MDP 212 Mechanics of Machines

Instructor Name: Dr. M.M. Hedaya

1.1 Examine this chain regarding whether it is constrained, locked or unconstrained.

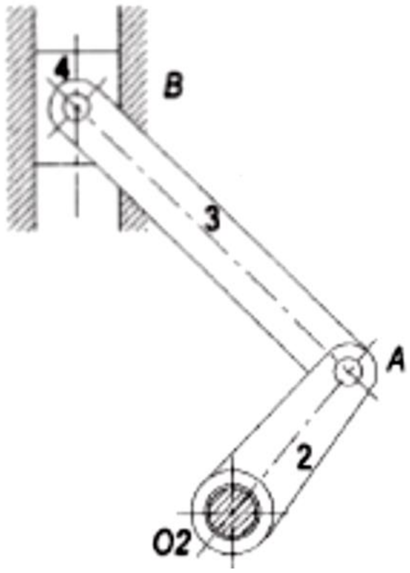


Figure.1

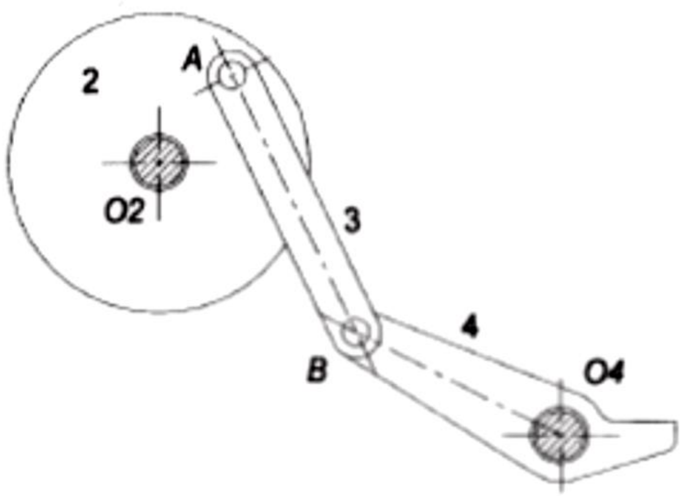


Figure.2

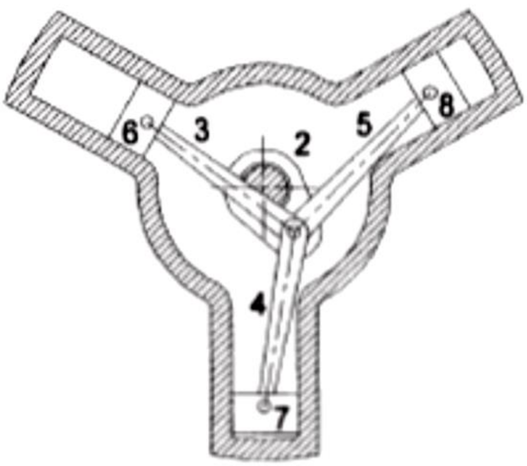


Figure.3

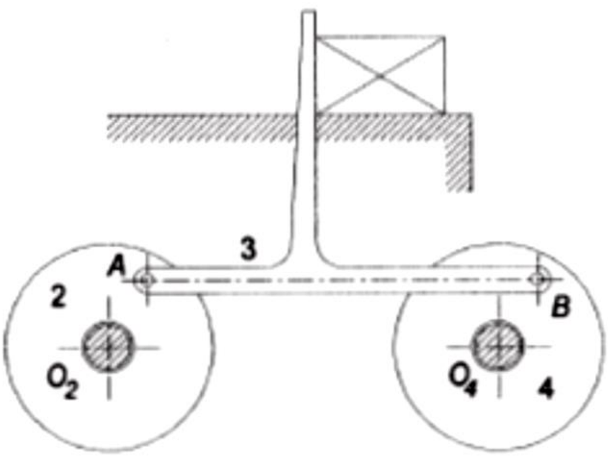


