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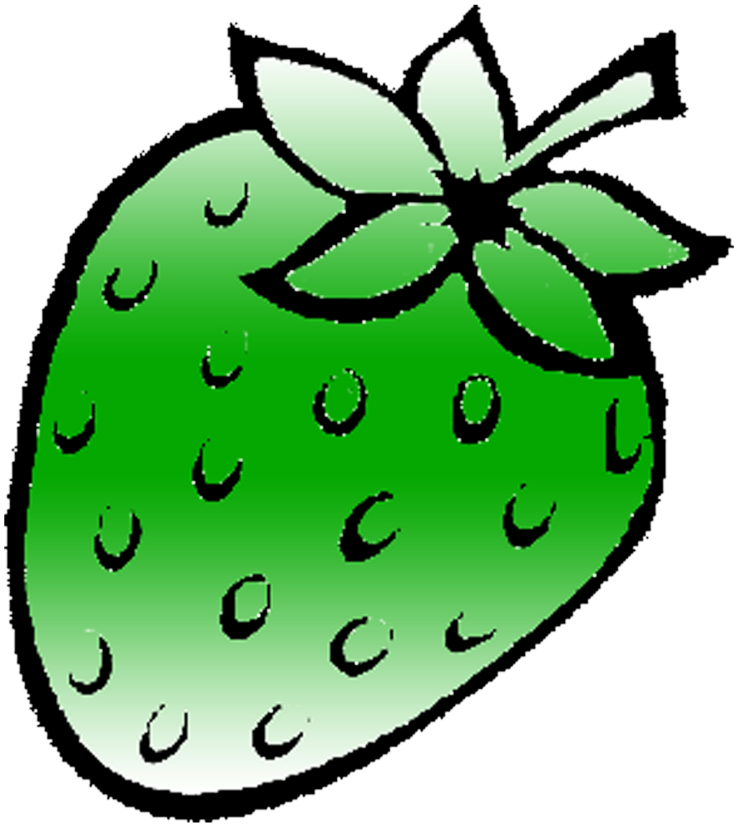

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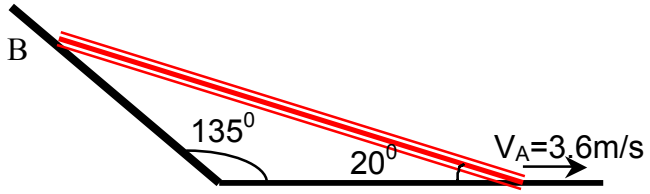
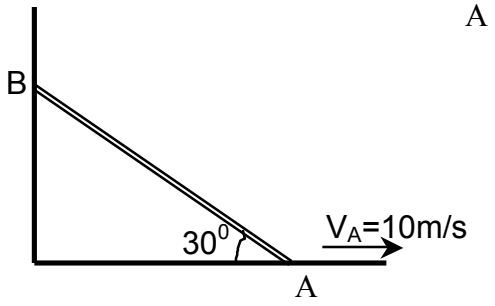
KINEMATICS OF RIGID BODIES

1. **A bar AB which is 3m long, it slides down the plane as shown in the fig. The velocity of end A is 3.6m/s to the right. Determine the angular velocity of AB and velocity of end B at the instant shown.**
   Ans. : ω_{AB}= 0.936rad/s , V_B= 3.73m/s .

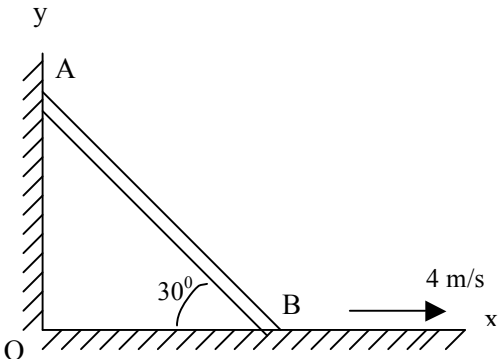


2. **A rod AB of length L with its ends A and B constrained to more along the wall and the horizontal ground is as shown in figure. If the end A on the ground is pulled towards right with a constant speed of V_A= 10m/s find the angular velocity ω_{AB} of the rod AB and the velocity V_b at the end B for the instant when the rod makes an angle of 30^0 with the ground.**
   Ans. : ω_{AB}=20/L r/s anticlockwise , V_B= 17.32m/s ↓

