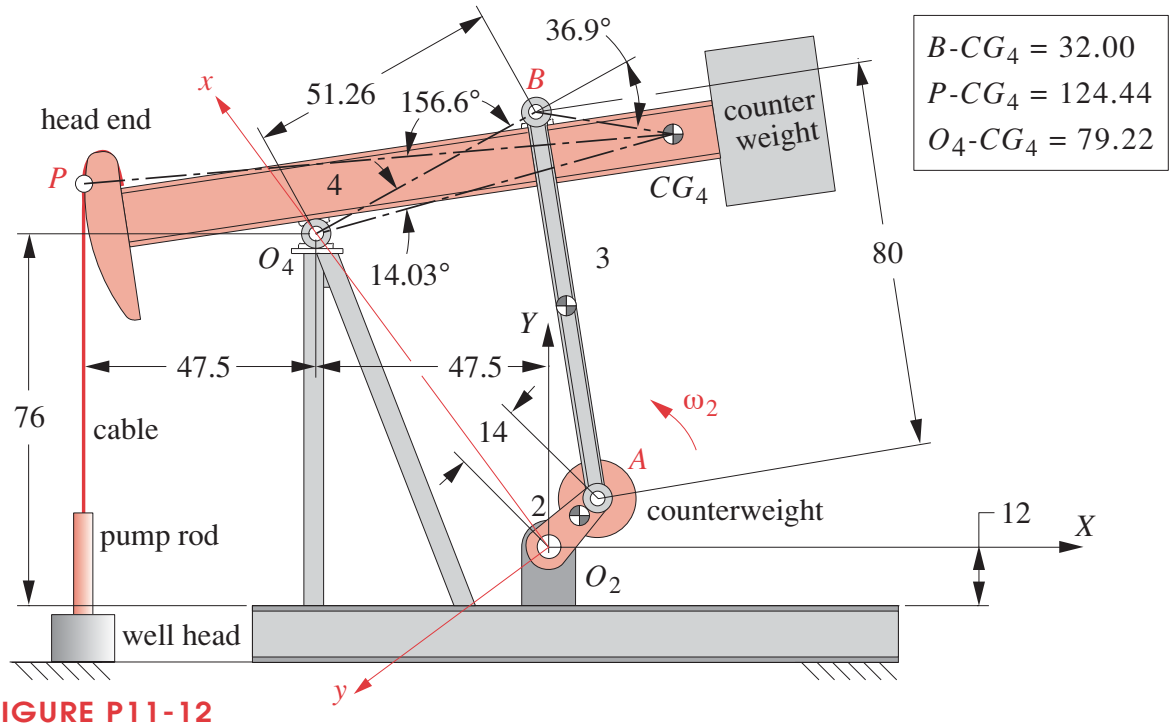

FIGURE P11-12

Problems 11-20 to 11-23 An oil field pump - dimensions in inches

11-20 Figure P11-12 (p. 605) shows an oil field pump mechanism. The head of the rocker arm is shaped such that the lower end of a flexible cable attached to it will always be directly over the well head regardless of the position of the rocker arm 4. The pump rod, which connects to the pump in the well casing, is connected to the lower end of the cable. The force in the pump rod on the up stroke is 2970 lb and the force on the down stroke is 2300 lb. Link 2 weighs 598.3 lb and has a mass moment of inertia of 11.8 lb-in-sec^2 (blob-in^2); both include the counterweight. Its *CG* is on the link centerline, 13.2 in from O_2. Link 3 weighs 108 lb and its *CG* is on the link centerline, 40 in from *A*. Link 4 weighs 2706 lb and has a mass moment of inertia of 10 700 lb-in-sec^2 (blob-in^2); both include the counterweight. Its *CG* is on the link centerline where shown. The crank turns at a constant speed of 4 rpm *CCW*. At the instant shown in the figure the crank angle is at 45° with respect to the global coordinate system. Find all pin forces and the torque needed to drive the crank for the position shown. Include gravity forces because the links are heavy and the speed is low.

†11-21 Use the information in Problem 11-20 to find and plot all pin forces and the torque needed to drive the crank for one revolution of the crank.

†11-22 Use the information in Problem 11-20 to find the torque needed to drive the crank for the position shown using the method of virtual work.

†11-23 Use the information in Problem 11-20 to find and plot the torque needed to drive the crank for one revolution of the crank using the method of virtual work.

† These problems are suited to solution using *Mathcad, Matlab,* or T*KSolver* equation solver programs.