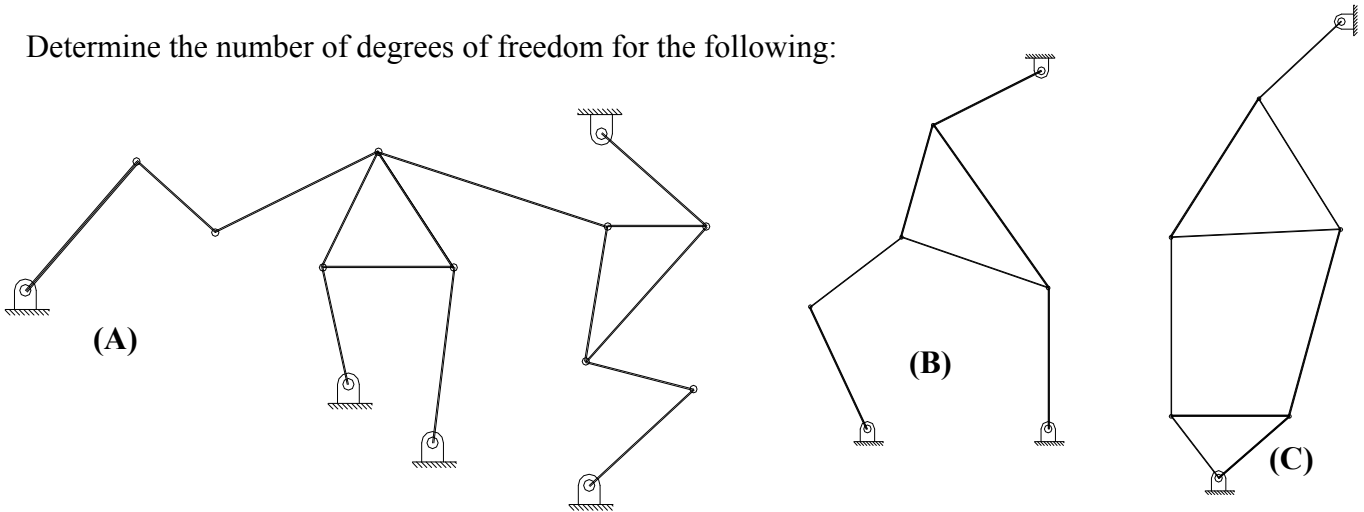
	<b>Alexandria Higher Institute of Engineering &amp; Technology (AIET)</b>	
	Mechatronics Engineering Department	
	EME 401	Mechanics of machines
	Examiners:	Dr. Rola Afify and committee
		4 <sup>th</sup> Year
		Final, Jan.,23,2010
		Time: 3 hour

Answer the following questions:

**Question (1)**

Determine the number of degrees of freedom for the following:



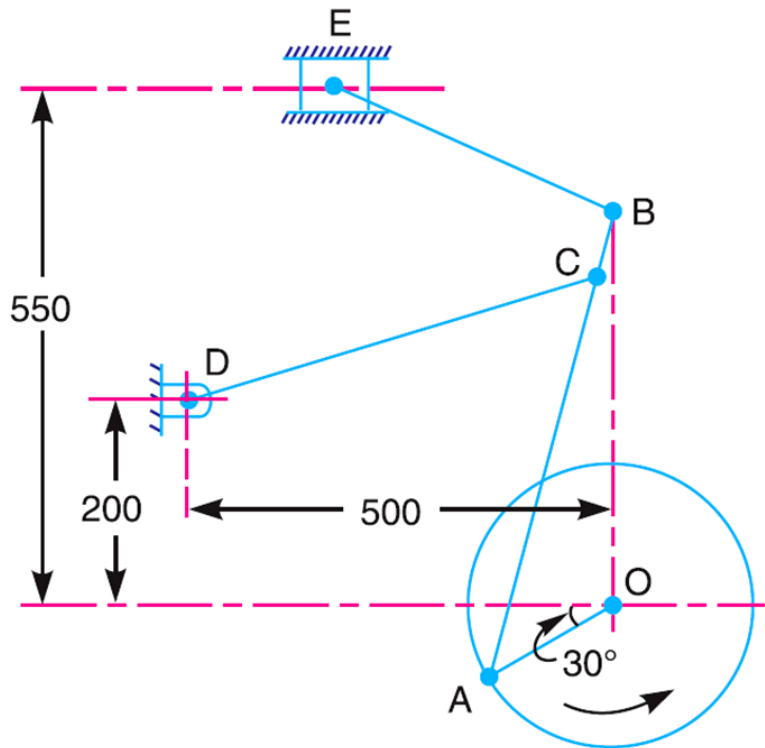
**Question (2)**

The crank OA turns uniformly at 150 rpm and is pinned at A to rod AB. The point C in the rod is guided in the circular path with D as center and DC as radius. The dimensions of various links are:

OA = 150 mm; AB = 550 mm;  
 AC = 450 mm; DC = 500 mm;  
 BE = 350 mm.

