工程力學
Exam. # 4 （01/06/2020）

1. (20pts) The elevation of the end of the steel beam supported by a concrete floor is adjusted by means of the steel wedges E and F shown in Fig. 1. The base plate CD has been welded to the lower flange of the beam, and the end reaction of the beam is known to be 100 kN. The coefficient of static friction is 0.30 between two steel surfaces and 0.60 between steel and concrete. If the horizontal motion of the beam is prevented by the force Q, determine (a) the force P required to raise the beam, (b) the corresponding force Q.

2. (20pts) Prove the following relation of the V-belt (Fig. 2):

$$\frac{T_2}{T_1} = e^{\mu_s \beta / \sin(\alpha/2)}$$

where T_1 and T_2 are the tensions, μ_s is the coefficient of static friction, β is the angle of belt contact, and α is angle of the V-shape.

3. (20pts) The square-threaded worm gear shown in Fig. 3 has a mean radius of 30 mm. and a lead of 7.5 mm. The large gear is subjected to a constant clockwise couple of 700 N·m. Knowing that the coefficient of static friction between the two gears is 0.12, determine the couple that must be applied to shaft AB in order to rotate the large gear counterclockwise. Neglect friction in the bearings at A, B, and C.

4. (20pts) Determine the moment of inertia and the radius of gyration of the shaded area shown in Fig. 4 with respect to the x axis.

5. (20pts) Determine by direct integration the mass moment of inertia with respect to the z axis of the right circular cylinder shown in Fig. 5, assuming that it has a uniform density and a mass m.
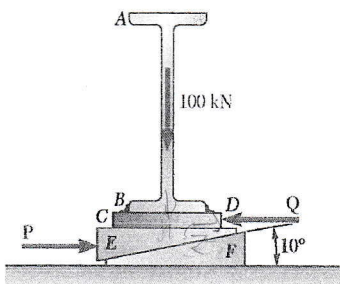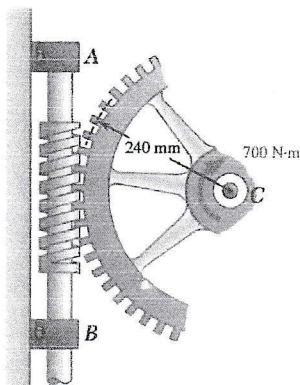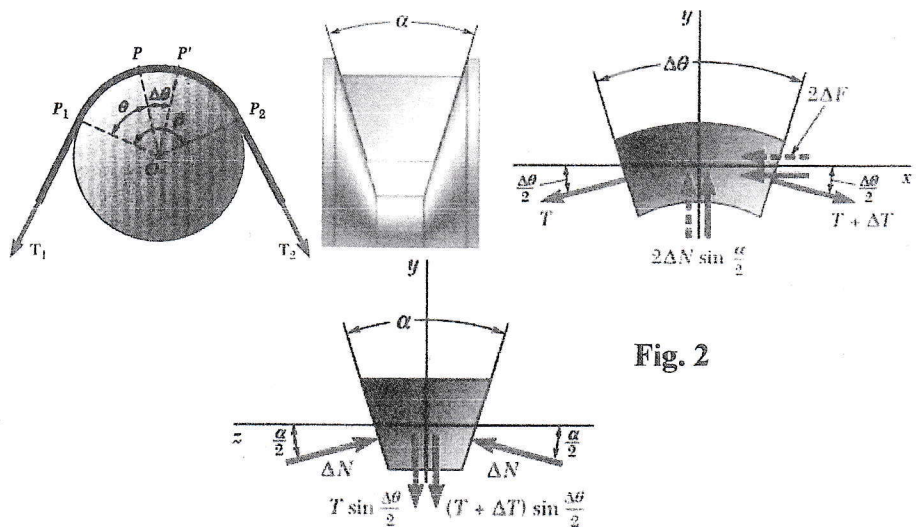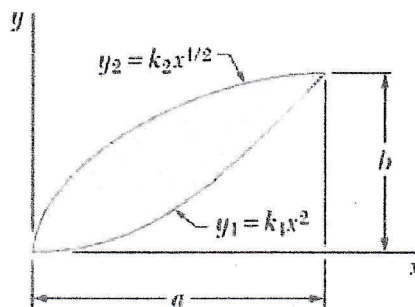

Fig 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5