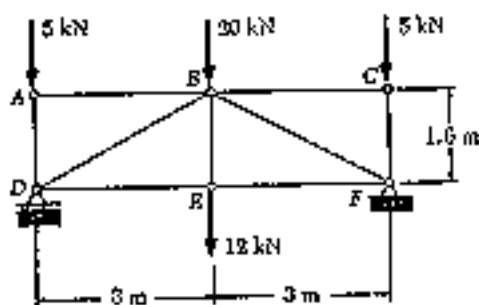1. Describe or define the following terms.

    a. (5%) Newton's Three Fundamental Laws.

    b. (5%) Moment of inertia of an area.

    c. (5%) Statically determinate structures.

    d. (5%) Principle of virtual work for a system of rigid bodies

2. ((10%) Determine the force in each member of the truss shown below. State whether each member is in tension or compression.

3. (10%) Draw the shear and bending-moment diagrams for the beam and loading shown below.

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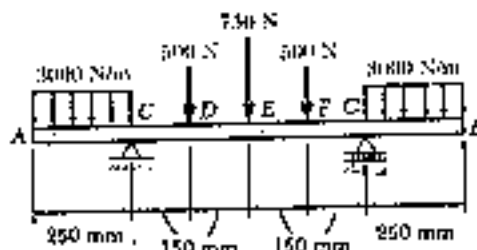
4. A wintertime fisherman of mass 70 kg is in trouble — he is being reeled in by Jaws on a lake of frozen ice. At the instant shown in Fig. a, the man has a velocity component, perpendicular to the radius r, of $v_{1\perp} = 0.3$ m/s at an instant when $r = R_1 = 5$ m. If Jaws pulls in the line with a force of 100 N, find the value of $v_{2\perp}$ when the radius is $R_2 = 1$ m.   (20%)

5. The cylinder β_1 shown in Fig. b is rolling on the fixed, circular track with the indicated angular velocity and acceleration when β_1 is at the bottom of the track. Rod β_2 is pinned to the center C of β_1, and its other end, B, slides on track J. Find the velocity and acceleration of B.   (20%)

6. A massless rope hanging over a frictionless pulley of mass M support two monkeys (one of mass M, the other of mass 2M). The system is released at rest at $t=0$, as shown in Fig. c. During the following 2 sec, monkey B travels down 15 ft of rope to obtain a massless peanut at end P. Monkey A holds tightly to the rope during these 2 sec. Find the displacement of A during the time interval. Treat the pulley as a uniform cylinder of radius R.
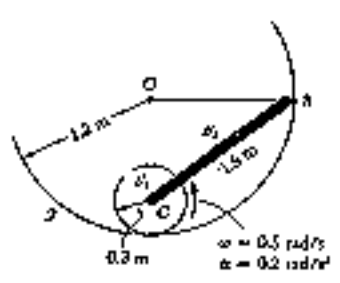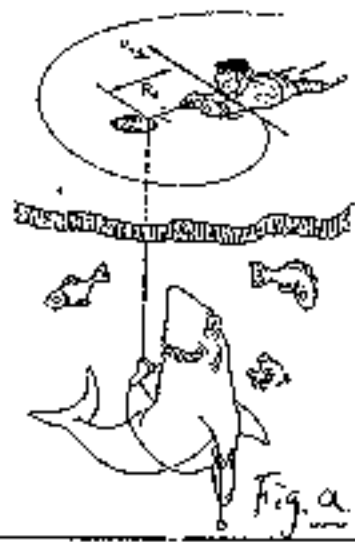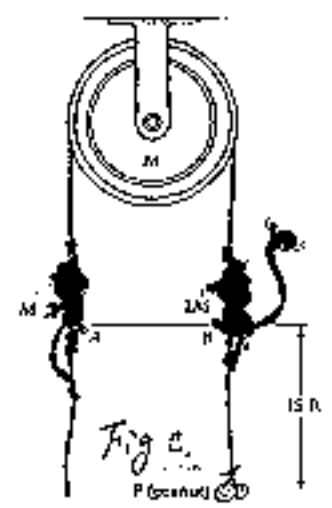

Fig. b.

0.3 m $\omega = 0.5$ rad/s $\alpha = 0.2$ rad/s²

Fig. a.

Fig c.

P (peanut)