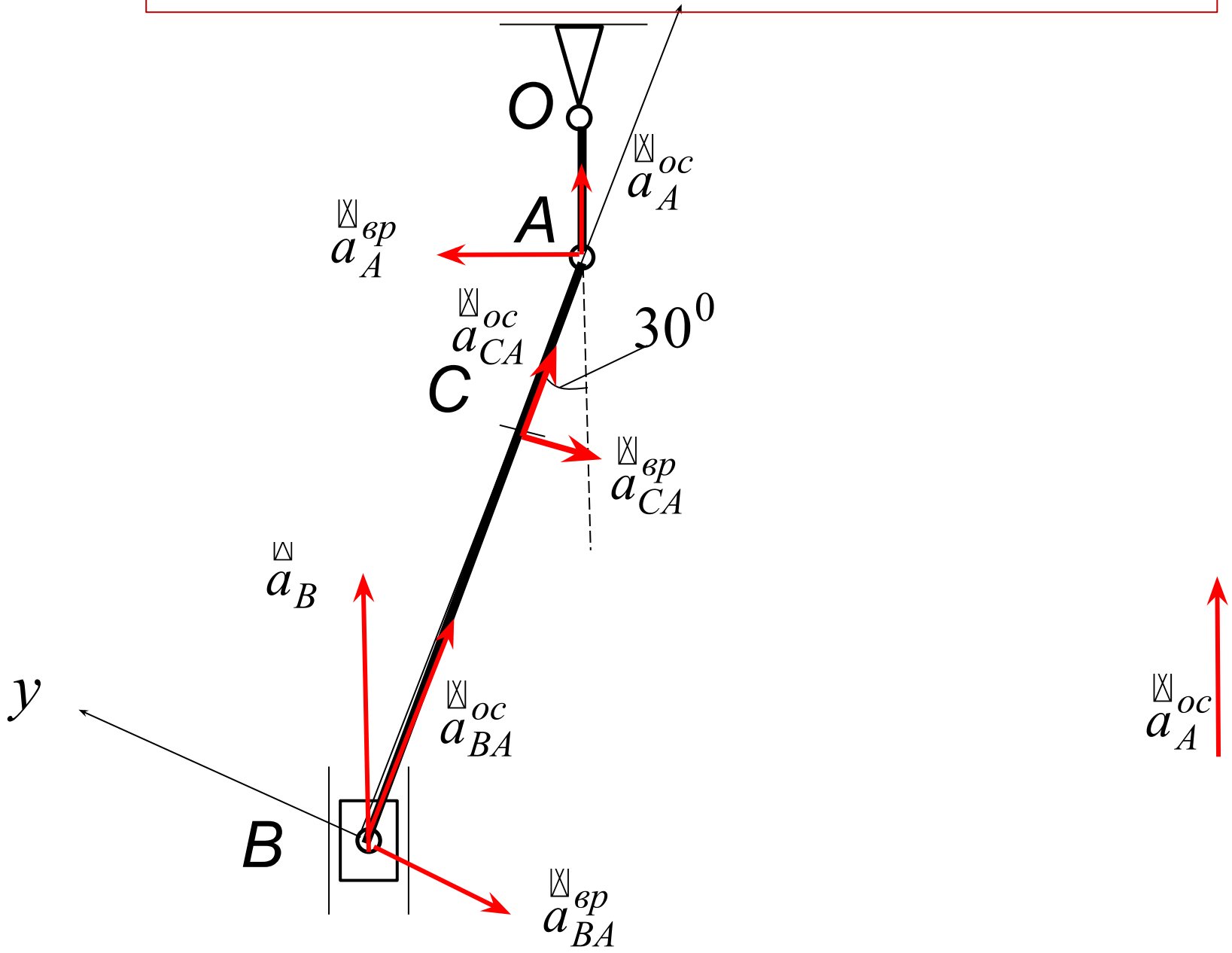
$$a_{Cx} = a_{AC}^{oc} + a_A^{oc}\cos 30^0 - a_A^{вр}\cos 60^0 = 11{,}2 см/с^2$$

$$a_{Cy} = -a_{AC}^{вр} + a_A^{oc}\cos 