CHAPTER NO:02

VELOCITY AND ACCELERATION IN MECHANISMS

(16 MARKS)

Course Outcome :C406.2

Draw velocity and acceleration diagram for different mechanisms.

Linear velocity:

Rate of change of linear displacement with respect to time.

$$V = dx/dt \quad m/sec$$

Angular velocity:

Rate of change of angular displacement with respect to time.

$$\omega = d\Theta/dt$$

Relation between Linear and angular velocity:

$$V = r\,\omega$$

Absolute Velocity:

Velocity of any point on kinematic link with respect to a fixed point.

Relative Velocity:

Velocity of any point on kinematic chain w.r.t. some other point on the same link such that both the points are in motion.

Linear acceleration:

Rate of change of linear velocity with respect to time

$$a = dv/dt$$

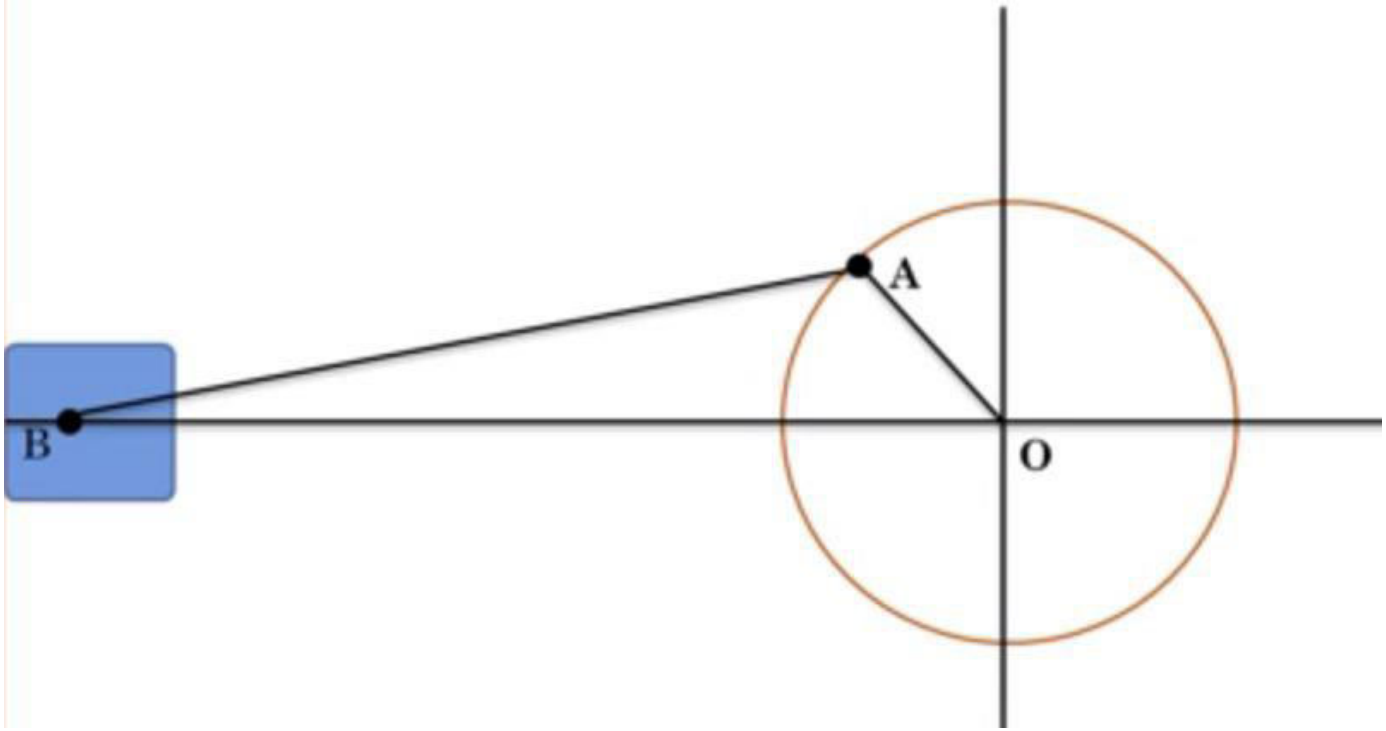
Angular acceleration:

Rate of change of angular velocity with respect to time

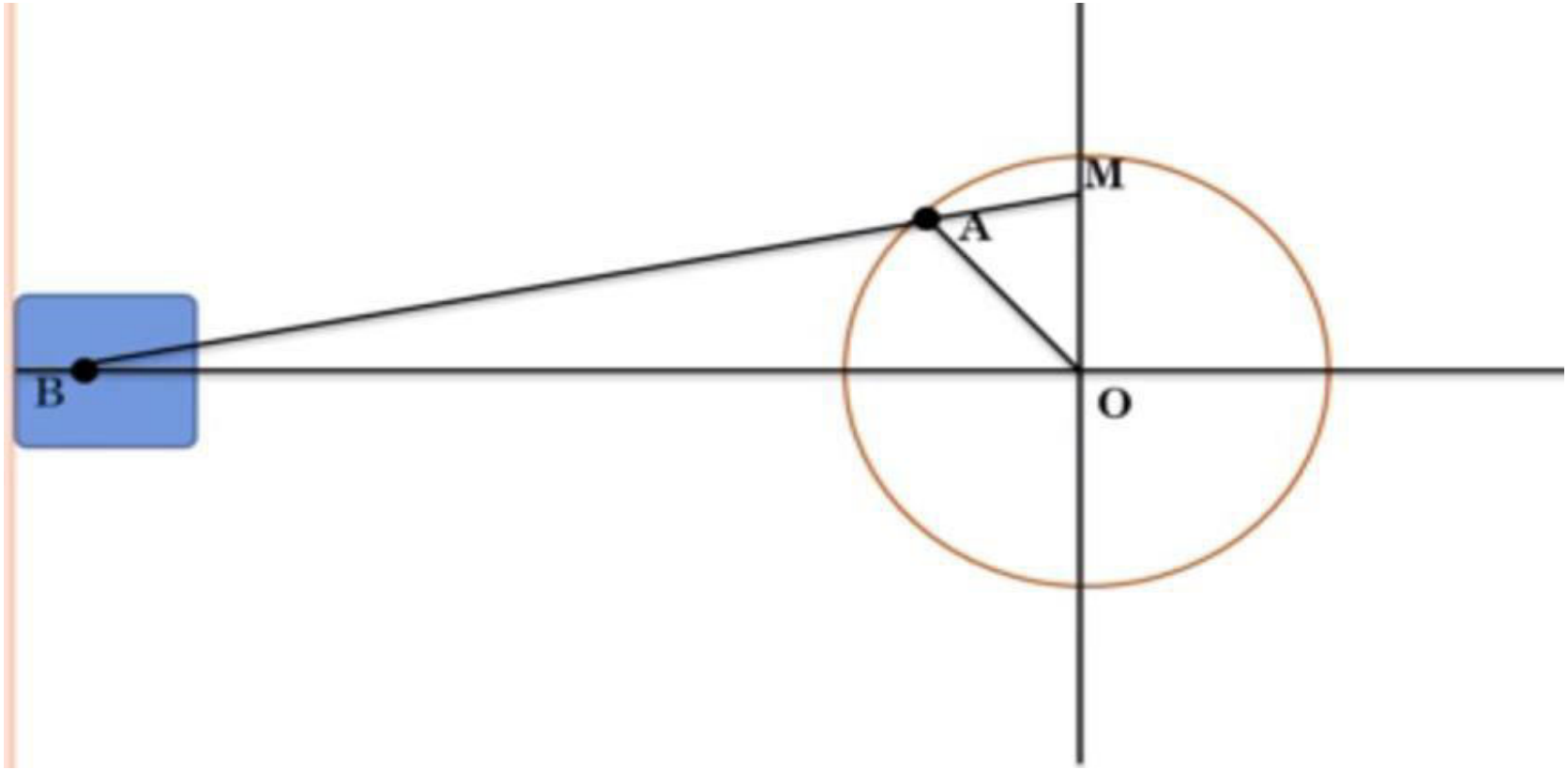
$$\alpha = d\omega/dt$$

Klein's Construction