Figure.4

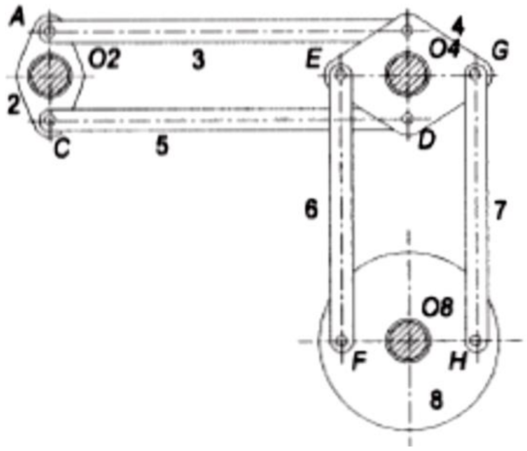


Figure.5

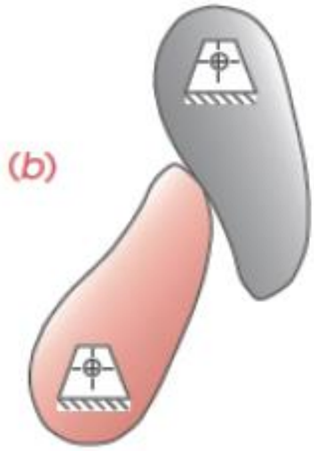


Figure.6

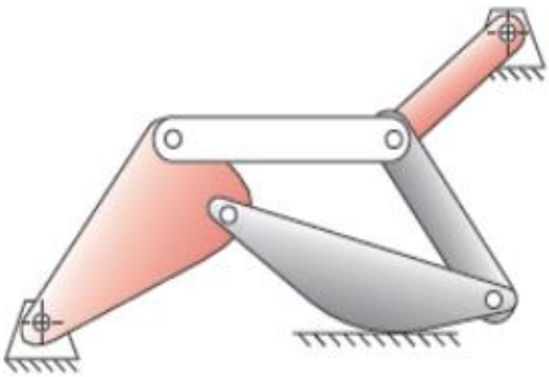


Figure.7

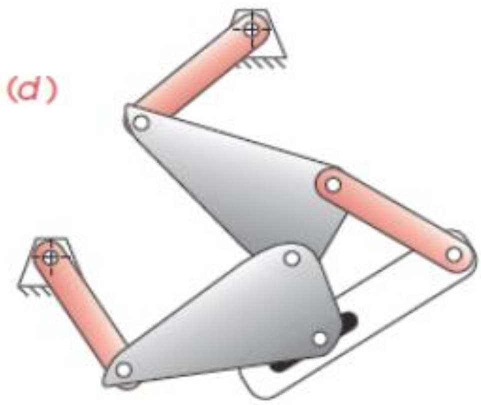


Figure.8

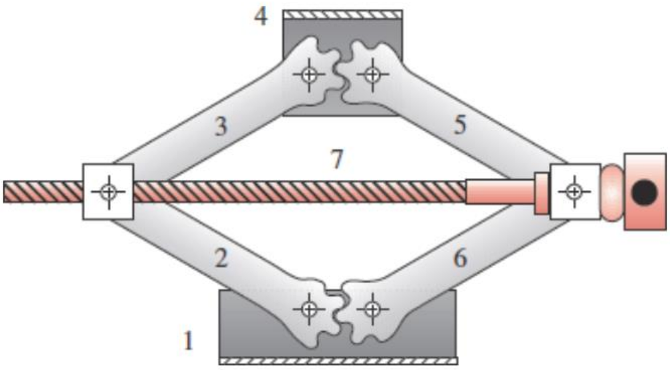


Figure.9

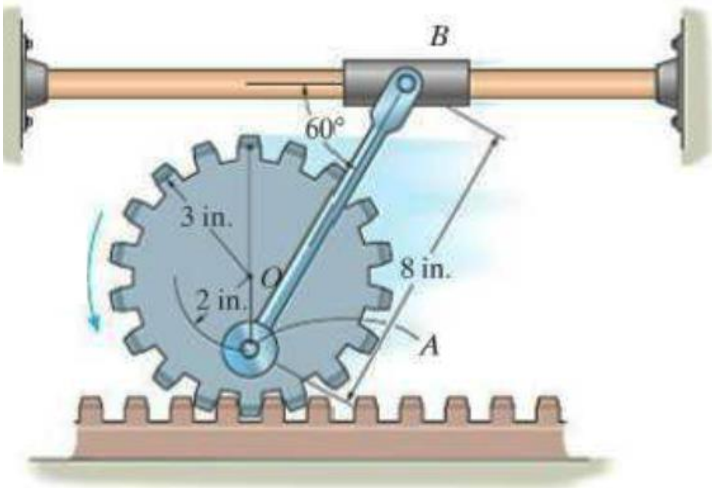


Figure.10

