5.1 KMRB – CLASSWORK PROBLEM.

1. Figure 5.1.1 shows a ladder AB = 6 m resting against a vertical wall at A and horizontal ground at B. If the end B of the ladder pulled towards right with a constant velocity V_B = 4m/s find (i) ICR of the ladder (ii) angular velocity of the ladder at this instant (iii) Velocity end A of the ladder (iv) Velocity components V_{CX}, V_{CY} of the mid-point C of the ladder.

[1.33 rad/sec, 6.927 m/s, V_C = 4m/s, 2m/s, 3.446m/s]

2. Velocity of point A on rod is 2 m/s at the instant shown in the Figure 5.1.2. Locate ICR and V_B on the rod

[1m/s at 60°]

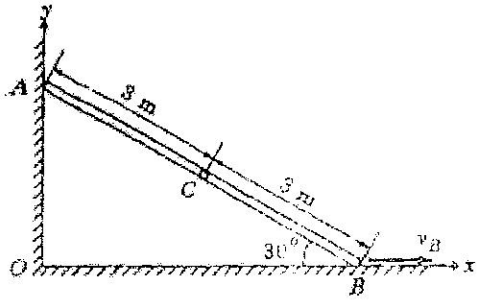

Figure 5.1.1

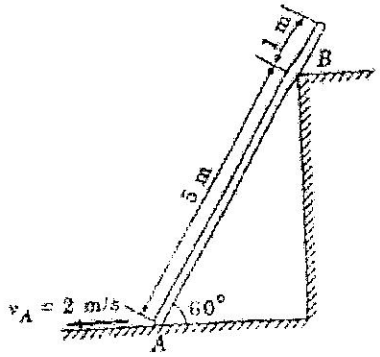

Figure 5.1.2

3. A cylinder with diameter 36 cm is held between two plates as shown in Figure 5.1.3. The upper plate moves to the right with velocity 8 cm/s while the lower plate moves to the left with velocity 4cm/s. Locate the ICR for the cylinder. Find the velocity of centre point C.

[12 cm above the bottom plate,]

4. Crank OA rotates at 60 r.p.m. in clock wise direction. In the position shown θ = 40°. Determine angular velocity of B which is constrained to move in a horizontal cylinder. Ref Fig - 5.1.4.

[ω_{AB} = 1.817 r/s, V_B = 1.53 m/s]

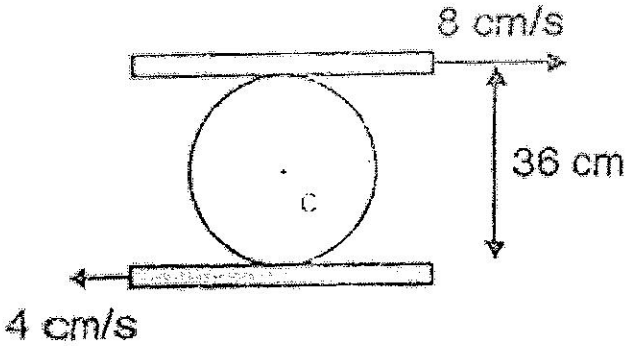

Figure 5.1.3

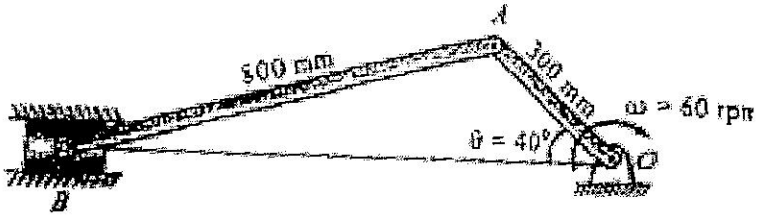

Figure 5.1.4

5. Figure 5.1.5 shows a collar B which moves upwards with constant velocity of 1.5 m/s. At the instant when θ = 50°, determine (i) angular velocity of rod pinned at B and freely resting at A against 25° sloping ground and (ii) Velocity of end A of the rod.