60^0 + a_A^{вр}\cos 30^0 = 21{,}5 см/с^2$$

$$a_C = \sqrt{a_{Cx}^2 + a_{Cy}^2} = 24{,}5 см/с^2$$


x
O
$\vec{a}_A^{oc}$
A
$\vec{a}_A^{вр}$
$\vec{a}_{CA}^{oc}$
30^0
C
$\vec{a}_{CA}^{вр}$
$\vec{a}_B$
y
$\vec{a}_{BA}^{oc}$
B
$\vec{a}_{BA}^{вр}$

Метод планов



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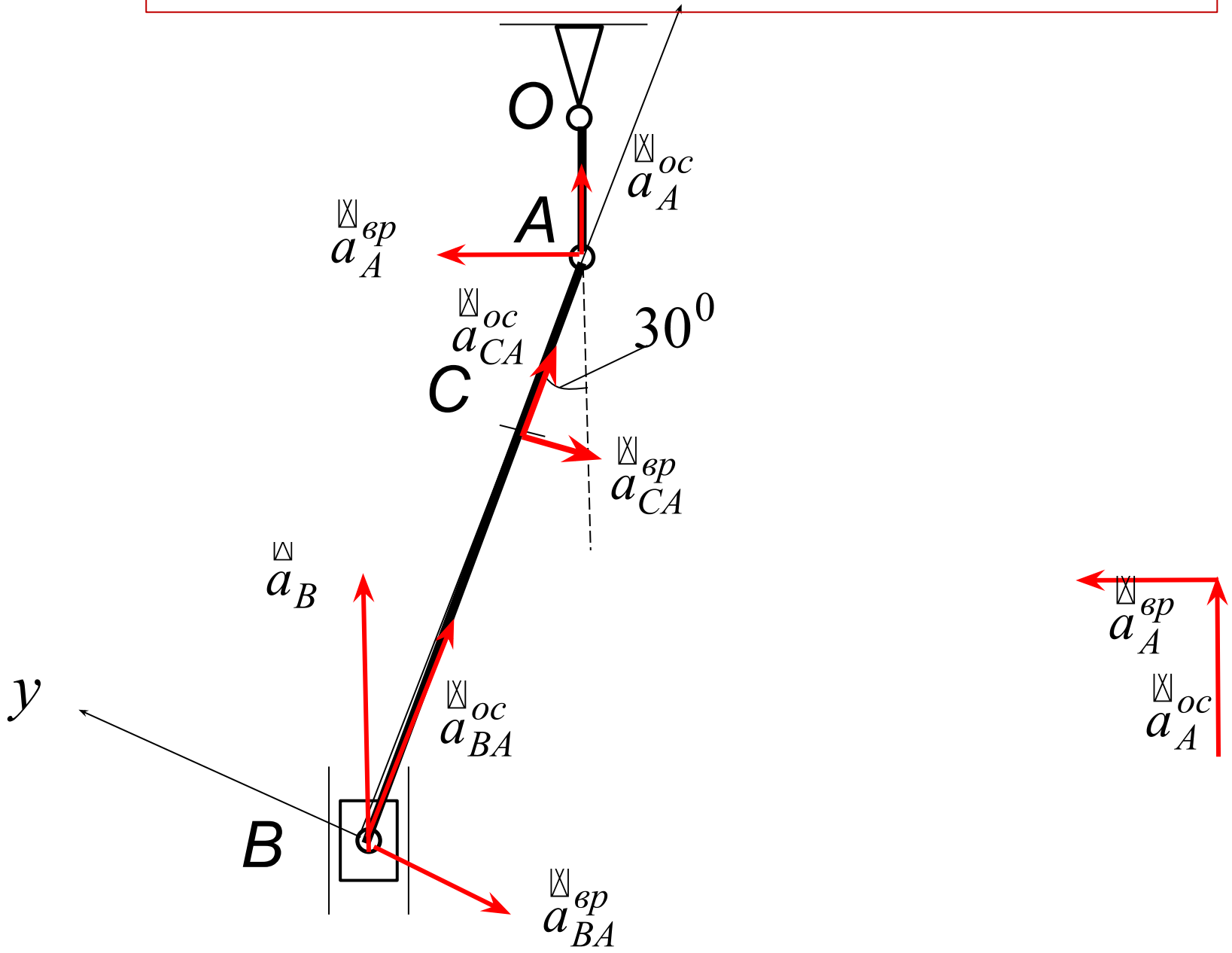

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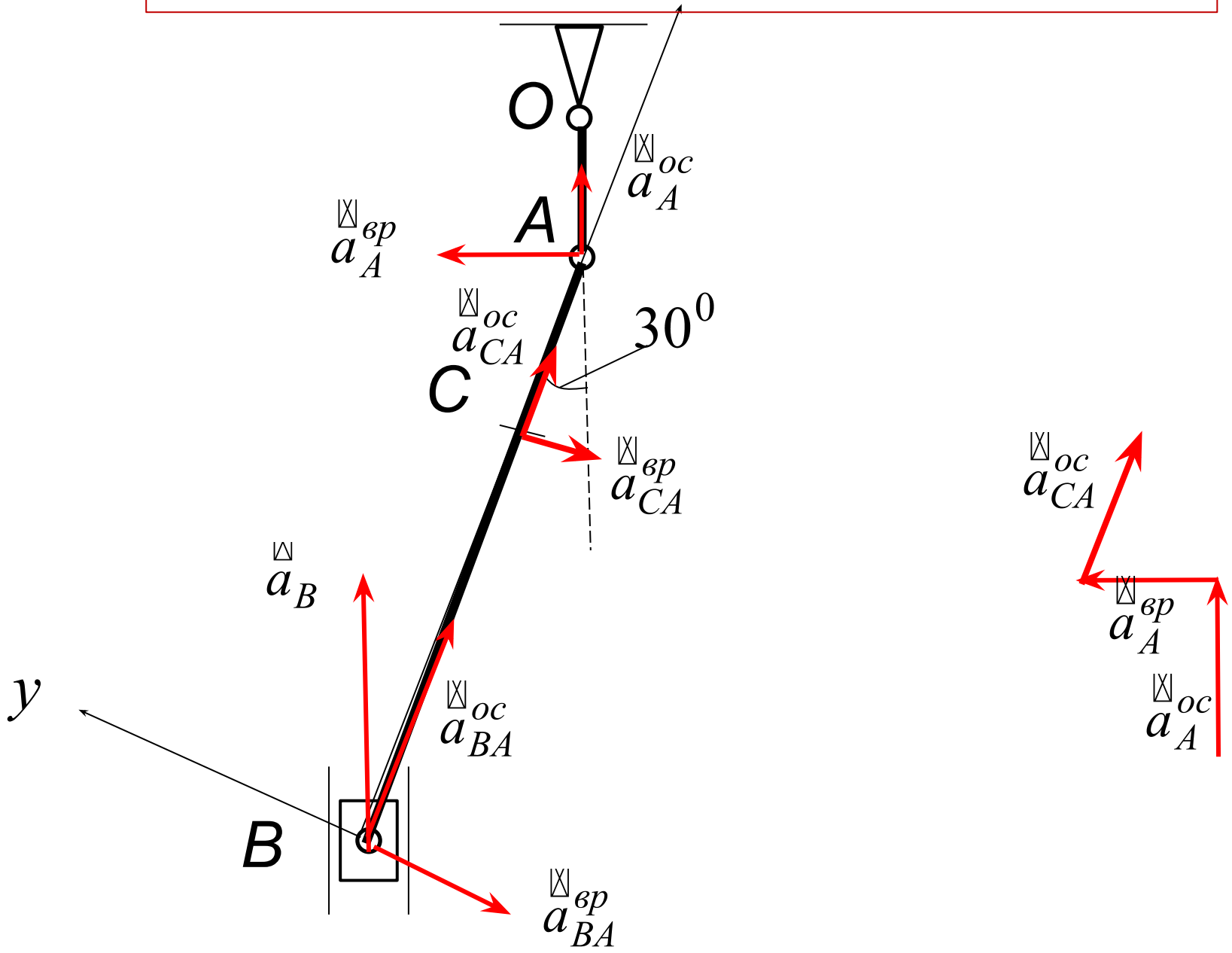

