Friction Summary

This lecture begins with explaining the theory of friction and then introduces two methods to measure friction. The third part of the lecture provides several calculated examples and a visual example. Finally examples of reduced friction are given in the end.

Friction is not a simple force. The reason why is if a force is applied to a stationary object, the friction will increase in value in a direction opposite to the applied force, until some threshold is met. This threshold is known as $\mu_s$, the static friction. That is the amount of friction threshold required to start an object moving. The kinetic friction $\mu_k$, is the friction force while the object is moving. The static friction is always greater than the kinetic friction.

Measurement of Friction

There are two methods to measure friction. The first is to use a slope. We need to increase the angle of the slope until the object begins moving. At the instant the object begins to move we can measure the angle of the slope and calculate the friction coefficient from Newton’s second law, $F = ma$.

The equation can be derived as $\mu_s = \tan \alpha$.

$\mu_s$ is the static friction. $\alpha$ is the angle that the object begins moving.

There are two interesting points from this equation. That first is that the mass of the object has no effect on frictional force and the second is that the surface area of contact has no effect on frictional force.

The second method of measurement involves the use of a pulley. Here a weight is added to a string through a pulley to provide a force in the opposite direction to that provided by gravity. Here we can calculate the friction by either increasing the angle, or increasing the weigh attached to the pulley.

Examples and experiments

Two worked examples were provided in the lecture. The first demonstrated acceleration uphill, the second no acceleration. This demonstrated that friction is a complicated and a very reactive force depending on which direction the force is coming from. Next two experiments were carried out to demonstrate the two measurement methods.

This was followed by examples of reduced friction. They were hydroplaning in a car where a little bit of water mixes with dirt and grease on the road. A hydroplane example was also provided by adding lubricant (water) between a lid and a pot. Finally, gas was demonstrated as being a very good lubricant. This was demonstrated by both an air-track and a container of carbon dioxide.