{MU, May 2017, 6 Marks}

[ω = 1.173 r/s, V_A = 0.998 m/s]

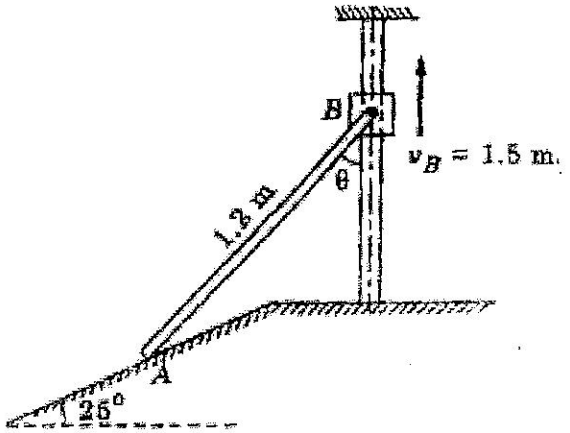

Figure 5.1.5

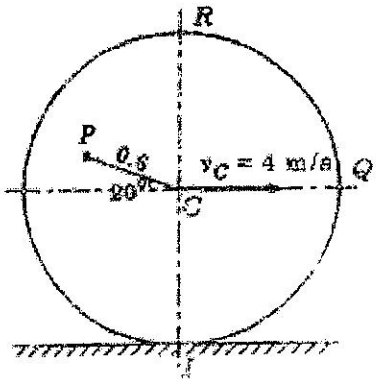

Figure 5.1.6

6. A wheel of 2 m diameter rolls without slipping on a flat surface. The Centre of the wheel is moving with a velocity of 4 m/s towards right. Determine the angular velocity of the wheel and velocity of P, Q and R shown on wheel. Refer Figure 5.1.6.

[ω = 4 r/s, V_P = 5.322 m/s, V_R = 8 m/s, V_Q = 5.6568 m/s]

7. In the mechanism shown in Figure 5.1.7 , piston C is constrained to move in a vertical slot. A and B moves on horizontal surface. Rods CA and CB are connected with smooth hinges. If VA = 0.45 m/s to the right. Find velocity of C and B. Also find angular velocity of two rods.

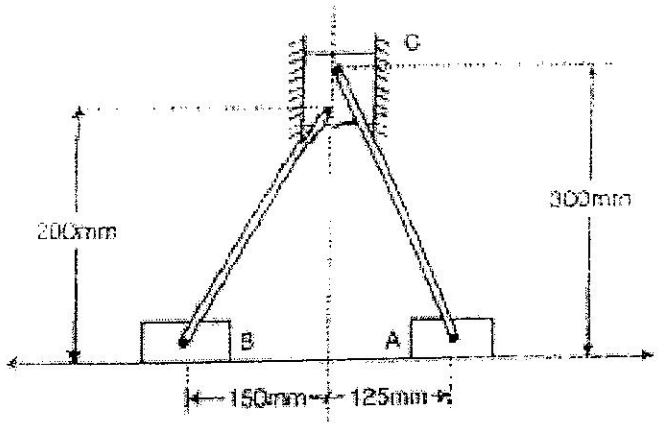

Figure 5.1.7

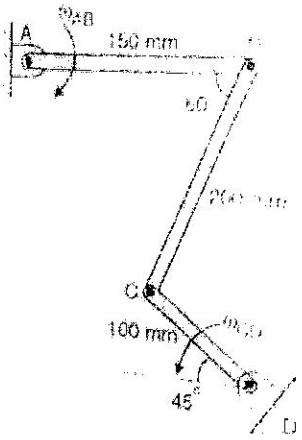

Figure 5.1.8

8. If link CD is rotating at WCD = 5 rad/s, anticlockwise determine the angular velocity of link AB at the instant shown in Figure 5.1.8.

[ω_{AB} = 3.71 rad/s]

5.2 KMRB ASSIGNMENT & TUTORIAL

1. A rod AB 26 m long leans against a vertical wall. The end A on the floor is drawn away from the wall at the rate of 24 m/s. When the end A of the rod is 10 m from the wall, determine the velocity of the end B sliding down vertically and the angular velocity of the rod AB. Refer Figure 5.2-1

[10m/s, 1rad/s]

2. A bar 3 m long slides down the plane shown in Figure 5.2.2. The velocity of end A is 3.6 m/s to the right. Determine the angular velocity of AB, velocity of end B and Centre C at the instant shown.