Determine the velocity of the ram E for the given position of the mechanism.

Calculate the rubbing velocity at joint B if the joint radius = 5 mm. All dimensions are in mm.

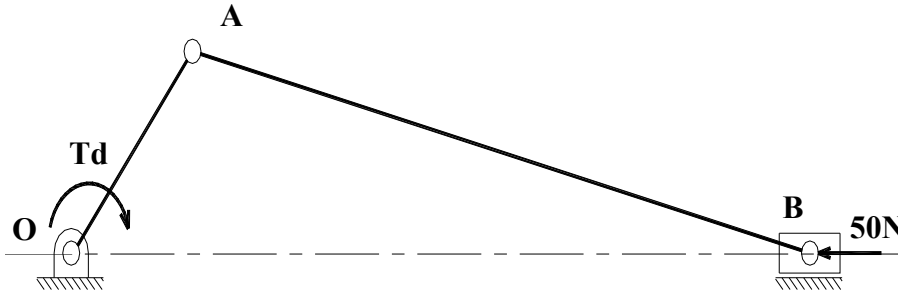


### **Question (3)**

For the shown engine mechanism, find the motor power at (O) required to drive it if the piston speed at this configuration is 0.5 m/sec, piston weight = 10 N and a resisting force acting on the piston is 50 N. assume the coefficient of friction on the piston is  $\mu = 0.1$

OA = 80 mm, AB = 250 mm, OB = 280 mm (use scale 1 cm = 40 mm)

(Hint: draw the velocity polygon with scale 1 cm = 0.1 cm/sec)



### **Question (4)**

I) Specify, using neat sketches, the types of followers.

II) A cam drives a roller reciprocating follower with radius of 10 mm in the following manner:

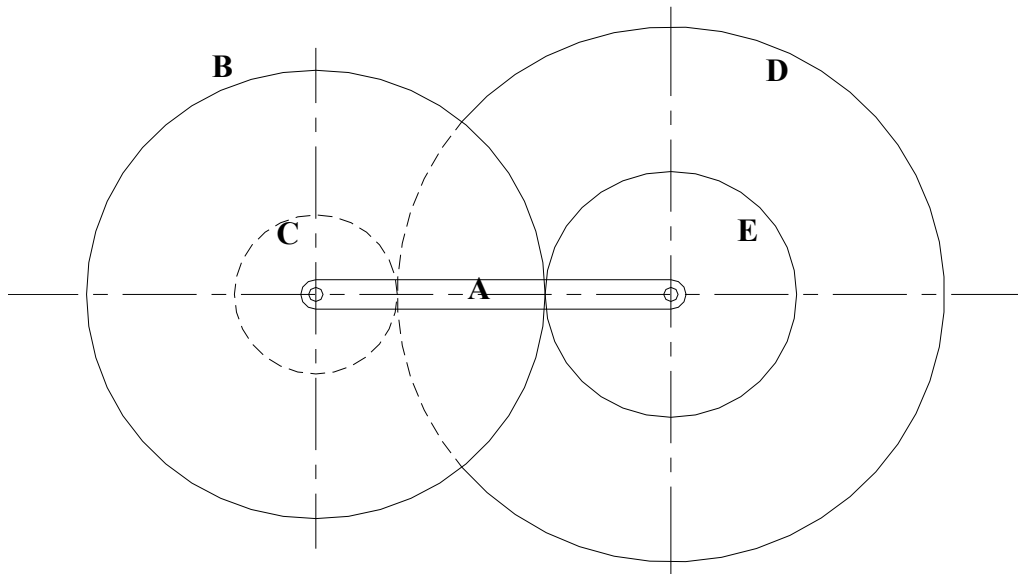
During the first  $120^\circ$  rotation of the cam, the follower moves outwards through a distance of 20 mm with constant acceleration motion. The follower dwells during next  $30^\circ$  of cam rotation. During next  $120^\circ$  of cam rotation, the follower moves inwards with cycloid motion. The follower dwells for the next  $90^\circ$  of the cam rotation.

The minimum radius of the cam is 25 mm. Draw the profile of the cam.

### **Question (5)**

I) Sketch the terminology used in gears.

II) In the reverted epicyclic gear train, the arm A carries two gears B and C and a compound gear D-E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm A makes 100 rpm clockwise.



**Question (6)**

A constant torque motor of 3 kW is used to drive a machine has a resisting torque as shown in figure. If the mean speed is 300 rpm, find the Inertia of the wheel to keep maximum speed variation of 3%.