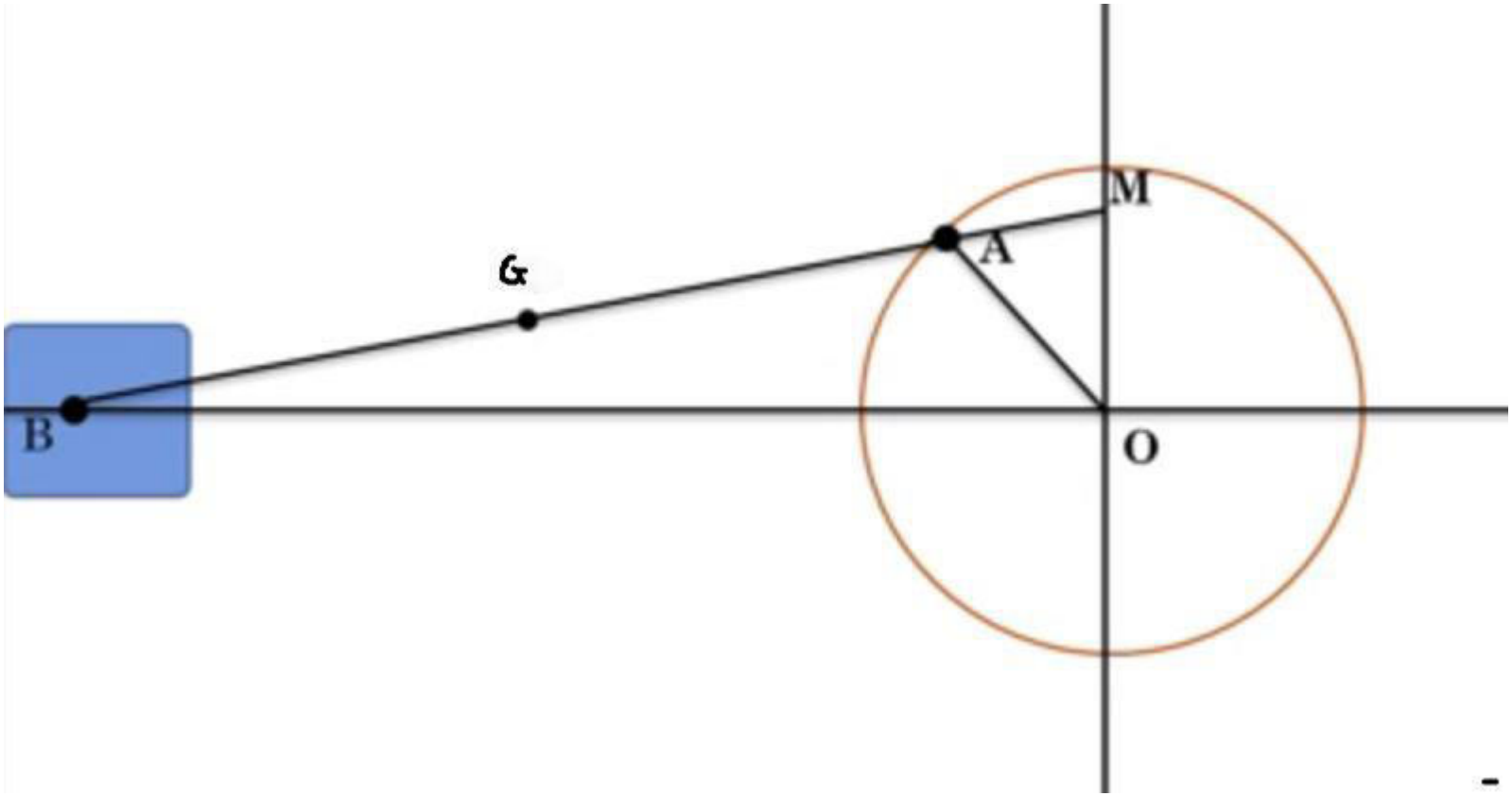
Step 1) Draw the basic configuration diagram by measuring the angle made by crank and also other dimension of crank and connecting rod.