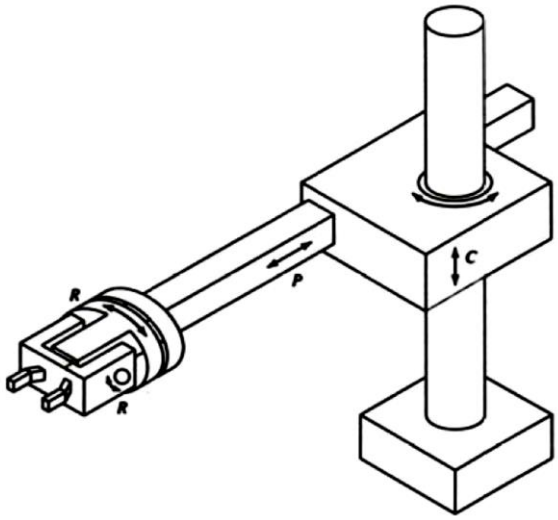


Figure.11

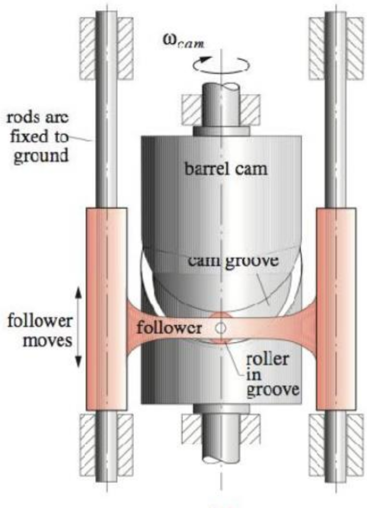


Figure.12

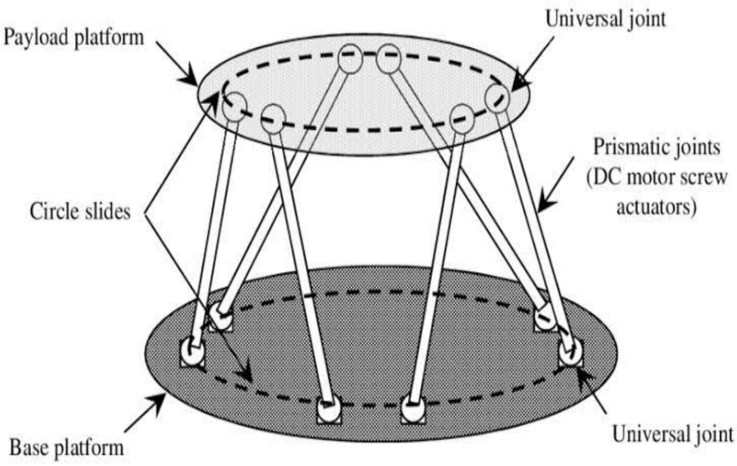


Figure.13

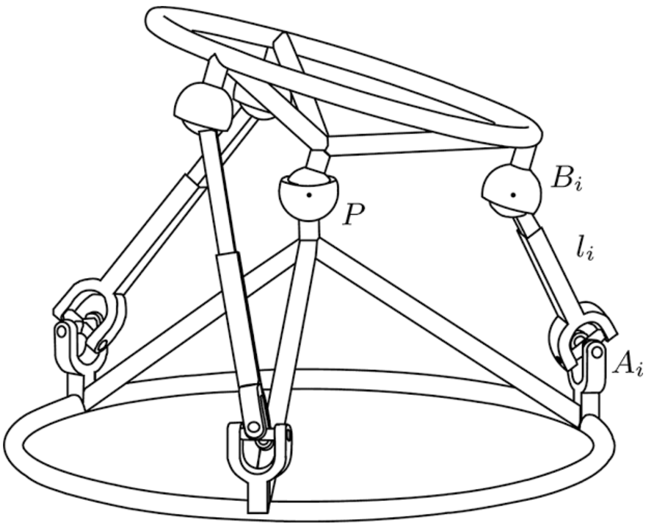


Figure.14

1.2 Figure.15 shows a hacksaw, used for material cutting. Sketch the dynamic diagram, and so determine the degrees of freedom.