[0.9363r/s, 3.733 m/s and 3.3874m/s]

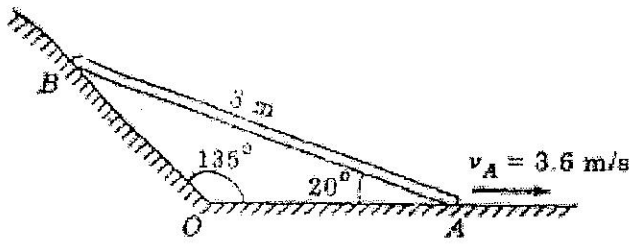

Figure5.2.1

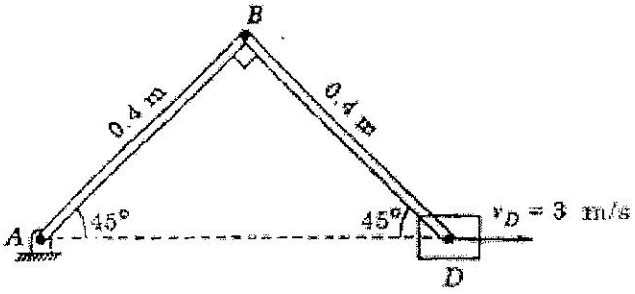

Figure 5.2.2

3. In the mechanism shown, rod AB is horizontal, CD is vertical. End A is guided in an inclined slot having slope 3 in 4. If velocity of A is 1.2 m/s up the slot. Determine (i) Angular velocity of AB and CD. (ii) Linear velocity of B. Refer Figure 5.2.3.

[ω_{AB} = 1.6 r/s, V_B = 1.073 m/s, ω_{CD} = 2.67 r/s.]

4. 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 r/s clockwise determine (i) angular velocity of rod BE (ii) velocity of point E. Refer Figure 5.2.4

[ω_{BDE} = 2.84 r/s, V_E = 1817.69 mm/sec]

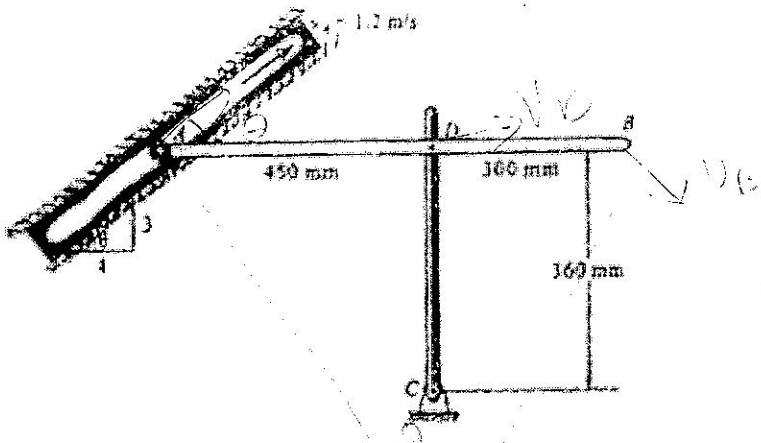

Figure 5.2.3

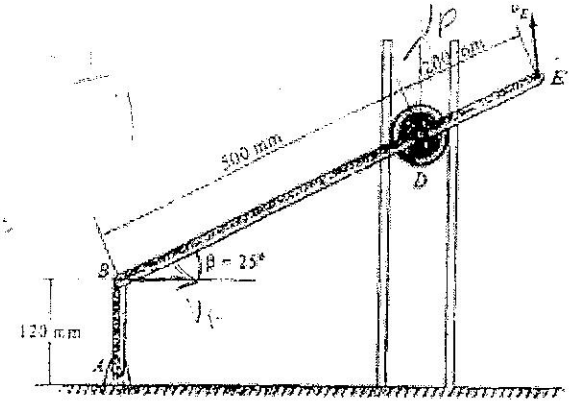

Figure 5.2.4

5. A bar 24 cm long and is hinged to a wall at A. Another bar CD 32 cm long is connected to it by a pin at B such that CB = 12 cm and BD = 20 cm. At the instant shown [AB is perpendicular to CD] the angular velocities of the bars are ω_{AB} = 4 r/s and ω_{CD} = 6 r/s. Determine the linear velocities of point C and D. Note that bar CD is un plane motion. Refer Figure 5.2.5

[V_C = 120 cm/sec, V_D = 153.675 cm/sec]

6. Locate the instantaneous centre of rotation for the link ABC and determine velocity of points B & C. Angular velocity of rod OA is 15 rad/sec counter clockwise. Length of OA is 200 mm, AB is 400 mm and BC is 150 mm. Ref Figure 5.2.6.