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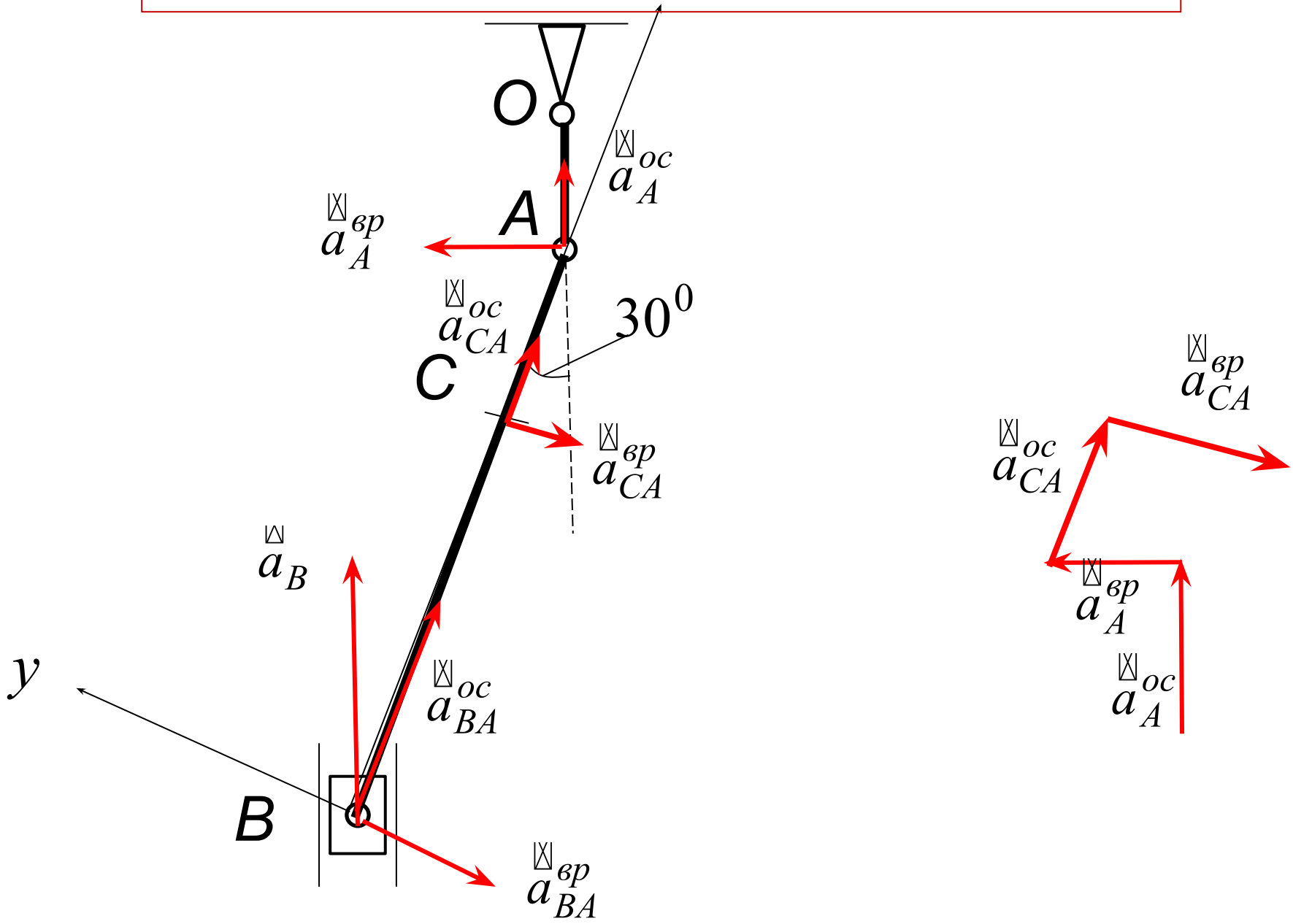
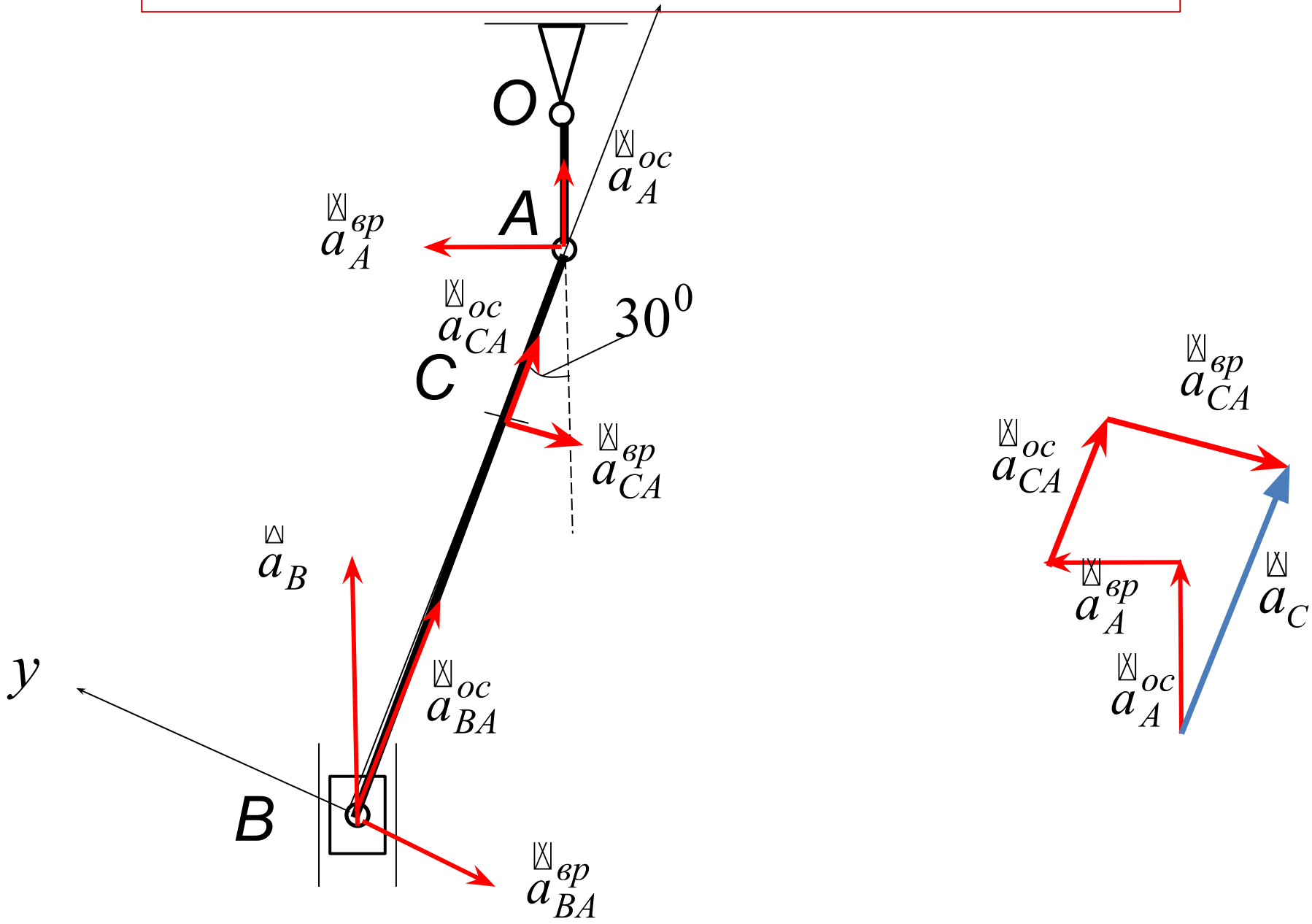
Метод планов