24AG401 THEORY OF MACHINES

NOTES UNIT 3

A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to give a knife edge follower the motion as described below :

1. To move outwards through 40 mm during 100° rotation of the cam ; 2. To dwell for next 80° ; 3. To return to its starting position during next 90°, and 4. To dwell for the rest period of a revolution i.e. 90°.

Draw the profile of the cam

(i) when the line of stroke of the follower passes through the centre of the cam shaft, and

(ii) when the line of stroke of the follower is off-set by 15 mm.

The displacement of the follower is to take place with uniform acceleration and uniform retardation. Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 900 r.p.m.

Draw the displacement, velocity and acceleration diagrams for one complete revolution of the cam.

Given : S = 40 mm = 0.04 m; o =100° = 100 × /180 = 1.745 rad ; R = 90° = /2 = 1.571 rad ; N = 900 r.p.m.

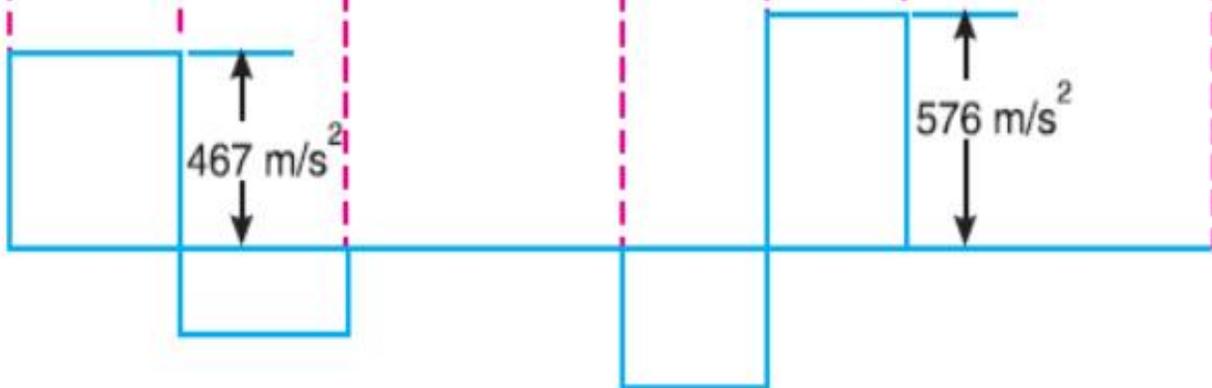First of all, the displacement diagram, as shown in Fig. 20.24 (a), is drawn as discussed in the following steps :

1. Draw a horizontal line ASTPQ such that AS represents the angular displacement of the cam during outward stroke (i.e. 100°) to some suitable scale. The line ST represents the dwell period of 80° after outward stroke. The line TP represents the angular displacement of the cam during return stroke (i.e. 90°) and the line PQ represents the dwell period of 90° after return stroke.

2. Divide AS and TP into any number of equal even parts (say six).

3. Draw vertical lines through points 0, 1, 2, 3 etc. and equal to the lift of the valve i.e. 40 mm.

4. Divide the vertical lines 3-f into six equal parts as shown by points a, b, c . . .

5. Since the follower moves with equal uniform acceleration and uniform retardation, therefore the displacement diagram of the outward and return stroke consists of a double parabola.

6. Join Aa, Ab and Ac intersecting the vertical lines through 1, 2 and 3 at B, C and D respectively.

7. Join the points B, C and D with a smooth curve. This is the required parabola for the half outstroke of the valve. Similarly the other curves may be drawn as shown in Fig. 20.24.