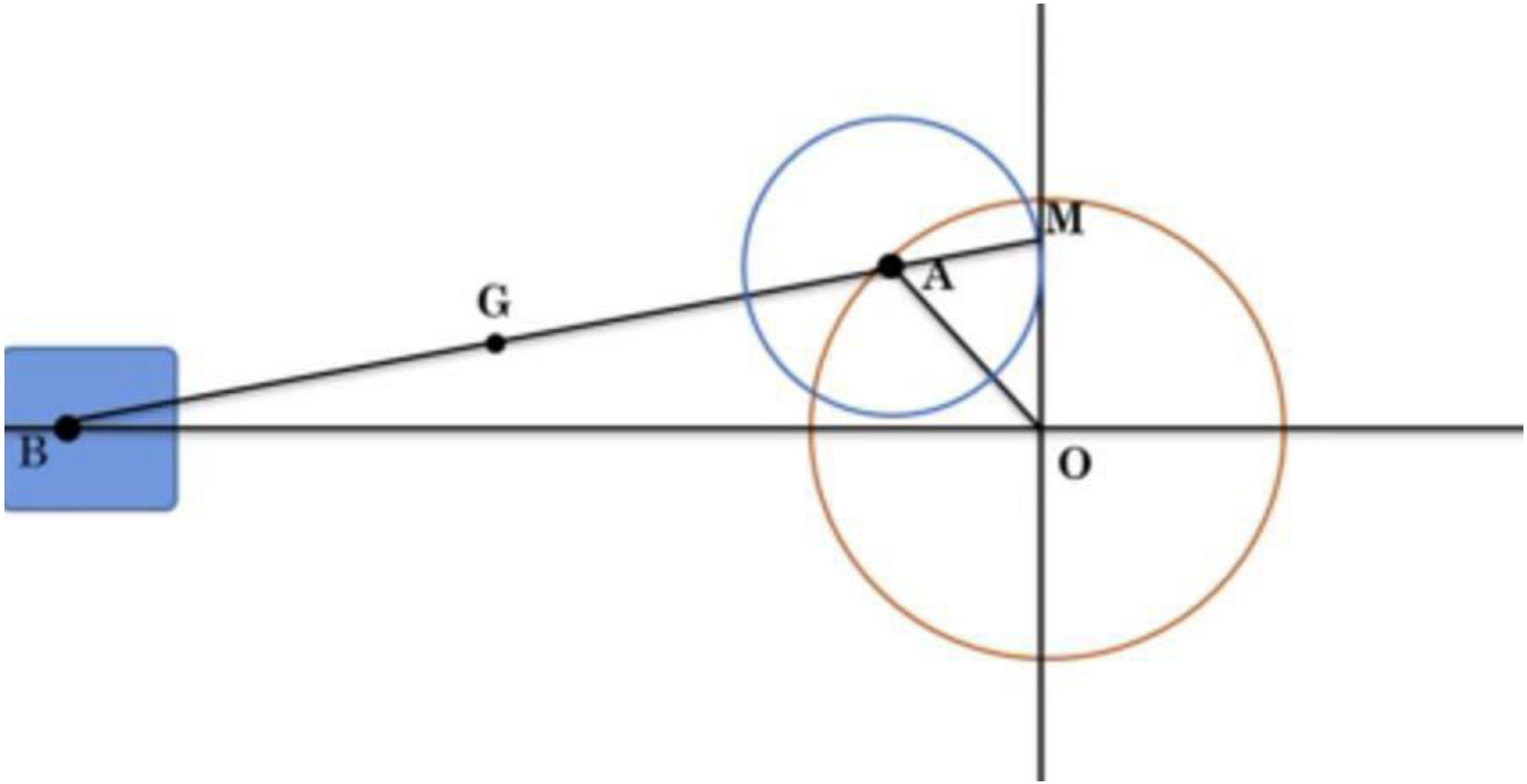
Step 2) Extend the connecting rod upto the vertical centre line of the crank circle and markpoint M, the triangle created *ΔOAM is the velocity triangle.*



