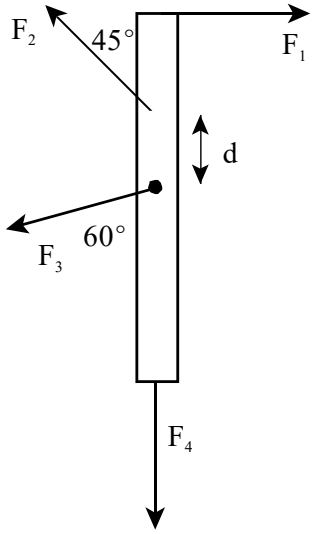
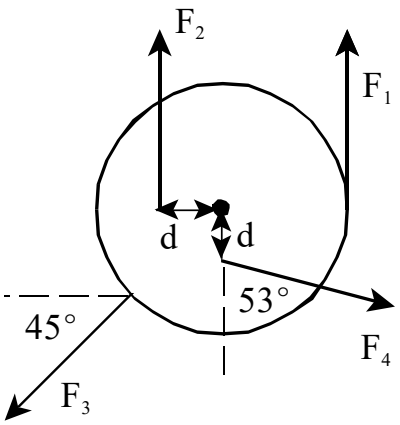
Physics 1145 Homework #10: Torque. Rotational dynamics. Equilibrium.

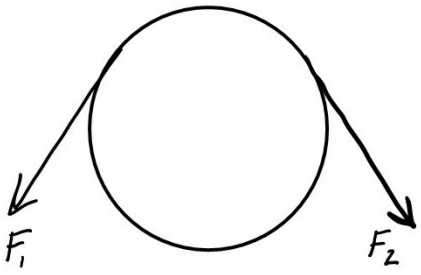
1. A uniform beam of mass m= 4.0 kg and length L= 2.0 m can rotate about an axle through its center. Four forces are acting on it as shown in the figure. Their magnitudes are F_1=4.0N, F_2=6.0N, F_3=3.5N and F_4=5.0N. F_2 acts a distance d=0.5m from the center of mass.
Calculate the torques exerted by each of the forces on the beam. Calculate the net torque. In which direction will the beam rotate?



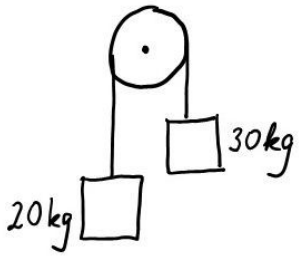
2. A uniform disk of mass m=4.5 kg and radius R= 10 cm can rotate about an axle through its center. Four forces are acting on it as shown in the figure. Their magnitudes are F_1=2.0N, F_2=6.0N, F_3=3.5N and F_4=5.0N.
F_2 and F_4 act a distance d=5 cm from the center of mass.
a) Calculate the torques exerted by each of the forces on the disk.
b) Calculate the angular acceleration of the disk.



3. A pulley in the shape of a uniform disk of mass 2kg and radius 20cm has a rope running over it. The tension in the rope is F_1=10N on one side and F_2=20N on the other side. Find the angular acceleration of the pulley.



4. Atwood machine revisited. A 20kg box and a 30kg crate are attached to the two ends of a massless string that passes over a disk shaped pulley. The system is released from rest.



Without performing a calculation, rate, smallest to largest, the magnitudes of the tensions in the string on the two sides of the pulley and the weights of box and crate, respectively. Explain your results.

5. A uniform disk of mass 2kg and radius 10cm is rolling without slipping down a slope that is inclined by 30º with the horizontal. Find the disk's linear acceleration.

6. A uniform beam of mass 10kg and length 2.0m is attached to a wall by a cable that makes an angle 30° with the horizontal. The beam is free to pivot at the point where it touches the wall. Calculate the tension in the cable when the beam is in the horizontal position.