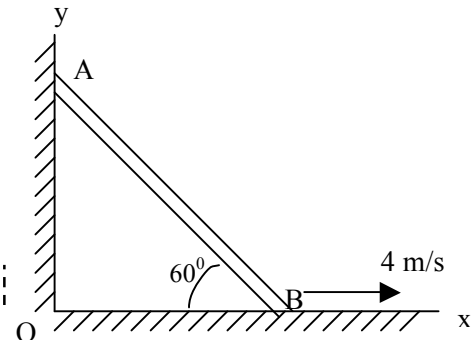


3. **Figure shows a ladder AB = 6m resting against a vertical wall at A and horizontal ground at B. If the end B of the ladder is pulled towards right with a constant velocity v_B = 4m/s. Find :**
   (i) Instantaneous centre of rotation of ladder.
   (ii) Angular velocity of the ladder at the instant.
   (iii) Velocity of point A.

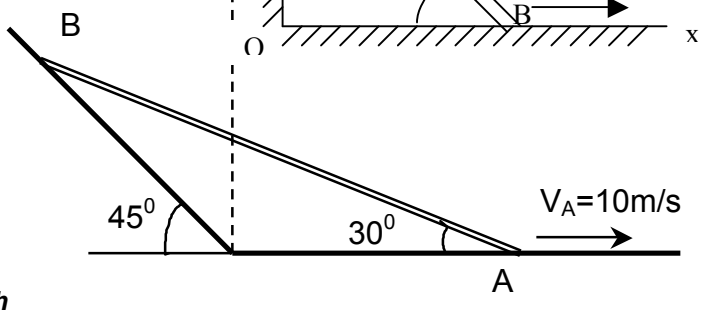
   Ans. : *(i) (5.196, 3) m (ii) 1.333 rad/sec (↺), (iii) v_A = 6.926 m/s (↓).*



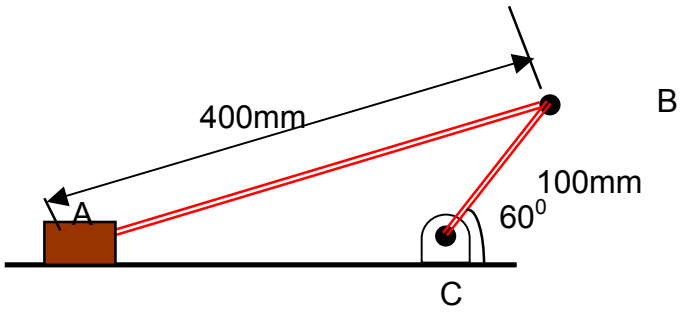
4. **A straight rod AB, 50 cm long, has one end B moving with a velocity of 4 m/s and the other end A moving along a vertical line YO. Find the velocity of the end A when it is inclined at 60^0 with the horizontal.**
   Ans. : *v_A = 2.309 m/s (↓).*



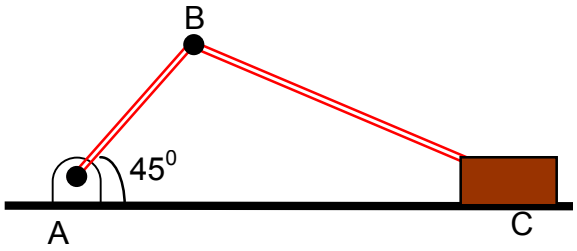
5. **A prismatic bar AB with its ends A and B being constrained to move along the planes on which it rests as shown in the figure. If the end A moves with constant velocity V_A= 10 m/s, find the angular velocity ω_{AB} of the bar AB and velocity V_B of the end B of the bar at the instant when the bar makes an angle of 30^0 with the horizontal as shown.**
   Ans. : *V_B=8.966m/s at an angle of 45^0 ↓ with horizontal, ω_{AB}=7.32 Lr/s*



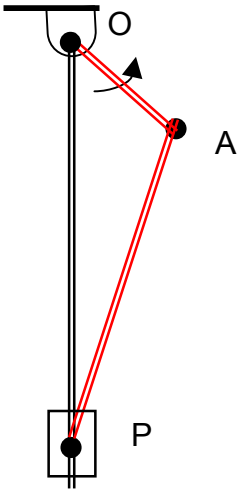
6. **The crank CB of a slider crank mechanism is rotating at a constant speed of 30 rpm clockwise. Determine the velocity of the cross head A at the given instant. AB = 400mm & BC is 100 mm.** ***Ans. : v_a = 26.5 cm/s →.***