[$\omega_{AB}=\omega_{BC}$= 3.7 r/s, V_B= 16 m/s, Vc = 20.6 m/s]

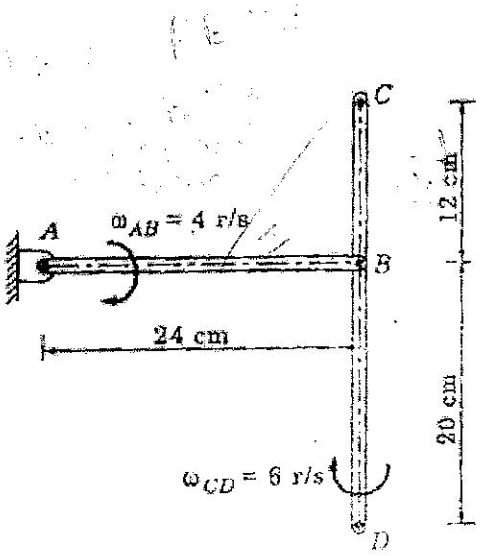

Figure 5.2.5

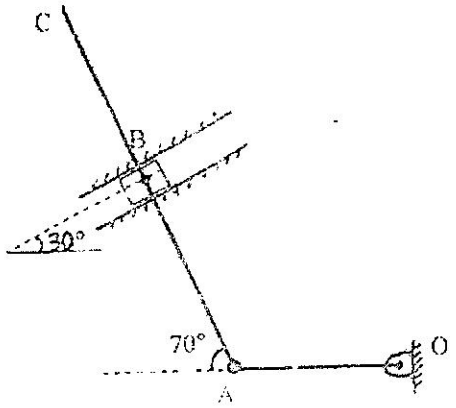

Figure 5.2.6

7. In Figure 5.2.7 , the disc rolls without slipping on the horizontal plane with an angular velocity of 10 rpm clockwise. The bar AB is attached as shown in fig. Line OA is horizontal. Point B moves along the horizontal plane. Determine the velocity of Point B at the instant shown.

[V_B = 1099.35 m/s]

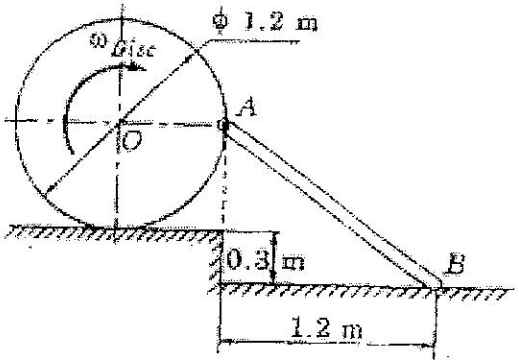

Figure 5.2.7

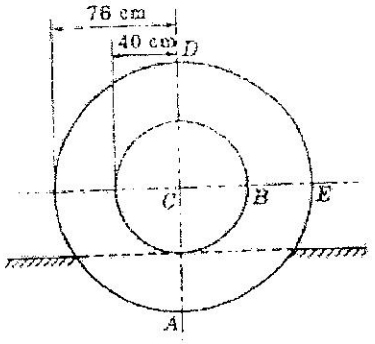

Figure 5.2.8

8. A flanged wheel rolls such that its Centre has a velocity of 8 m/s to the left. Find the velocities of points A, B, D and E on the wheel. Refer Figure 5.2.8.

V_A = 3.6 m/s (right), V_B = 5.65 m/s at 45°, V_D = 11.6 m/s (left), V_E = 8.59 m/s at 62.24°

9. The trolley shown in Figure 5.2.9 moves to the left along a horizontal pipe at a speed of 2.4 m/s. The angular velocity of 0.5 m disc is 8 r/s anticlockwise. Determine the velocity of point D on the disc

[1.6 m/s (right)]

10. In the position shown, bar AB has constant angular velocity of 3r/s anticlockwise determine the angular velocity of bar CD. Refer 5.2.10

[I_B = 0.35m, I_C = 0.495m, V_B = 0.72m/s, W_{BC} = 2.057r/s, V_C = 1.08m/s, W_{CD} = 4.8r/s]