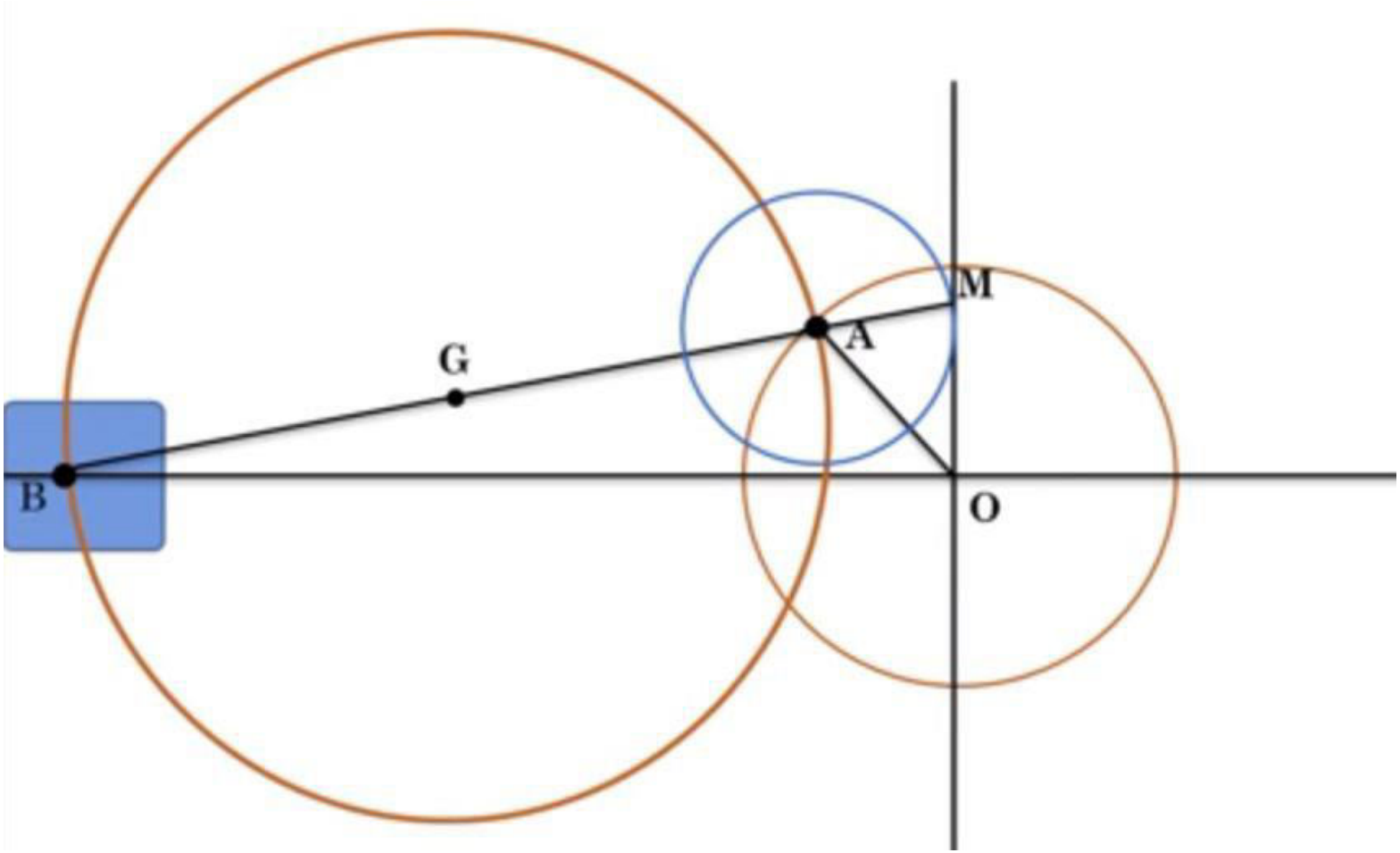
Step3) Locate the midpoint of the connectingrod as point G.



