1. (a)Show as many structural sketches of quick-return mechanisms as you can. [10%]
   (b)Design a quick-return mechanism with a 100-mm stroke and a forward-to-return time ratio of approximately 2 to 1. The driving crank rotates at constant speed. [10%]

2. For the planar PRPR mechanism shown in Fig. 1, the velocity of slider 2 is 10 ft/s and the acceleration is 200 ft/s^2, both toward the right.
   (a) Determine the angular velocity and acceleration of link 4 analytically. [15%]
   (b) Check your results of (a) by using a graphical approach. [15%]

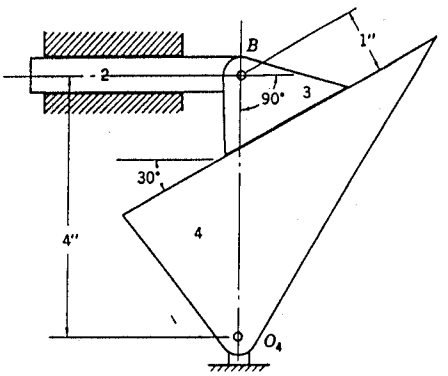


Fig. 1

(背面仍有題目,請繼續作答)

3. (20%)

a. Explain "Theory of Envelopes".

b. Explain "Contact Ratio" in gearing.

c. What is the tooth profile of a rack cutter for generating an involute gear?

d. List three types of gears that can be used in transmissions between nonparallel, nonintersecting shafts.

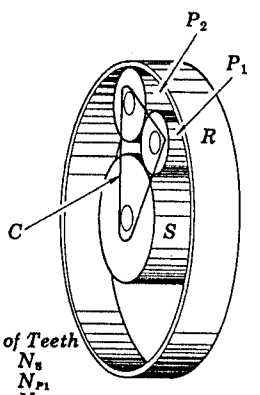
4. (10%)

Given a planetary gear train, as shown in Figure 2, assume that the sun gear is fixed. Given the speed of the carrier C, ω_C, find the speed of the ring gear R in terms of ω_C and tooth numbers.

5. (20%)

Figure 3 shows a disk cam with translating, offset roller follower. Determine the profile of the cam if the follower displacement s is prescribed as a function of the cam angle θ, i.e., $s = s(\theta)$.

You are asked to solve this problem by using an analytical method—the theory of envelopes. The theory of envelopes can be summarized as solving two simultaneous equations: the first equation is the family of curves of the follower. The second equation is the partial derivative the first equation with respect to the cam angle. You are asked to write down the two equations, without solving them simultaneously. To make this problem easier, let us assume that the offset is zero, namely, $e = 0$ and $\beta = 0$.



Gear	No. of Teeth
S (Sun)	N_S
P_1 (Planet)	N_{P1}
P_2 (Planet)	N_{P2}
R (Ring)	N_R

P_1 and P_2 are both held in carrier C
P_1 contacts S and P_2
P_2 contacts P_1 and R

Figure 2

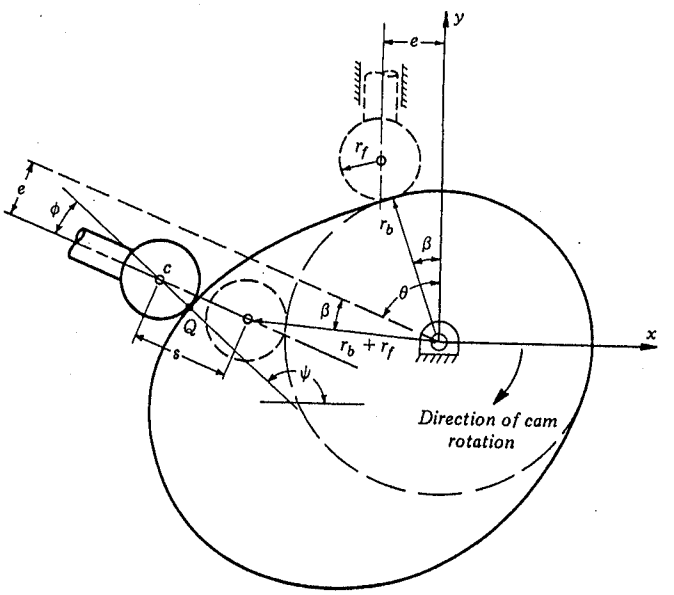


Figure 3