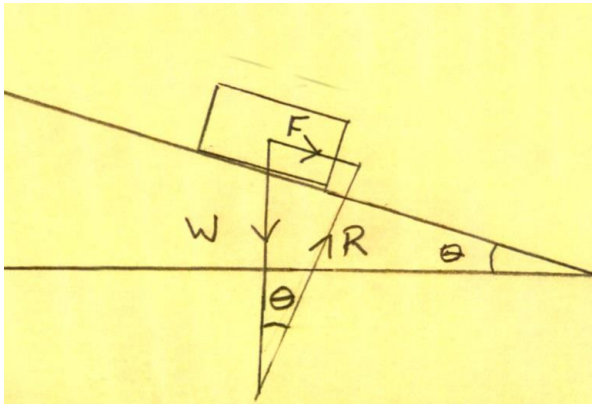
Candidate 8 evidence (Acceleration of a Trolley)

Acceleration of a Trolley on a Slope

AIM :

My aim is to find how the acceleration of a trolley varies with the sine of the angle of the slope.

PHYSICS:



When it sits on a slope, the weight of the box, which acts straight down, is split into two vectors. In the diagram, W is the weight and its split into vector F which points down the slope and vector R which points up from the slope.

The slope is at θ° to the flat and so R is at θ° to the vertical weight.

Triangle WFR is right angled, so by Pythagoras R=Wcos θ° and F=Wsin θ°

F is the force that acts down the slope on the box and so using Newton's second law, F=ma,

The acceleration of the box

$$a = \frac{F}{m}$$

and so

$$a = \frac{W \sin\theta}{m}$$

So the graph should be a straight line. When θ is zero, the acceleration is zero, so the line should go through the origin.

EXPERIMENT:

I will measure the angle of the slope with a big protractor and the acceleration of a trolley with a light gate.

TABLE: Here is my table of results

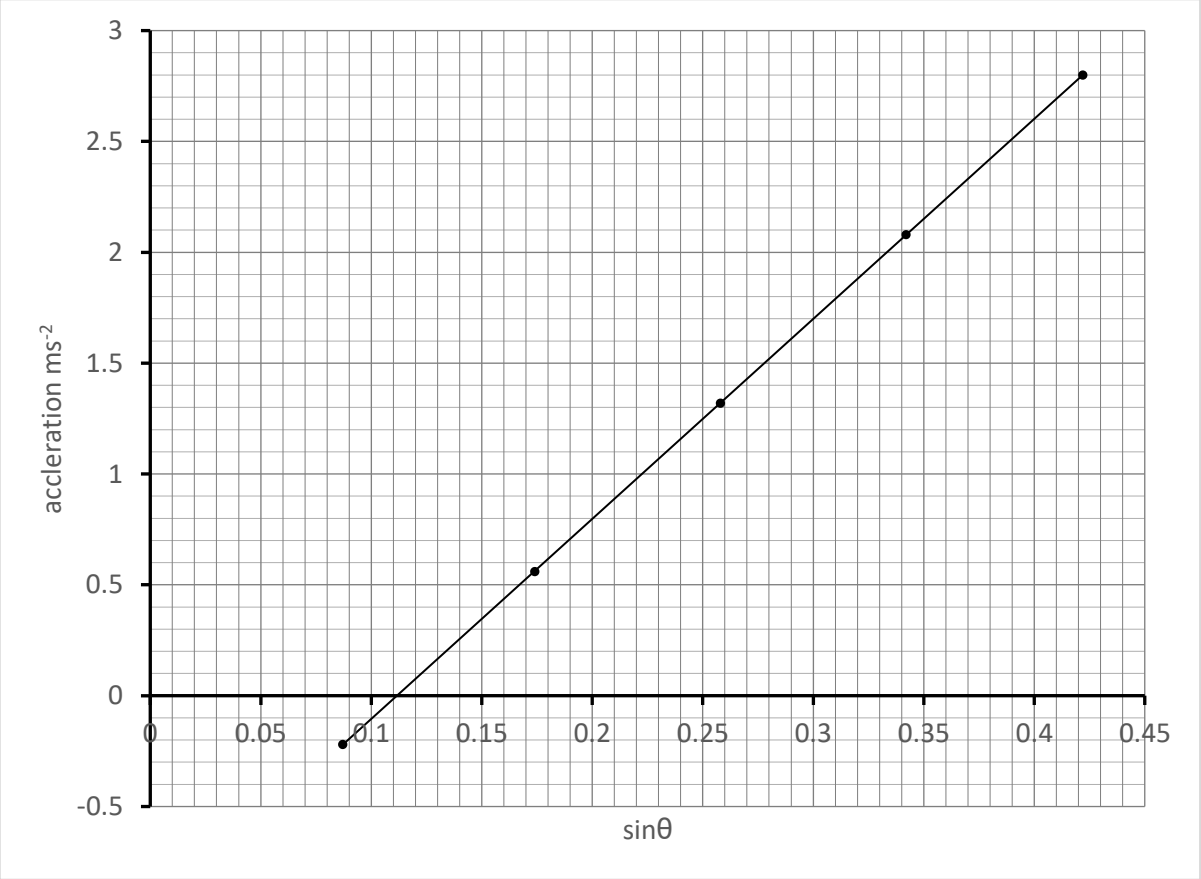
Angle (θ°)	**Sin θ°**	**Acceleration (ms^{-2})**				
		First	Second	Third	Average	Random uncertainty
5	0.087	-0.21	-0.23	-0.22	-0.22	0.006
10	0.174	0.51	0.56	0.61	0.56	0.003
15	0.258	1.34	1.32	1.31	1.32	0.001
20	0.342	2.08	2.00	2.16	2.08	0.005
25	0.422	2.81	2.65	2.94	2.8	0.009

UNCERTAINTIES:

The scale reading uncertainty in the TSA unit was ±0.01 ms^{-2}.

