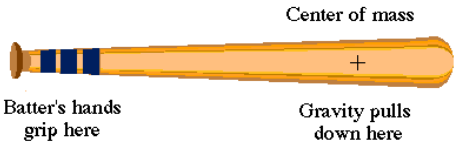
If a batter holds a baseball bat out horizontally, the center of mass is quite far from where he grips it. Discuss the forces (plural!) he must apply to keep it stationary in this position. And try to be thorough.



Can you balance two torques with different lever arms?

In this case, the handle would be the pivot point and the force that causes the torque is the weight of the bat. The pivot force cannot cause torque because the lever arm is zero. The value is the perpendicular distance from the pivot point to where the weight of the bat acts.

Can you add a third force without a lever arm?

the bat has a force of gravity and a normal force that go directly toward the sky and the ground. The force of gravity is far greater then the normal force though so the force you have to exert to get it to stay level is the force of friction of you holding the bat. That force will be going back towards you, perpendicular to the force of gravity and normal force. This perpendicular force will create a net zero torque.

Discusses force but doesn't explain how the torques can cancel

To keep the bat in the air he must exert a force that is in the opposite direction of gravity, so a force upward with the same magnitude as the force of gravity.

To keep the bat from rotating he must exert a force in the opposite direction the bat wants to fall, which is clockwise. He must exert a force that results in the same amount of torque that gravity is causing on the bat.

Estimate the magnitude of the torque exerted by the batter in the discussion question. Explain your reasoning.

Can the various torques all be zero?

Net torque is the product between a force and the distance. Since a normal force is applied in an upwards direction in the previous question, its distance would be zero. Therefore, the magnitude of torque would also be zero. This makes sense as net torque must be zero in order to maintain static equilibrium.

Good estimation of gravity's torque and implication about batter's torque

A standard bat is about 0.5m and the center of mass is about 0.4m away from the handle and weighs 5kg.

So the moment arm in this situation would be 0.4m

The moment arm for the torque that is caused by the force of gravity is 0.1m

So, torque caused by gravity is (10m/s^2)(5kg)(0.1m) = 5 N*M

The only way for the bat not to rotate is for the batter to exert the same torque but in the opposite direction, so he would exert a -5n*M.

Good discussion with a curious terminology error

A net torque with the original center of mass would be exerted by the normal force of his hands. Gravity would exert no torque because it does not require a lever arm since it passes through the center of mass. However, static equilibrium problems allow movement of the center of mass to wherever is convenient. The most convenient spot for the center of mass would be in the center of the bat. Then, both forces would have lever arms and create torques. These torques, since they are in opposite directions, can sum to zero. The sum of the forces is also zero. The bat can therefore be in a state of static equilibrium.

Where should you chose the axis for a body in static equilibrium?

a. The center of mass
b. The geometric center
c. The axis of rotation if the body started rotating
d. The far left end
e. The far right end
f. Wherever makes the problem simple