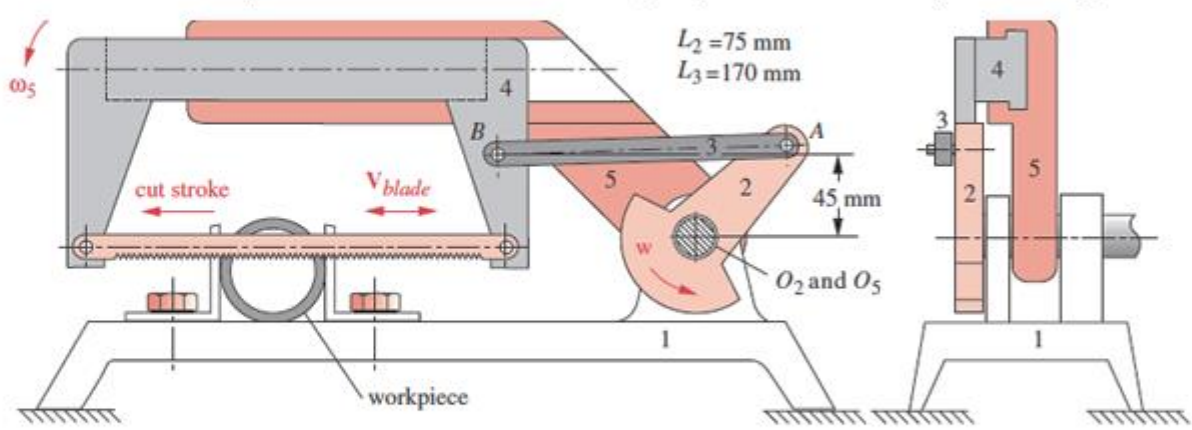
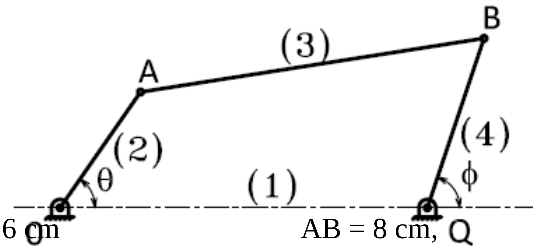


Figure.15

1.3 Calculate the Grashof condition of the fourbar chains defined below. State the possible fourbar mechanisms which can be generated from each chain. The lengths of the links are as following.

a. 20, 45, 70, 90.
b. 20, 35, 70, 90.

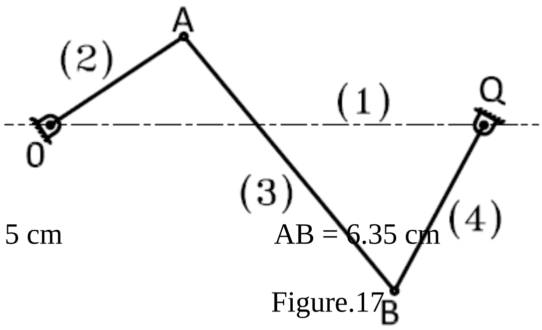
1.4 In the four-bar mechanism shown in Figure.16, axes O and Q are fixed. Determine its type. If the link (2), which is the driver, turns C.C.W., find the two extreme positions of QB and the angle through which link (4) oscillates.



BQ = 6 cm AB = 8 cm, OA = 4 cm,
QO = 8 cm.

Figure.16

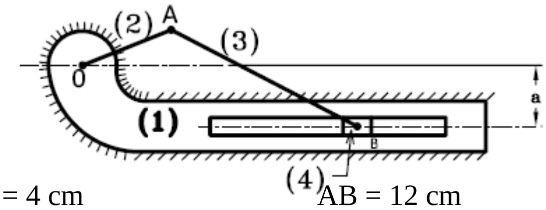
1.5 In the four-bar mechanism shown in Figure.17, axes O and Q are fixed. Prove that it is a crank-lever four-bar mechanism and name its crank. Determine the two extreme positions of the lever and the angle through which it oscillates.



