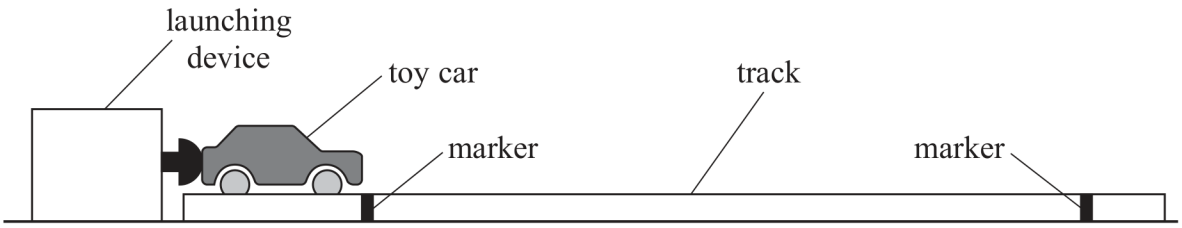
4 A student investigated the motion of a toy car along a horizontal track using the apparatus shown.



The launching device applies a force on the car. The force causes the car to accelerate. The mean value of the applied force during each launch is F.

(a) The student used a stopwatch to measure the time the toy car took to travel between the two markers.

She recorded the following measurements.

Time / s	3.57	3.61	3.54	3.51

(i) Determine the mean value of time in s.

(2)

Mean value of time = ... s

(ii) Determine the percentage uncertainty in the mean value of time.

(2)

Percentage uncertainty = ...

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(b) The student adjusted the launching device to vary the mean force F applied to the car.

For larger values of F there was a greater percentage uncertainty in the measurement of time.

Describe how different apparatus could be used to measure the time, so that the percentage uncertainty is reduced.

(2)

(c) For each launch, the launching device applied the force to the car for a constant time t. For each value of F the student determined the mean velocity v of the toy car.

The relationship between F and v is given by

$$Ft = Mv$$

where M is the mass of the toy car.

(i) Explain why a graph of F against v can be used to determine a value for t.

(2)

(ii) The student recorded the following results.

F/N	v/m s^{-1}
0.5	0.28
1.5	0.84
2.5	1.40
3.5	1.97
4.5	2.52

Plot a graph of F on the y axis against v on the x axis on the grid opposite.

(5)

(iii) Determine a value for t using the gradient of your graph.

$M = 0.125$ kg

(3)

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$t =$ .....

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