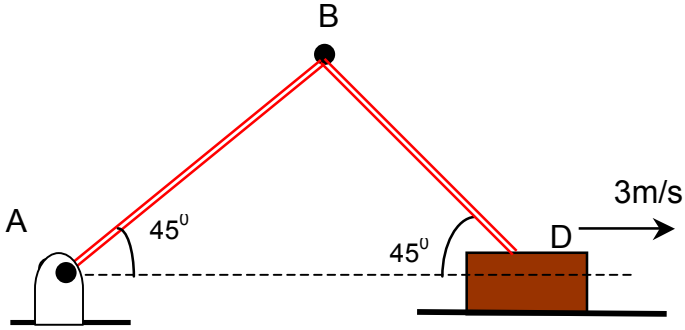
7. **Arm AB rotates anti clockwise with uniform angular velocity 10 rad/s. Point C is constrained to move along the x axis. Calculate the angular velocity and acceleration of bar BC. Also determine velocity of C.**
Ans. : 3.78 c/s clockwise, 2.43 m/s ←



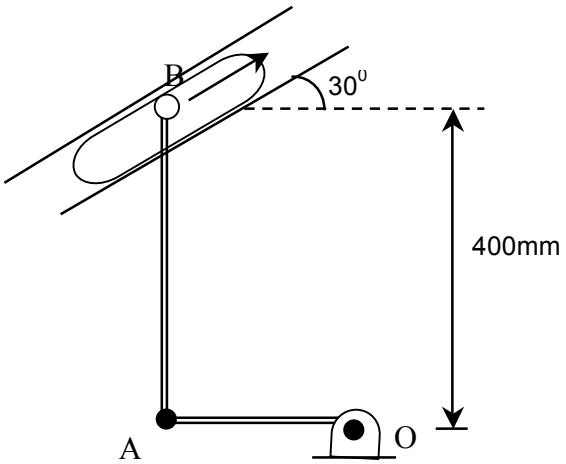
8. **For the slider- crank mechanism shown, find the velocity of the piston 'P' and the angular velocity of the connecting rod AP. OA is 0.1 m , AP is 0.4m and angular velocity of OA is 90 rpm.**
Ans. : v_p= 5.737m/s ↑ and ω_{AP}= 2.057c/s clockwise .



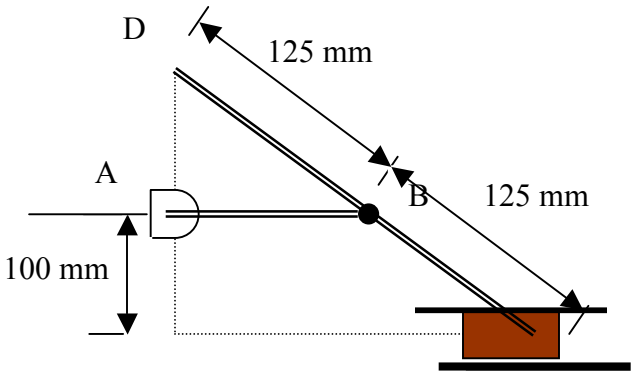
9. **Block D shown in fig. moves with a speed of 3m/s. Determine angular velocities of links BD and AB and velocity of point B at the instant shown. Take lengths of links AB and BD as 0.4m.**
Ans. : ***ω_{BD}=5.304c/s anticlockwise, ω_{AB}= 2.057c/sclockwise, V_B= 2.122m/s at an angle of 45⁰ with horizontal.***



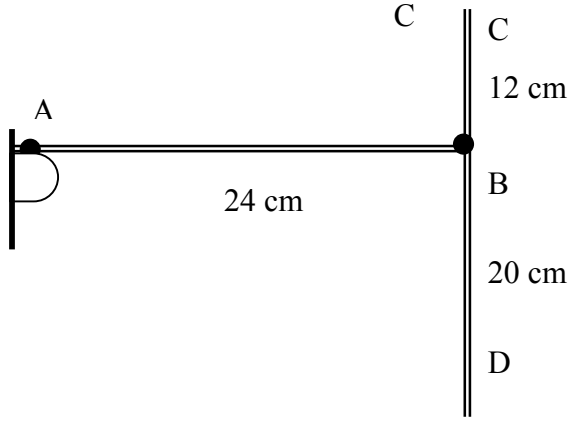
10. **Locate the instantaneous centre of rotation of link AB. Find also the angular velocity of link OA. Take velocity of slider at B= 2.5 m/s. The link and slider mechanism is as shown in the figure.**
Ans. : C is at 30.94mm on right of O on line AO. ω_{OA}= 6.25rad/sec clockwise.



