Student 1: Low Excellence

Aim: *To find a relationship between the distance travelled by a marble down a ramp and the time taken.*

Note: This snippet contains the discussion only. The method, results, graphs and conclusion meet the requirements for Merit. The gradient of the student's graph is 0.53 ms^{-2} and there is an intercept at 0.1 m. The ramp angle is set at 9.5°.

Discussion

When I was measuring the distance travelled by the marble down the ramp, I lined up the scale of the ruler to the edge of the ramp. This made it easier to measure accurately. I reduced parallax error by reading the scale when my eyes were level with the scale. I made sure the zero mark on the ruler lined up with the "0.000" mark in the channelled wood to prevent zero error. (1) This improved the accuracy of my data.

It was difficult to accurately time how long it took for the marble to reach the bottom of the ramp because it was hard to start and stop the stopwatch at exactly the same time as the marble was released or reached the bottom. Since there are reaction time errors in the timings I repeated each trial twice (total of 3 trials) and used the average of these three times for the data analysis. By repeating and averaging I was able to improve the accuracy of my data. (2)

There was a lower limit to the range of distances that I could use in my experiment. Smaller distances were too hard to measure because the time taken was short. In addition there were reaction errors in the timing. These errors mean that data for short distances could be more inaccurate as the error makes up a large proportion of the time measured. (3) I started collecting data from a distance of 0.400 m to ensure that I could collect more reliable data.

The equation I have worked out from my linear graph showed that $d = 0.53t^2 + 0.1$. While the given equation states that $d = \frac{1}{2}at^2$ when v_i is zero. My intercept of 0.1 may have resulted from inaccuracy in my measurements.

My experimental acceleration worked out to be 1.06 ms^2. The angle of my slope was 9.5° so the experimental value for the acceleration was $a = g \times \sin 9.5 = 1.65\ ms^2$. My acceleration value may have been smaller due to friction acting on the marble. As friction opposes the motion of the marble it decreases the net accelerating force on the marble, therefore decreases the acceleration as F = ma. (4)

Friction acting on the marble would cause some energy to be lost as the marble travels down the channelled wood. As the marble's gravitational potential energy is changed into kinetic energy as it rolls down. Friction acting on the marble causes some energy to be lost as heat energy, therefore kinetic energy is less. As $E_K = \frac{1}{2}\ mv^2$, a lower E_K means that v is also lower. This means that acceleration is also lower as $a = \Delta v/\Delta t$. (5)