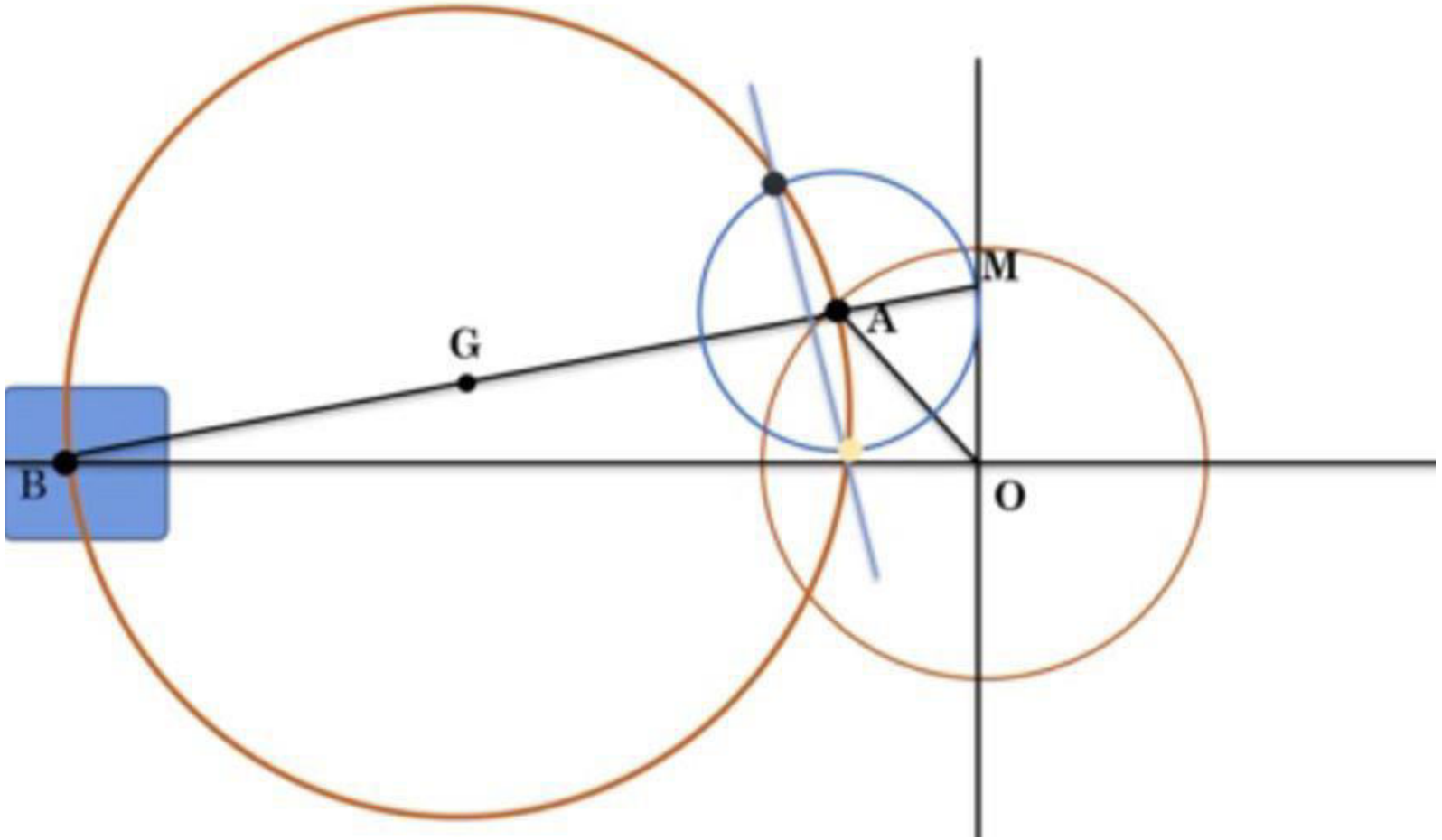
Step 4: With Centre as “A” and radius equal to AM draw the circle.