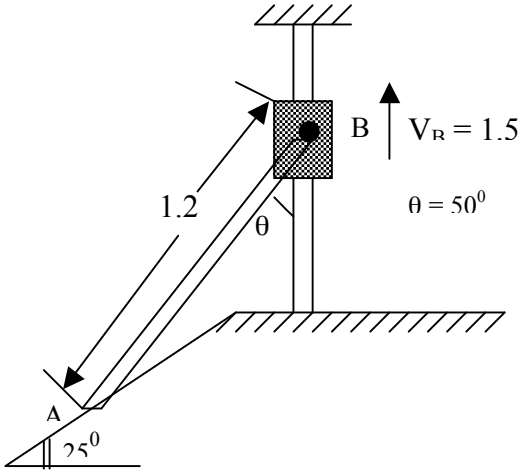
11. At the position shown in figure, the crank AB has Angular velocity of 3rad/sec clockwise. Find the velocity of slider C and the point D at the instant shown.



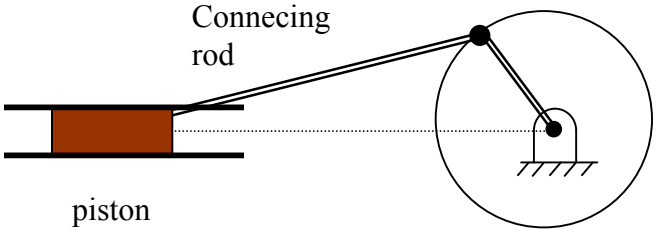
12. A Bar AB 24m long is hinged to a wall at A. Another bar CD 32cm long is connected to it by a pin at B such that CD= 12cm and BD = 20cm. At the instant shown, (AB ⊥ CD) the angular velocities of the bars are W_{AB}= 4 rad/sec and W_{CD} = 6rad/sec. Determine the linear velocities of C and D.



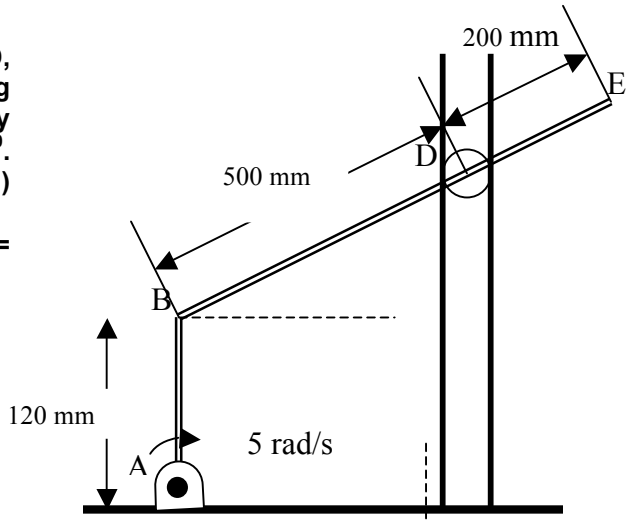
13. Figure shows a collar B which moves upwards with a constant velocity of 1.5 m/s. At the instant when θ = 50^0 determine (i) the angular velocity of rod AB which is pinned at B and freely resting at A against 25^0 slope and (ii) the velocity of end A of the rod.
Ans. : (i) w = 1.173 rad/s ( ), (ii) v_A = 0.998 m/s.



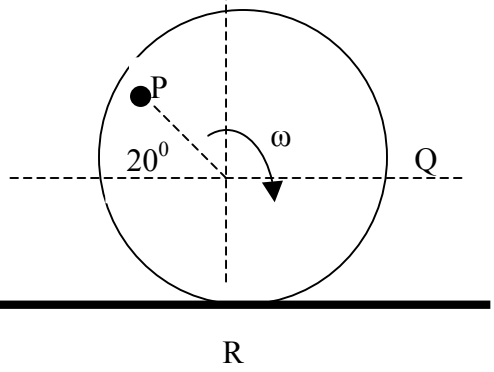
14. In a crank and connecting rod mechanism, the length of crank and the connecting rod are 300mm and 1200mm respectively. The crank is rotating at 180 rpm. Find the velocity of piston, when the crank is at an angle of 45^0 with the horizontal.