BQ = 5 cm AB = 6.35 cm OA = 4 cm
QO = 5.5 cm

Figure.17

1.6 In the mechanism shown in Figure.18, block (4) slides in a slot in the fixed frame (1). Axis O of crank (2) is fixed on (1). Find the two extreme positions of B, the axis of the pin by which link (3) is attached to the block (4), and the length of the stroke of the block (4).



a = 4 cm AB = 12 cm OA = 4 cm

Figure.18

1.7 In the slider-crank mechanism shown in Figure.19, the slider B travels along the centerline xx, OA = 4 cm and AB = 15 cm. Name the finite and infinite cranks. Find the two extreme positions of B. Dimension the length of the stroke of B. What is the distance between its two extreme positions? Show and dimension the angular movements in degrees of the crank OA when the slider B moves between its extreme positions.

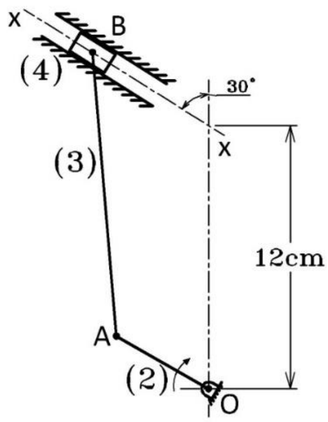


Figure.19

1.8 Figure.20 shows the quick-return mechanism of a slotting machine. The toothed sector gears with a rack on the ram which carries the tool box. If the ratio of the times taken for cutting and the return stokes is to be 1.5: 1. Determine the length of the driving crank CP. Determine the stroke, the cutting and the idle angles.

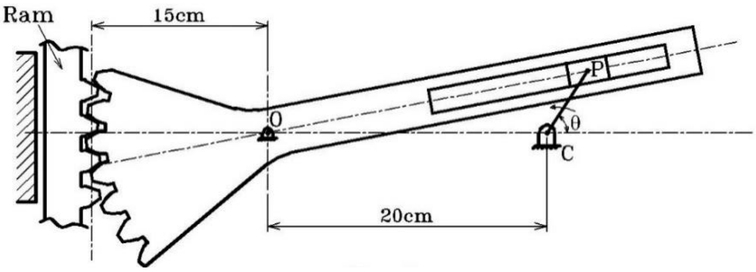


Figure.20

1.9 In the mechanism of a shaping machine shown in Figure.21, the pinion E rotates at a uniform speed, and drives the wheel F, which rotates on the fixed pin B. The pin C, which is fixed to the wheel F, carries the block D, which slides in the slot of the lever AH. The lever AH oscillates about the fixed pin A. The connecting link HI transmits the motion to the ram carrying the cutting tool. The stroke of the ram is varied by changing the distance CB. For the shown configuration, find the length of the stroke of the ram and the ratio between the times of the cutting and return strokes.

BA = 20 cm, AH = 22.5 cm, HI = 10 cm, a = 6 cm, b = 0.5 cm

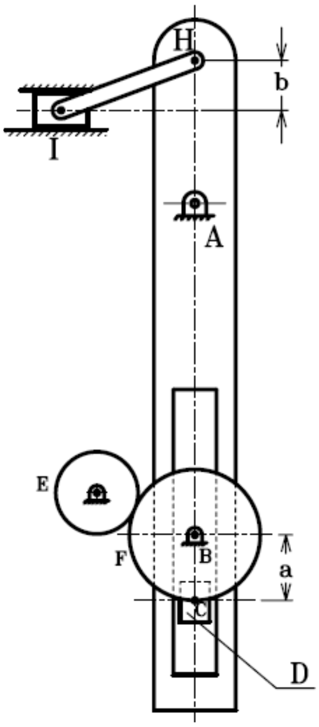


Figure.21

1.10 In the elliptic trammel shown in Figure.22, AB = 10 cm. Draw the path of point p at a distance 4 cm outside AB and point Q at a distance 4 cm from B inside AB.

