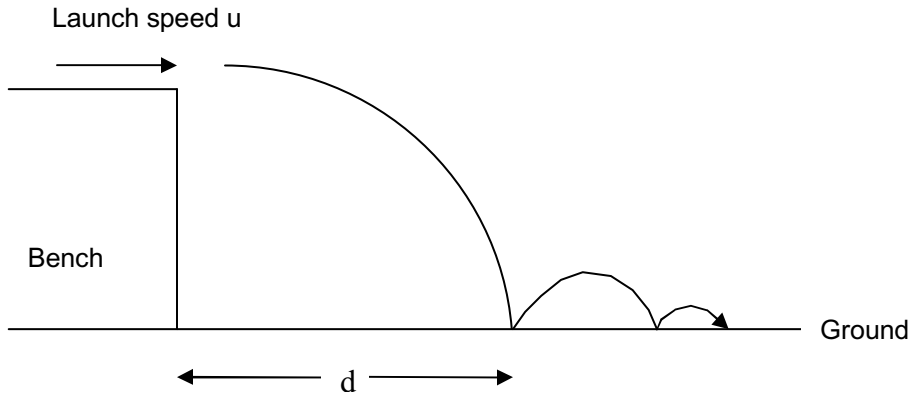
Experiment

Aim: To see if the horizontal motion of a wooden block affects the time it takes the block to fall from the bench to the ground.

Hypothesis: Time taken for the block to reach the ground is not affected by the horizontal motion.

Method: A wooden block of length 10cm is launched with different speeds from a bench. The time during which the block blocked the light source is measured with a data logger. The distance between the point where the block first reaches the ground and the bench is measured using a ruler.

Diagram:



Measurements of the time during which the wooden block blocked the light source of the light gate and the corresponding distance between the landing point and the bench, d, are recorded in a table:

time/ms	distance/m
88.04	0.37
78.02	0.54
52.03	0.78
48.93	0.83
48.57	0.95
37.63	1.12
30.40	1.20
27.36	1.46
25.19	1.30
23.34	1.67
21.39	2.44
20.10	1.06
19.75	2.15
16.28	2.43

The launch speed is obtained by dividing the length of the wooden block by the time elapsed when the wooden block blocked the light source:

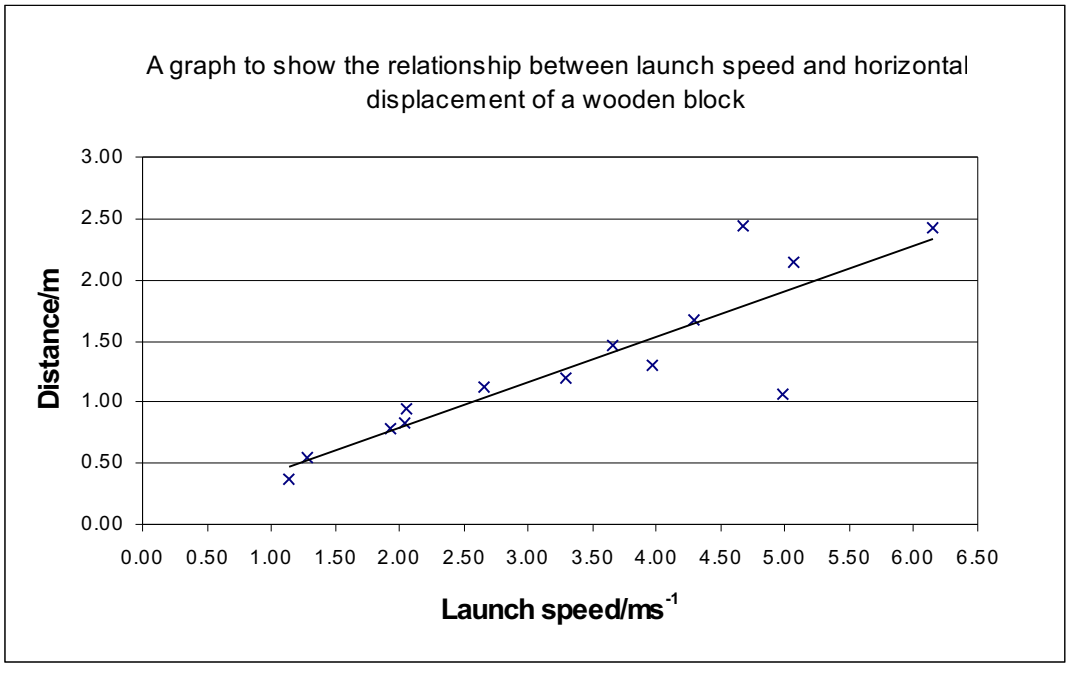
Launch Speed= length of wooden block/ time elapsed

For example, when time=27.36ms, launch speed= (10÷100)m/(27.36÷1000)s= 3.65ms^{-1}
The launch speeds calculated are recorded in the same table.

Results:

time/ms	distance/m	launch speed/ms^{-1}
88.04	0.37	1.14
78.02	0.54	1.28
52.03	0.78	1.92
48.93	0.83	2.04
48.57	0.95	2.06
37.63	1.12	2.66
30.40	1.20	3.29
27.36	1.46	3.65
25.19	1.30	3.97
23.34	1.67	4.28
21.39	2.44	4.68
20.10	1.06	4.98
19.75	2.15	5.06
16.28	2.43	6.14

A graph of distance against launch speed is plotted. Gradient of this graph is the time taken for the block to fall from the bench to the ground.



Analysis:
Gradient of the graph is roughly constant.

Conclusion:
Time taken for the block to fall from the bench to the ground is constant. This shows that the horizontal motion does not affect the falling time. This is because no matter what horizontal launching speed, the initial vertical speed is zero. Only considering the vertical motion, initial velocity (zero), acceleration (gravity), and displacement (height of bench) are constant. Hence, using:

$$s=ut+1/2at^2$$

With u, a, s constant, t is constant.

Human errors:

1. The launcher's hand had not left the wooden block when the block passed through the light source, hence it was still accelerating when the reading was taken, making the launching speeds calculated inaccurate.
2. As the block bounced and glided on the ground before stopping, the point on which the wooden block landed was not identified correctly, so there were anomalous results for the distances between the landing points and the bench.

Limitations:
There was friction between the bench and the wooden block, so the launching speed calculated was different from the block's actual launching speed as it left the bench.