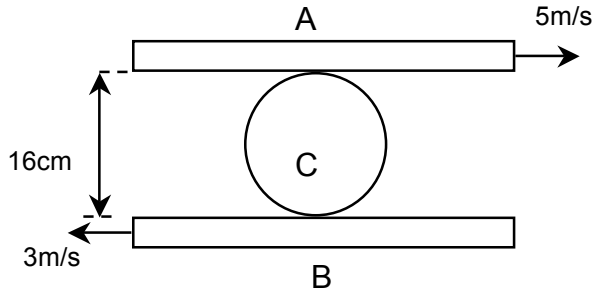
15. **Rod BDE is partially guided by a roller at D, which moves in a vertical track. Knowing that at the instant shown the angular velocity of AB is 5 rad/s clockwise and β = 25^0. Determine (1) angular velocity of rod BE (2) velocity of point E .**
Ans. : ω_{BE} = 2.84 rad/s anticlockwise, V_E = 1.817 m/s.



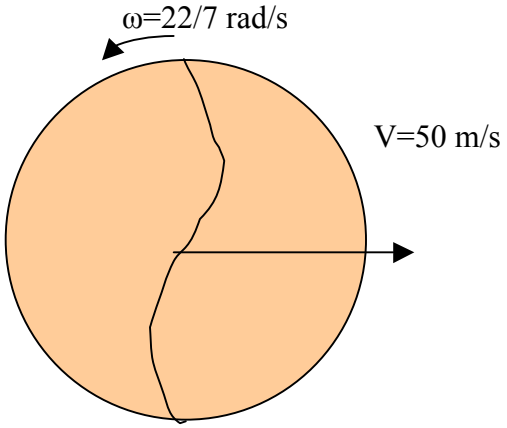
16. **A 2m diameter wheel moves in such a way that its centre has a velocity of 4m/s towards right horizontally. The angular velocity of the wheel is 4rad/sec clockwise. Determine the velocities of the points P, Q, R shown on the wheel.**
Ans. : V_R= 0 , V_Q= 5.6m/s ↓ at an angle of 45^0 with horizontal, V_P= 5.32m/s ↑ at an angle of 20^0 with horizontal.



17. **A roller of radius 8cm. rides between two horizontal bars moving in the opposite direction as shown in the figure. (1) Locate the instantaneous centre of velocity and give its distance from A. Assume no slip conditions at the points A and B. (2) Locate the position of the instantaneous centre when both the bars are moving in the same direction.**
Ans :{(1) 0.06m, (2) 0.24m }

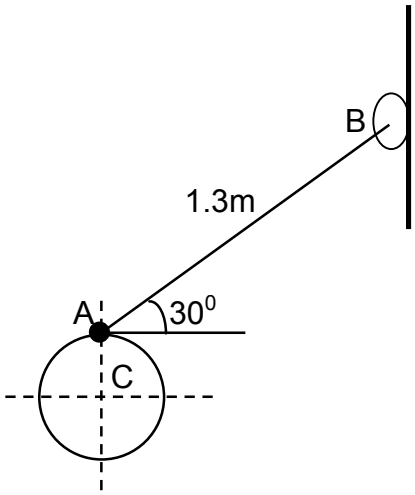


18. **In an aerodynamic investigation of tennis ball is given a speed of v and w as shown in figure. The maximum and minimum speeds of points on the surface.**
Ans: 50.11,49.89m/s



19. A uniform cylinder C of diameter 0.6m is pinned to a rod AB at A with other end B is moving along vertical wall, as shown in fig. If the end B of the rod is moving upward along the vertical wall at a speed of 3.3m/s Find the angular velocity of the cylinder assuming the cylinder is rolling without slipping.

Ans: ω_C ***= 3.175rad/sec***



20. A compound wheel as shown in figure rolls without slipping on a guide PQ. At the given instant if V_C=3m/s and a_C= 6m/s^2 both rightwards, determine acceleration of points A and B.