**Theoretical mechanics. Midterm exam. Variant \_\_\_\_.**

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| First name | Last name | Points#1 |
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**Task 1**. Statics

Determine the reactions of ABC body supports in equilibrium. The body is affected by a force, a uniformly distributed load of intensity q and a pair of forces with moment M. At point C, a weight weight is suspended on a thread thrown over a block. Linear dimensions are given in meters. ABC body weight is not taken into account.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variant | *F*, N | *P*, N | *q*, N/m | *M*, N·m |
| 1 | 10 | 14 | 5 | 20 |
| 2 | 15 | 25 | 4 | 10 |
| 3 | 12 | 15 | 4 | 20 |
| 4 | 20 | 25 | 6 | 15 |
| 5 | 12 | 16 | 4 | 10 |
| 6 | 16 | 10 | 2 | 20 |
| 7 | 20 | 15 | 5 | 18 |
| 8 | 25 | 10 | 3 | 20 |
| 9 | 20 | 10 | 4 | 25 |
| 10 | 30 | 20 | 5 | 12 |
| 11 | 12 | 16 | 4 | 20 |
| 12 | 16 | 10 | 4 | 15 |

|  |  |
| --- | --- |
| 1  А  В  С  P  q  M  45º  30º  4  3  2  2 | 2  А  В  С  P  q  M  45º  30º  3  2  2  2 |
| 3  А  В  С  P  q  M  45º  60º  45º  R2  4 | P  4  А  В  С  q  M  60º  30º  30º  2  1,5  2  2  2 |

|  |  |
| --- | --- |
| 3  А  В  С  P  q  M  45º  60º  45º  R2  4 | P  4  А  В  С  q  M  60º  30º  30º  2  1,5  2  2  2 |
| 5  А  В  С  P  q  M  45º  45º  2  2  1 | 30º  6  А  В  С  P  q  M  45º  2  2  4 |
| 7  А  В  С  P  q  M  30º  1  2  3  1    60º | 8  А  В  С  P  q  M  45º  30º  2  2  1 |
| 9  А  В  С  P  q  M  30º  30º  4  1  3  5    30º | А  10  В  С  P  q  M  30º  60º  1  2  3  3 |

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| First name | Last name | Points#2 |
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**Task 2**. Kinematic analysis of the plane mechanism

Determine the velocity and acceleration of the center of mass of the roller *3*, as well as angular velocity and acceleration, if known velocity and acceleration of the load *1*.



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| First name | Last name | Points#3 |
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**Task 3**. Kinematic analysis of the plane mechanism

The mechanism, consisting of several links, moves in the plane of the drawing. Determine for a given position of the mechanism:

1. Velocities for points В and С;

2. Angular velocities for the links, which belongs to these points.

3. Acceleration for В and С.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variant | ω*OA*  s-1 | ε*OA*  s-2 | *VA*  cm/s | *a*A  cm/s2 | *ОА*  cm | *АВ*  cm | *АС*  cm | Additional info |
| 1 | *V1* = 20 cm/s, *a1* = 5 cm/s2 | | | | | | | R = 10 cm, r = 5 cm |
| 2 |  |  | 50 | 10 |  | 20 | 10 |  |
| 3 |  |  | 40 | 20 |  | 20 | 10 |  |
| 4 | 6 | 4 |  |  | 10 | 30 | 15 |  |
| 5 | *V1* = 40 cm/s, *a1* = 10 cm/s2 | | | | | | | R =20 cm, r =10 cm |
| 6 |  |  | 30 | 10 |  | 40 |  | АВ = АС = СВ |
| 7 | *V1* = 20 cm/s, *a1* = 10 cm/s2 | | | | | | | R = 20 cm, r = 10 cm, |
| 8 |  |  | 50 | 10 |  | 50 | 25 |  |
| 9 | 10 | 5 |  |  | 10 | 20 | 10 |  |
| 10 | 5 | 2 |  |  | 10 | 20 | 10 |  |
| 11 | 10 | 2 |  |  |  | 40 | 20 |  |
| 12 | *V1* = 30 cm/s, *a1* = 10 cm/s2 | | | | | | | R = 20 cm |

|  |  |  |
| --- | --- | --- |
| |  |  | | --- | --- | | 1  1    R  r  С  A  2  В | 2      30º  120º  C  B  A | |
| |  |  | | --- | --- | | 3  30º  45º      C  B  A | 4  εOA  ωOA  B  30˚  O  A  C | |
| |  |  | | --- | --- | | 5  1      A  R  2  r  С  30º  B | 6  C      A  B | |
| |  |  | | --- | --- | | 7  C  B  R  r  1  A      2 | 8      60º  A  B  C | |
| |  |  | | --- | --- | | 9  30º  εOA  ωOA  60º  O  B  A  C | εOA  ωOA  O  A  C  B  10  30º | |

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| First name | Last name | Points#4 |
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**Task 4**. Estimation of the absolute velocity and the absolute acceleration of a point in a complex motion.

The figure illustrates a body performing a rotational motion according to the law Phi\_e = f1(t). On the surface of this body moves the point M by the law Sr = f2(t). At the moment t = t1 find the absolute velocity and the absolute acceleration of the point M. The position of the point M is shown at a positive value of the natural coordinate of OM.

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| Variant | Equation of Transport motion  ϕ*e = f1(t)*, rad | Equation of relative motion  *Sr = f2(t)*, cm | *R*,  cm | *a*,  cm | α,  degree | *t1*,  s |
| 1 |  |  | 40 |  |  | 1 |
| 2 |  |  |  |  | 30 | 1 |
| 3 |  |  |  |  |  | 2 |
| 4 |  |  | 50 |  |  | 1 |
| 5 |  |  |  | 30 | 60 | 1 |
| 6 |  |  | 20 |  | 30 | 1 |
| 7 |  |  |  |  | 30 |  |
| 8 |  |  |  | 20 |  | 1 |
| 9 |  |  |  | 25 |  | 1 |
| 10 |  |  |  | 20 |  | 1 |
| 11 |  |  | 30 |  |  | 1 |
| 12 |  |  | 20 |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| M  O  R  1  φ*e* | | M  α  φ*e*  2 | |
| O  M  φ*e*  3 | | 4  φ*e*  M  O  R  O1 | |
| O  M  φ*e*  *a*  α  α  O1  5 | | 6  O  M  R  φ*e*  α | |
| O  M  φ*e*  α  7 | | O  M  φ*e*  *2a*  8  O1 | |
| O  M  *a*  *a*  *a*  φ*e*  O1  9 | | O  M  *a*  O1  φ*e*  10 | |