The three factors that affect friction between surfaces are

Weight (Mass)

Surface type (Roughness)

Area of Contact

I will investigate how weight affects friction.

I will keep the other factors constant to make it a fair test.

Trial Experiment

I will choose the 100g masses.

I will choose the 95g sled.

I will take 5 numbers of readings.

My range will be from 0g to 1kg.

I will repeat each reading by 2 times.

Reasons

I chose to use the 100g masses because they are easy to read and covers the required range.

I chose the 95g sled because the sled could hold more weight than the 31g sled, it is easier to read and easier to plot.

I chose to take 5 numbers of readings because it fits with my range. I will go up by 200g for each reading.

I chose to use my range from 0g to 1kg because it is easy to read.

I will repeat each reading 3 times, I will repeat readings and take average so that it will be a fair test.

Trial Results

Mass of sled

(g)

Added Mass

(g)

Total Mass

(g)

Frictional Force (N)

Reading 1 Reading2 1 Reading 3

Average

Friction

95

200

295

0. 2 0. 2 0. 2

0. 2

31

200

231

0. 1 0. 1 0. 1

0. 1

Diagram

Theory

Friction is the force that opposes the motion of an object as it slides across a surface. As soon as you try to slide an object across a surface, friction acts upon it. To be able to slide the object, the pushing or pulling force must match the friction force. The force required to move the object is always larger than the force to keep it moving. There are two types of friction: static friction where there is no motion and kinetic friction where there is motion. The friction that will be investigated in this coursework will be the kinetic friction. Static friction is always greater than kinetic friction. Friction can be reduced by lubrication.

Friction is due to surface roughness, the bumps on one surface fall into the hollows of the other surface and vice-versa. By making the surfaces

smoother the friction should be reduced but this is not so, for many materials (i. e. metals) the opposite happens: the friction between hard materials becomes larger as they are made smoother.

Smoother surfaces make for closer contact; the surfaces get close enough for atoms so they attract making them stick together. There is no such thing as the smoothest surface because even the smoothest surface is rough on an atomic scale. Therefore even two very smooth surfaces are in close contact at only a few points. This diagram shows this:

Thus the weight of an object with a smooth surface is supported at a few points of contact. The area of these points of contact is very small. The weight of the object divided by the total area of contact (resulting pressure) is huge. When these high pressures occur, atoms of one surface are pushed close enough to the other surface that they attract one another as strongly as they would if they were all part of the same surface. Due to this the two surfaces fuse (melt or weld) together at those points.

The surface area of the object does not affect friction because the total area of contact at these points is small compared to the total surface area of the object. If the weight of the object increases, the pressure at the contact points also increases and the surfaces are pushed together. This leads to an increase in the friction force between them.

Prediction

I predict that as mass increases the frictional force increases. I also predict that when I double the added mass, the frictional force will double as well due to the fact that friction is proportional to mass.

Obtaining Evidence

Corrected Table of results:

Mass of sled (g)

Added mass (g)

Total mass (g)

Frictional Force (N)

Reading 1 Reading 2 Reading 3

Average Friction (N)

95

200

295

0. 4 0. 4 0. 5

0. 4

95

400

495

0. 7 0. 8 0. 8

0. 8

95

600

695

1. 2 1. 2 1. 2

1. 2

95

800

895

1. 5 1. 4 1. 5

1. 5

95

1000

1095

1. 8 1. 8 1. 8

1. 8

The range that is used in this experiment is from 0g to 1000g. This table shows the frictional force without the zero error.

Analysis

Trend: As the total mass increases, the frictional force needed increases.

A straight-line show that mass is proportional to frictional force.

The graph does pass through the origin because I have estimated the zero error. The zero error is an error, which the Newton meter had. The Newton meter is usually used vertically, but in this experiment the Newton meter was used horizontally, when this happened the meter didn’t start at 0 but before it. I estimated that it started 0. 2N before 0 thus I added 0. 2N to all of my original results.

I can conclude that as force increases mass increases thus force is proportional to mass. My results are supported by my theory which states that as the weight of the object increases, the pressure at the contact points also increases and the surfaces are pushed together. This leads to an increase in the friction force between them. This happened in my experiment. My results are supported by my theory as well as my prediction. The frictional force approximately doubled as I doubled the added mass. For example when I used 200g of added mass it was 0. 4N and when I used 400g it doubled to 0. 8N as shown in the table above.

Evaluation

My readings were easily obtained which proves that a suitable method was used, although there were some problems that are mentioned in this evaluation.

In my graph there were no anomalous results. This shows that the results have been found properly and that as mass increases friction increases. The graph did pass through the origin because I estimated the zero error that the Newton meter had and added 0. 2N to my original readings.

The errors of the experiment are the zero error, which was estimated and corrected although this estimation is not 100% accurate, the speed the sled was pulled varied from each reading, this is because the speed was not measured but was only looked to remain constant by human eye, it was often hard to read the Newton meter, which was due to the fact that the Newton meter only faced two directions and was very small to read and the surface area of the table that was used varied as the sled went along.

To make the experiment more accurate mechanical apparatus should be used that is capable of measuring by itself without human help, this would help greatly to the accuracy of the experiment. Due to the time limitations of the experiment each mass and sled in existence could not be tested to see if it gave clearer results also due to time limitations if the experiment was repeated 10 times the average fiction would be more accurate.

The results were reliable because all the plotted points were near the line of best fit and there were no anomalous results.

I could also investigate how surface area affects friction or use a different range of masses.