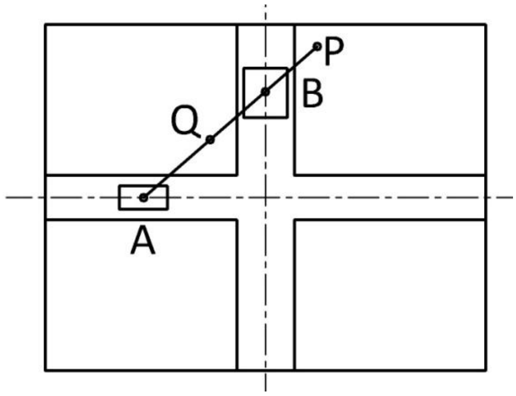


Figure.22

1.11 In the Davis steering-gear shown in Figure.23, the stub axles CA and DB are pivoted at A and B on the rigid axle and are continuous with the arms AG and BH respectively. The cross link EF is pivoted at the ends to the blocks sliding on the arms AG, BH and slides in the guides at M & N. Show that correct steering is obtained if the distance between front and rear axles is (ac/2b).

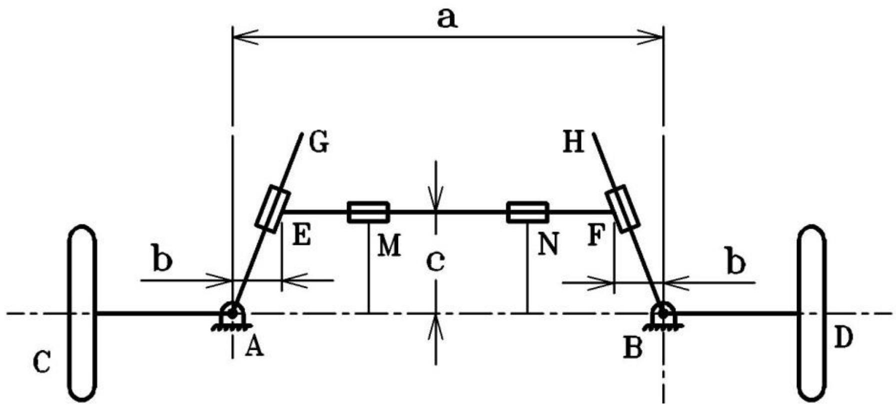
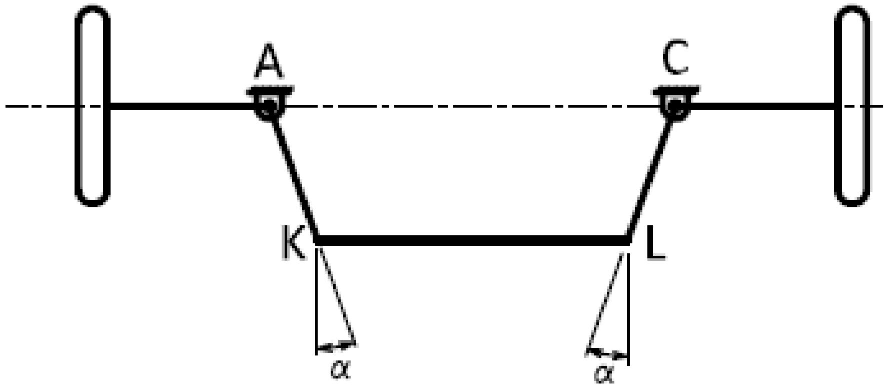


Figure.23

1.12 The Ackermann steering gear shown in Figure.24, consists of a four-bar mechanism in which the links AK and CL are equal in length, and are rigidly connected to the stub axles of the two front wheels. In the mid-position, when the car is moving along a straight path, KL is parallel to AC, while AK and CL are inclined to the longitudinal axis of the car by an angle $\alpha = 18^o$. Find the angle to which the left front wheel turns when the right front wheel turns 30^o to the right (i.e. C.W.).



AC = 119 cm AK = 14 cm.
Figure.24

1.13 Two shafts, the axes of which intersect, are coupled by Hooke's joint. The driving shaft rotates uniformly and the total variation in speed of the driven shaft is not to exceed 8% of the mean speed. What is the greatest possible inclination of the center lines of the shafts?

1.14 Two parallel shafts are connected by an intermediate shaft inclined at an angle α to both. Two Hooke's joints are used for connecting the intermediate shaft with both shafts. Find the ratios of the angular velocities of the two parallel shafts when the forked ends of connecting shafts are:

a) In the same plane.
b) In the planes at right angles.