Navlakhi®

Mechanics

Chapter 5: Instantaneous Center

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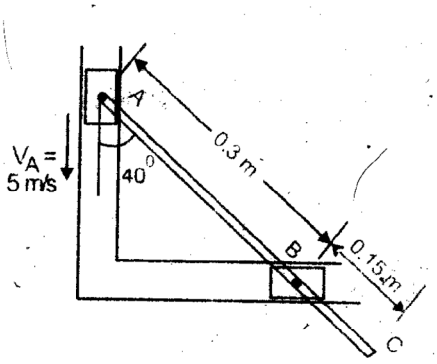
$$\frac{\text{Sin A}}{\text{BC}} = \frac{\text{Sin B}}{\text{AC}} = \frac{\text{Sin C}}{\text{AB}}$$

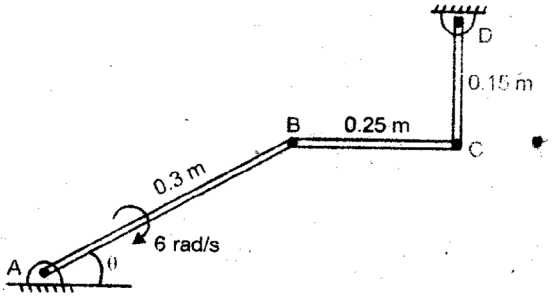
$$BC = \sqrt{AB^2 + AC^2 - 2\,AB.AC.cosA}$$

Examples

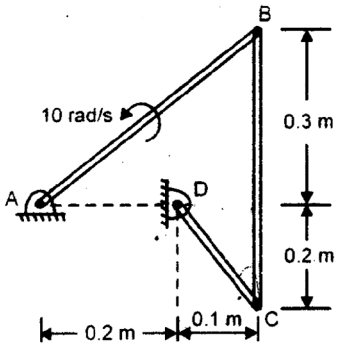
P1. The rod ABC is guided by two blocks A and B which move in channels as shown. At the given instant, velocity of block A is 5 m/s downwards. Determine
a) the angular velocity of rod ABC
b) velocities of block B and end C of rod.



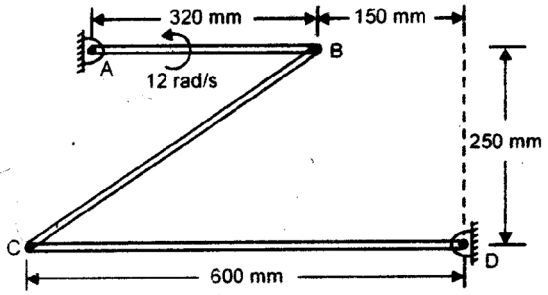
P2. The bar AB has an angular velocity of 6 rad/sec clockwise when θ = 50°. Determine the corresponding angular velocities of bars BC and CD at this instant.



P3. For the position shown, the angular velocity of bar AB is 10 rad/s anticlockwise. Determine the angular velocities of bars BC and CD.

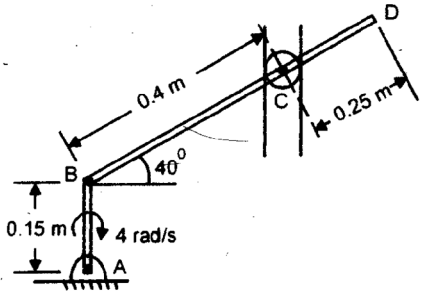


P4. For the mechanism shown, bar AB has a constant angular velocity of 12 rad/s counterclockwise. Determine the angular velocity of the bar BC and CD for the instant shown.

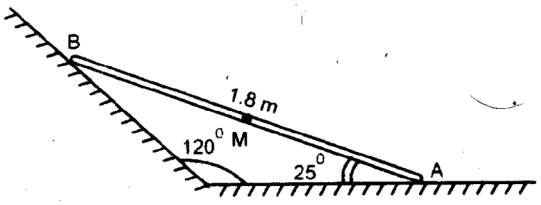


P5. Rod BCD is pinned to rod AB at B and has a roller at C which slides freely in the vertical slot. At the instant shown, the angular velocity of rod AB is 4 rad/s clockwise. Determine

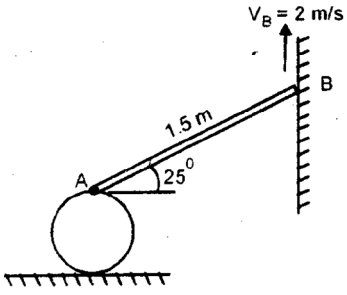
a) angular velocity of rod BD
b) velocity of roller C
c) velocity of end D of the rod BD



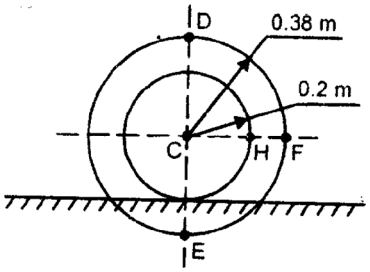
P6. A rod AB 1.8 m long, slides against an inclined plane and a horizontal floor. The end A has a velocity of 5 m/s to the right. Determine the angular velocity of the rod and the magnitude of velocity of end B and the midpoint M of the rod for the instant shown.