8. The curve A B C . . . N P Q is the required displacement diagram
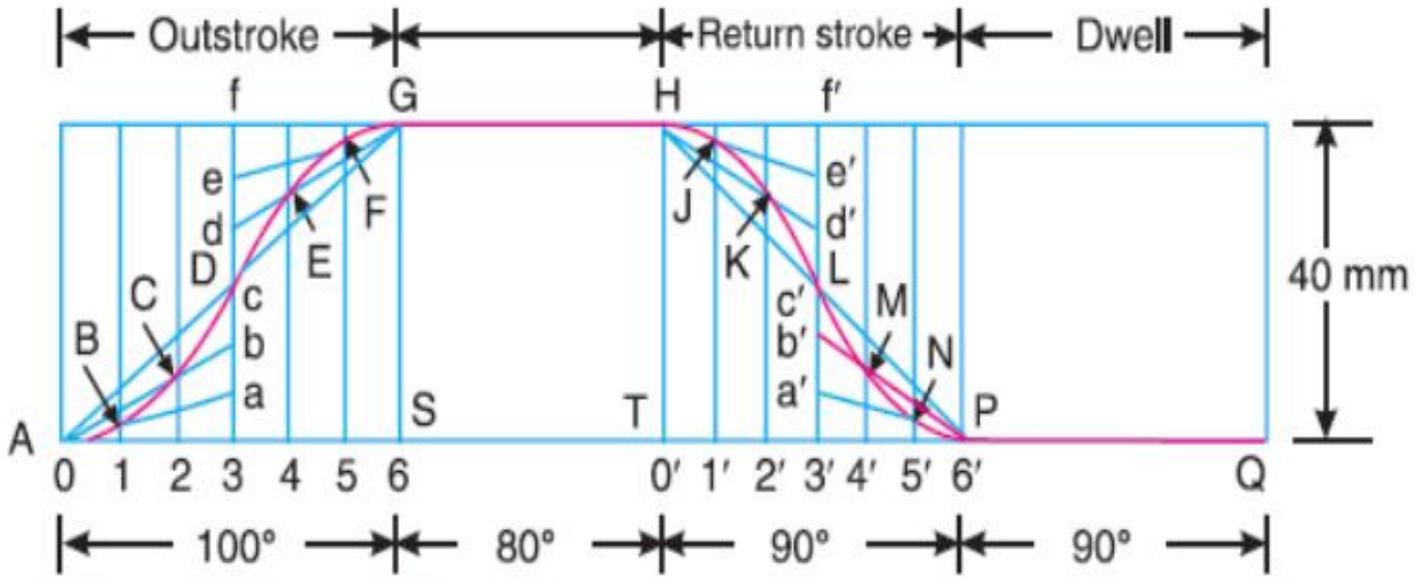
(a) Displacement diagram
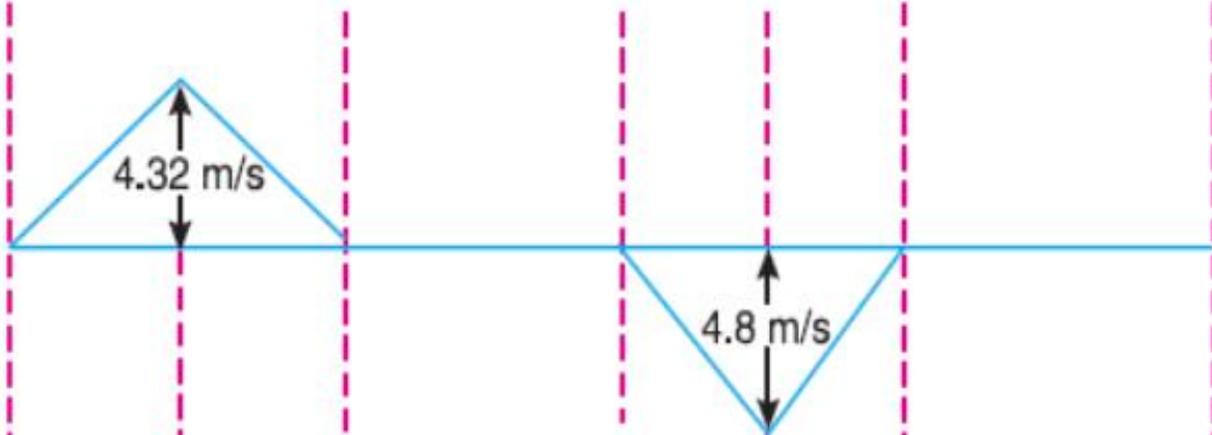
(b) Velocity diagram