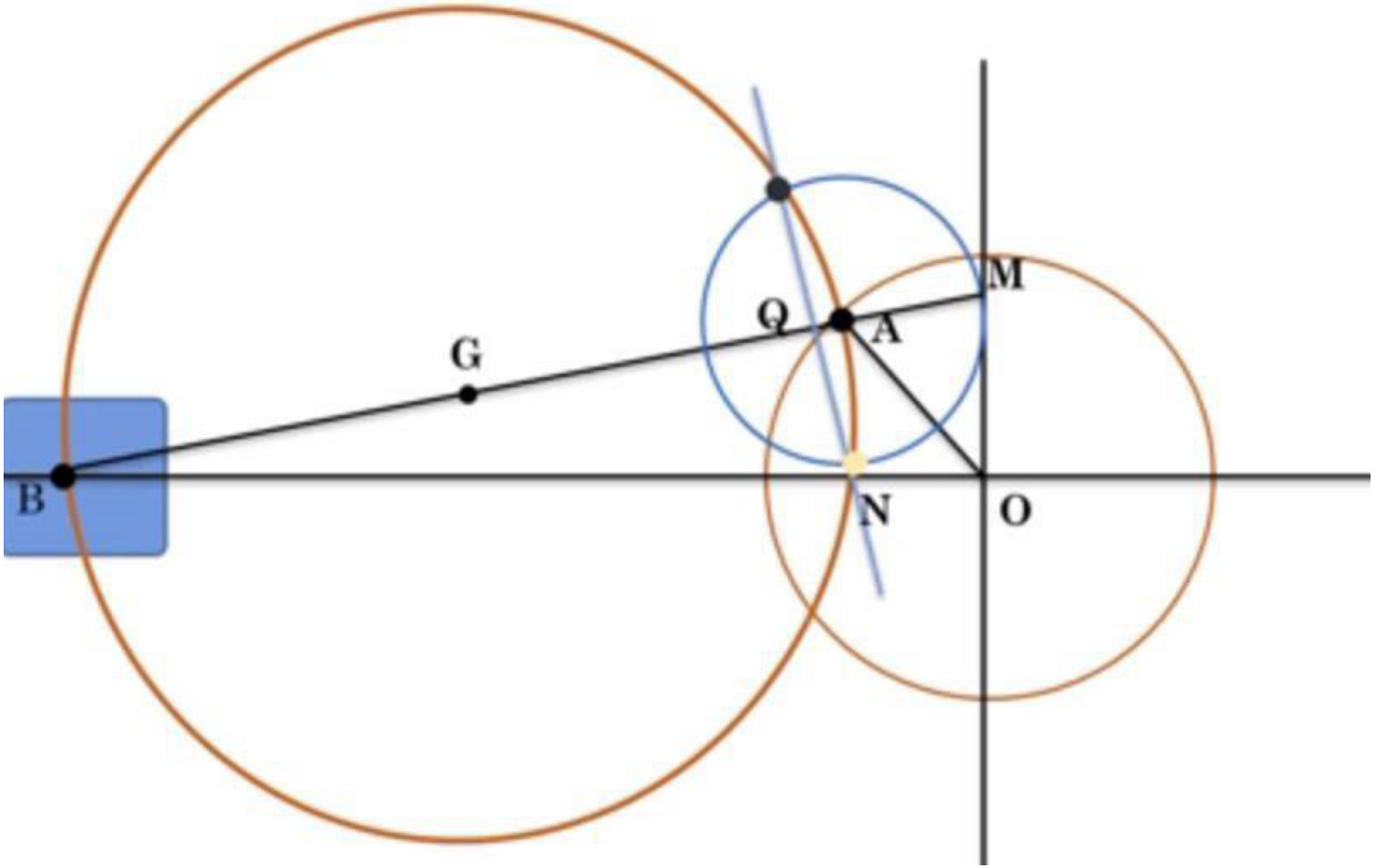
Step 5: With Centre as “G” and radius equal to GA or GB draw the circle.



Step 6: Both circles will intersect each other at two points,join these two points.



Step 7: This line will intersect the connecting rod at point “Q” and line of stroke at point “N”. Name these two points.



- Step 8: Now OAM is the velocity triangle and the OAQN is the acceleration diagram. Which can be used to find the required velocity of acceleration of the links of various points on the links.

- **Numerical problems**

(1) The crank and connecting rod of a reciprocating engine are 200 mm and 700 mm respectively. The crank is rotating in clockwise direction at 120 rad/s. Find with the help of Klein's construction:

1. Velocity and acceleration of the piston,

2. Velocity and acceleration of the mid point of the connecting rod, and 3. Angular velocity and angular acceleration of the connecting rod, at the instant when the crank is at 30° to I.D.C. (inner dead centre).

(2) In a slider crank mechanism, the length of the crank and connecting rod are 150 mm and 600 mm respectively. The crank position is 60° from inner dead centre. The crank shaft speed is 450 r.p.m. clockwise. Using Klein's construction, determine

1. Velocity and acceleration of the slider,

2. Velocity and acceleration of point D on the connecting rod which is 150 mm from crank pin C, and 3. angular velocity and angular acceleration of the connecting rod

- (3) The crank of a reciprocating engine is rotating in clockwise direction with a constant angular
- velocity of 30 rad/sec. The lengths of crank and connecting rod are 200 mm and 750 mm respectively.
- Using Klein's construction find
- 1) Velocity of piston
- 2) Velocity of midpoint of connecting rod
- 3) Acceleration of piston
- 4) Angular acceleration of connecting rod when the crank has turned through 30 degrees
- from inner dead center.
- {Ans : 3.8 m/s ,4.2 m/s ,180 m/s2,119.57 rad/sec2)