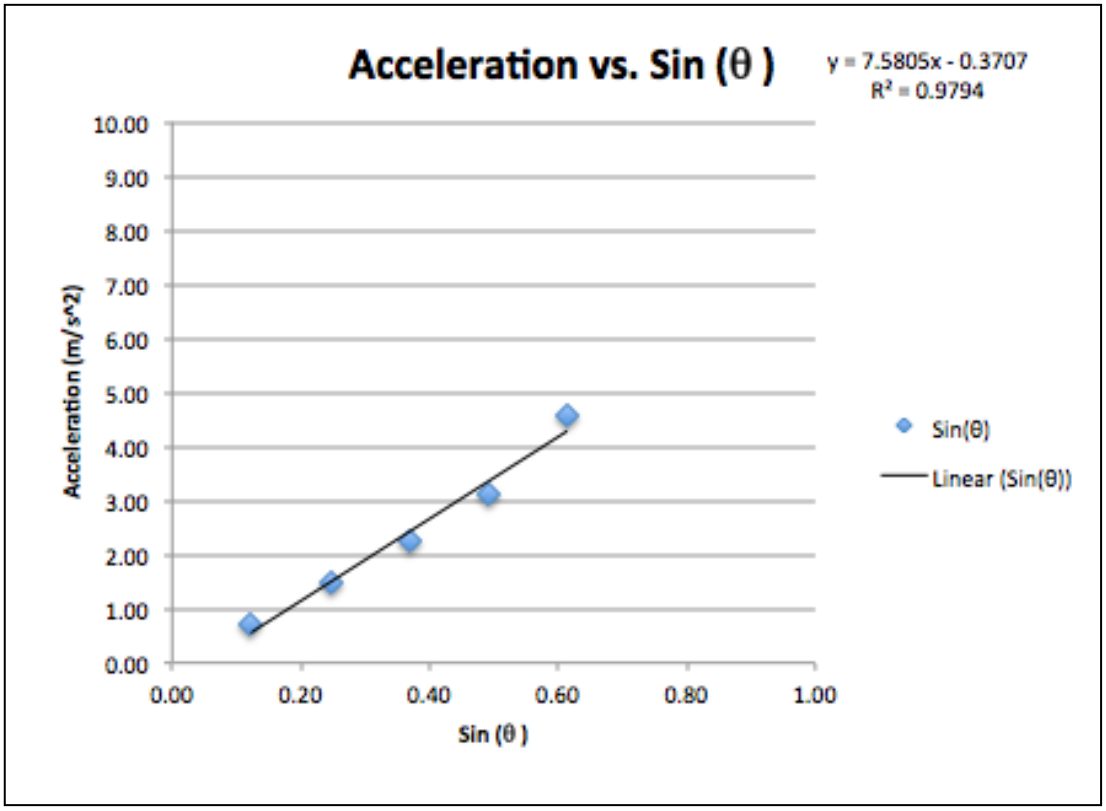
The protractor was difficult to read, so the scale reading uncertainty was ± 2°.

GRAPH:



INTERNET DATA:

I got a graph of somebody else's results



(1)

ANALYSIS:

I worked out the gradient of my graph

$$gradient = \frac{y_2 - y_1}{x_2 - x_1}$$

$$gradient = \frac{2 \cdot 6 - 0 \cdot 8}{0 \cdot 4 - 0 \cdot 2}$$

$$gradient = \frac{1 \cdot 8}{0 \cdot 2}$$

$$gradient = 9 \text{ ms}^{-2}$$

The gradient of the other graph was 7.5805, which is close to mine and the graphs are a similar shape.

The gradients of the graphs should give you a value for g the acceleration of gravity.

g is 9.8 ms^{-2}.

CONCLUSION:

Because the graphs are straight lines, the acceleration of the trolley is directly proportional to the sine of the angle of the slope.

EVALUATION:

I think my experiment went well, but the line of the graph didn't pass through the origin as it should. This might be because I had to push the trolley at the top of the slope to get it going. I could have used steeper slopes and then the trolley would run down by itself.

There was a big reading uncertainty in the protractor because it was difficult to use. It would have been better to measure the height of the slope and its length along the bench and used

$\tan\theta = \frac{height}{length}$ to find θ. This would have made the scale reading uncertainty smaller.

The internet graph was reliable because it came from 'wikispace' and also because the results agreed with mine.

REFERENCE

1. https://honorsphysicsrocks.wikispace.com/Group2_4_ch4