(c) Acceleration diagram

Knife edge follower

Base circle

Cam profile

50 mm

100°

80°

90°

Design a cam for operating the exhaust valve of an oil engine. It is required to give equal uniform acceleration and retardation during opening and closing of the valve each

of which corresponds to 60° of cam rotation. The valve must remain in the fully open position for 20° of cam rotation.

The lift of the valve is 37.5 mm and the least radius of the cam is 40 mm. The follower is

provided with a roller of radius 20 mm and its line of stroke passes through the axis of the cam

First of all, the displacement diagram, as shown in Fig. 20.27, is drawn as discussed in the following steps :
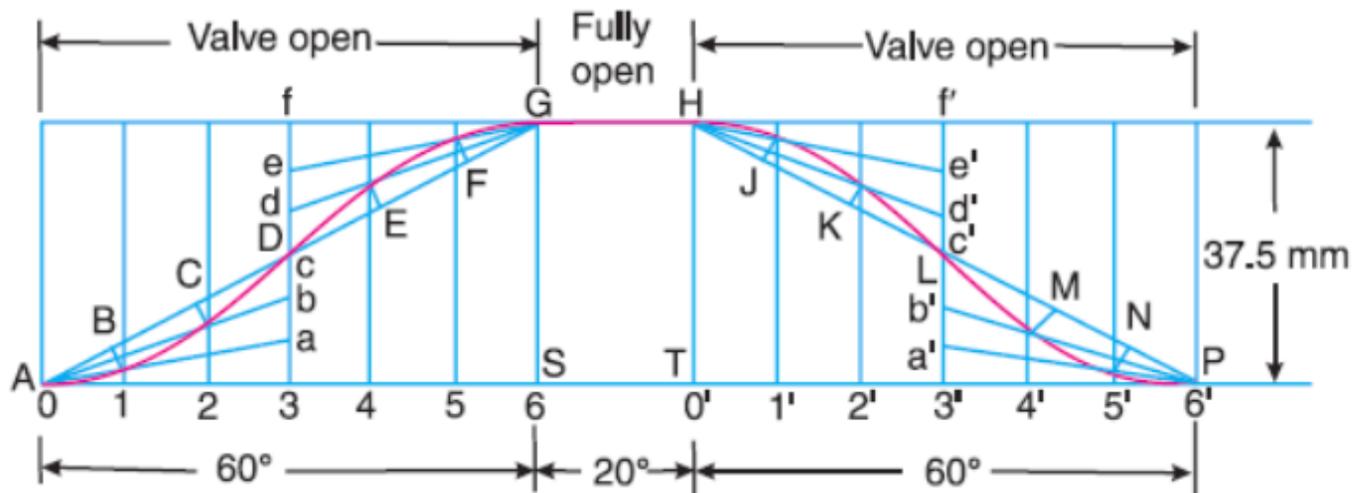
1. Draw a horizontal line ASTP such that AS represents the angular displacement of the cam during opening (i.e. out stroke) of the valve (equal to 60°), to some suitable scale. The line ST represents the dwell period of 20° i.e. the period during which the valve remains A type of roller follower.

fully open and TP represents the angular displacement during closing (i.e. return stroke) of the valve which is equal to 60°.

2. Divide AS and TP into any number of equal even parts (say six).

3. Draw vertical lines through points 0, 1, 2, 3 etc. and equal to lift of the valve i.e. 37.5 mm.

4. Divide the vertical lines 3f into six equal parts as shown by the points a, b, c . ..

5. Since the valve moves with equal uniform acceleration and retardation, therefore the displacement

diagram for opening and closing of a valve consists of double parabola.

6. Complete the displacement diagram as shown in Fig.