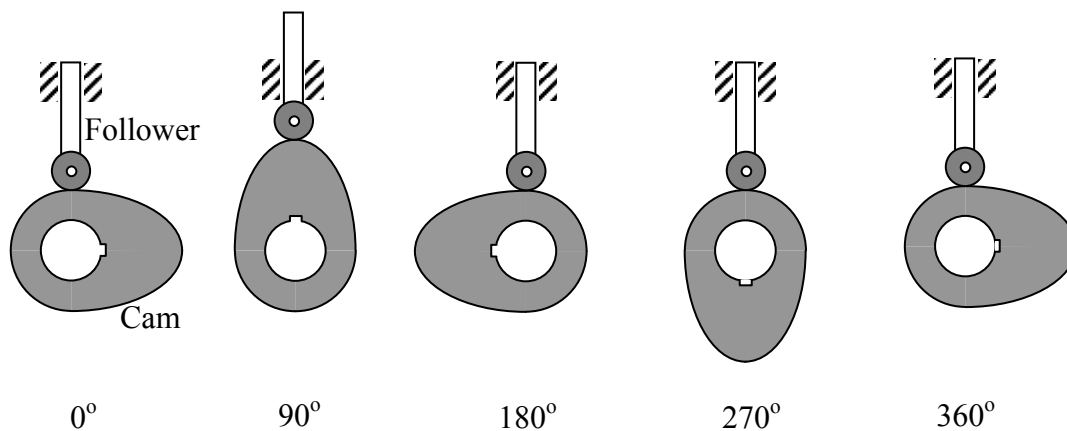


## Chapter 05.00F

# Physical Problem of Interpolation Industrial Engineering

### Problem Statement

An Industrial Engineer needs to program a Computer Numerical Control (CNC) milling machine to fabricate a cam profile that was designed by a Industrial Engineer to operate the intake valves in an internal combustion engine. The Mechanical Engineer's task was to design a disk cam (rotating counterclockwise) to move a radial roller follower (in the vertical y-direction) as shown in Figure 1 below.



**Figure 1** Motion of cam and follower.

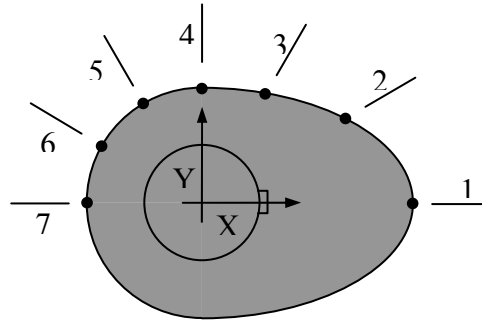
Specifically, the cam is to move the follower as described in Table 1 below.

**Table 1** Cam follower movement as a function of cam rotation.

Cam rotation from X-axis	Follower movement in Y-direction
0°	0.0
90°	1.0
180°	0.0
270°	0.0
360°	0.0

**Solution**

The Mechanical Engineer has specified seven points along the profile of the cam (see Figure below) at 30° increments as shown in Figure 2 below.



**Figure 2** Schematic of cam profile

The geometry of the cam (i.e., coordinates of the seven points on the cam surface) are given in Table 2 below.

**Table 2** Geometry of the cam.

Point	Angle from X-axis	X	Y
1	$-90^\circ$	2.20	0.00
2	$-60^\circ$	1.28	0.88
3	$-30^\circ$	0.66	1.14
4	$0^\circ$	0.00	1.20
5	$30^\circ$	-0.60	1.04
6	$60^\circ$	-1.04	0.60
7	$90^\circ$	-1.20	0.00

The Industrial Engineer is responsible for fitting a *smooth* curve through the 7 points keeping in mind that the final curve must have a infinite slope at points 1 and 7, and zero slope at point 4.

Topic	INTERPOLATION
Sub Topic	Physical Problem
Summary	To program a milling machine to make a cam profile, one needs to use interpolation to develop the path of the profile.
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