Equilibrium Examples

Pre-Lecture Questions

Problem Set #33 (due next time)

Lecture Outline

1. Examples Involving Three Equations

Pre-Class Summary:

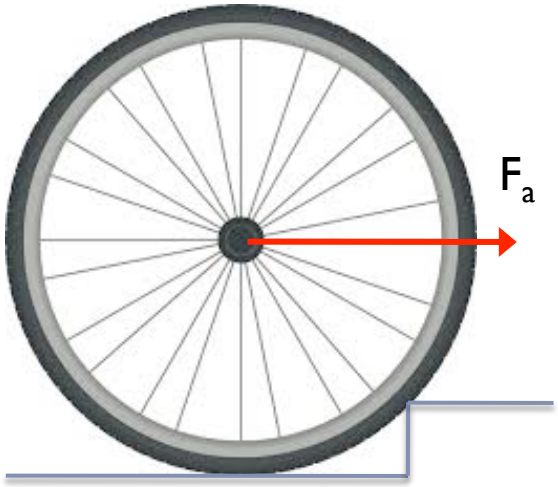
A system in static equilibrium feels no net force and no net torque.

$$\Sigma\vec{\tau}_P = 0 \qquad \Sigma\vec{F} = 0$$

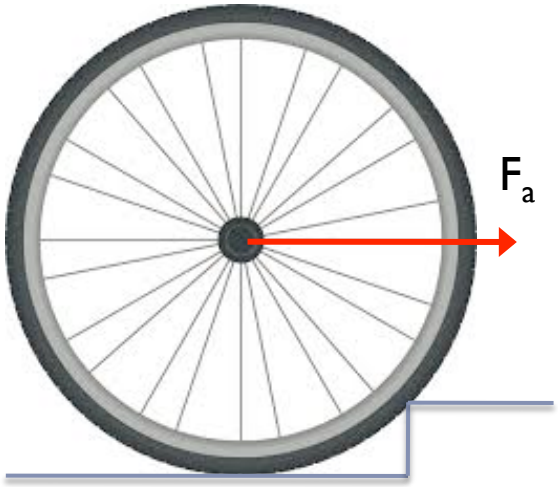
For an object in equilibrium, the sum of the torques is zero about any point. Judicious choice of this point can make the algebra of the solution easier.

When there are more unknowns than equation from the 2nd Law, numerical solution is impossible and the system is said to be "statically indeterminate."

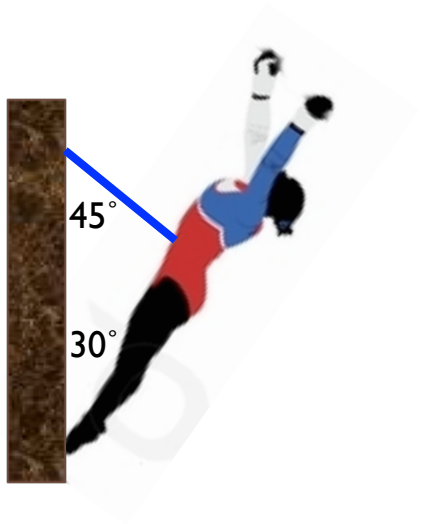
Example 1: A 1.00kg bicycle wheel with a radius of 22.0cm comes up against a curb 6.00cm high. The bike exerts a horizontal force on the axle. Draw the other forces that act on the wheel.



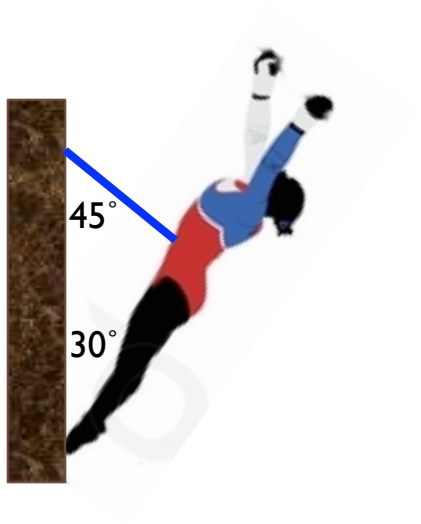
Example 2: A 1.00kg bicycle wheel with a radius of 22.0cm comes up against a curb 6.00cm high. The bike exerts a horizontal force on the axle. Find the size of the force exerted by the axle if the wheel is to go over the curb.



Example 3: A 60kg rock climber is supported by a rope attached to her center of mass. Draw the forces that act on her.



Example 4: A 60kg rock climber is supported by a rope attached to her center of mass. Find the magnitude of the forces that act on her.



Example 5: An 1.0kg baseball bat has a center of mass 60cm from the handle. It is 90cm long and leans against a smooth wall making a 53° with the floor. Draw the forces that act on it.

Example 6: An 1.0kg baseball bat has a center of mass 60cm from the handle. It is 90cm long and leans against a smooth wall making a 53° with the floor. Find the minimum coefficient of friction required to keep the bat from slipping.

Lecture 33 - Summary

A system in static equilibrium feels no net force and no net torque.

$$\Sigma\vec{\tau}_P = 0 \qquad \Sigma\vec{F} = 0$$

For an object in equilibrium, the sum of the torques is zero about any point. Judicious choice of this point can make the algebra of the solution easier.

When there are more unknowns than equation from the 2nd Law, numerical solution is impossible and the system is said to be "statically indeterminate."