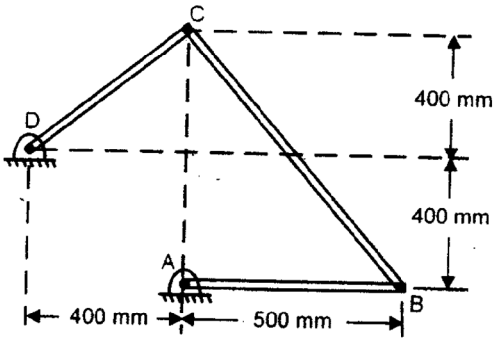
P7. One end of rod AB is pinned to the cylinder of diameter 0.5 m while the other end slides vertically up the wall with a uniform speed of 2 m/s. For the instant, when the end A is vertically over the centre of the cylinder, find the angular velocity of the cylinder, assuming it to roll without slip.



P8. A flanged wheel rolls to the left on a horizontal rail as shown. The velocity of the wheel's centre is 4 m/s. Find velocities of points D, E, F and H on the wheel.

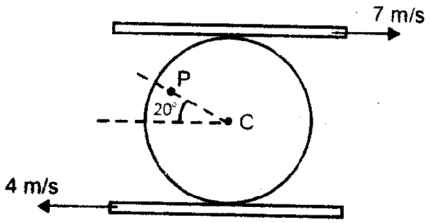


P9. Rod AB has a constant angular velocity of 50 rpm clockwise. For the given position of the mechanism, find the angular velocity of rods BC and CD.

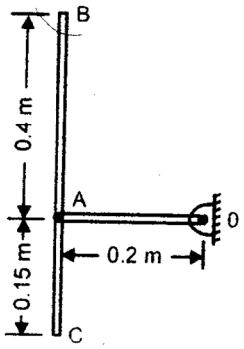


P10. A roller of radius 400 mm rolls without slip between two parallel plates moving in the opposite direction with the speed shown.
Determine,

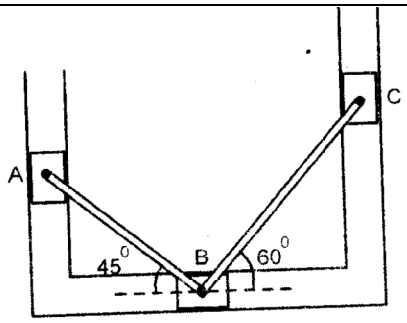
a) the location of instantaneous centre with respect to lower plate
b) the location of instantaneous centre with respect to lower plate, when both plates travel with given speed to the right.
c) velocity of point P on the roller for the 2nd case. Given L (CP) = 250 mm



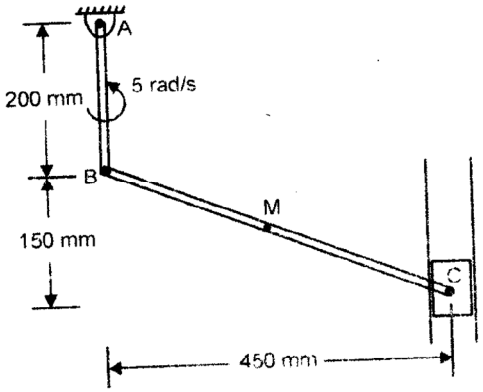
P11. Bar OA and bar BC are pin-connected at A. For the given instant bar OA has a angular velocity of 6.25 rad/s clockwise, while bar BC performing general plane motion has an angular velocity of 5.41 rad/s clockwise. Determine for the given instant the velocities of the ends B and C of the bar BC.



P12. Blocks A, B and C slide in fixed slots as shown. The blocks form a mechanism, being interconnected by pin-connected links AB and BC. L (AB) = 400 mm and L (BC) = 600 mm. At the given instant, block A has a velocity of 0.15 m/s downwards. Determine the velocities of blocks B and C for the given instant.



P13. In the mechanism shown the angular velocity of link AB is 5 rad/s anticlockwise. At the instant shown, determine the angular velocity of link BC, velocity of piston C and velocity of midpoint M of link BC.



Answers

P1. 25.93 rad/s ↺ ;
v_B = 5.964 m/s →,
v_C = 9.28 m/s, θ = 15.61° ↙

P2. ω_{BC} = 4.629 rad/s ↺,
ω_{CD} = 9.19 rad/s ↺

P3. ω_{BC} = 18 rad/s ↺,
ω_{CD} = 30 rad/s ↺

P4. ω_{BC} = 0,
ω_{CD} = 6.4 rad/s ↻

P5. 2.335 rad/s ↺ ,
v_C = 0.715 m/s ↑,
v_D = 1.219 m/s, θ = 72.14° ↖

P6. 2.936 rad/s ↺ , v_B = 5.531 m/s,
v_M = 4.555 m/s

P7. 1.866 rad/s ↻

P8. v_D = 11.6 m/s ←, v_E = 3.6 m/s →
V_F = 8.59 m/s θ = 62.24 ↖
v_H = 5.65 m/s θ = 45° ↖

P9. ω_{BC} = 2.014 rad/s ↻ ,
ω_{CD} = 4.027 rad/s ↻

P10. 0.291 m ; 1.067 m;
5.885 m/s , θ = 8.6° ↗

P11. v_B = 2.5 m/s, θ = 30° ↗
v_C = 1.49 m/s, θ = 57° ↖

P12. v_B = 0.15 m/s →,
v_C = 0.0866 m/s ↑

P13. ω_{BC} = 6.67 rad/s ↻
v_C = 3 m/s ↓,
v_M = 1.58 m/s ↘ 71.56°