4 Figure 4 shows two students investigating their reaction times.

Student B supports his left hand on a desk.

Student A holds a ruler so that the bottom end of the ruler is between the finger and thumb of student B.

When student A releases the ruler, student B catches the ruler as quickly as he can.

The investigation is repeated with the right hand of student B.

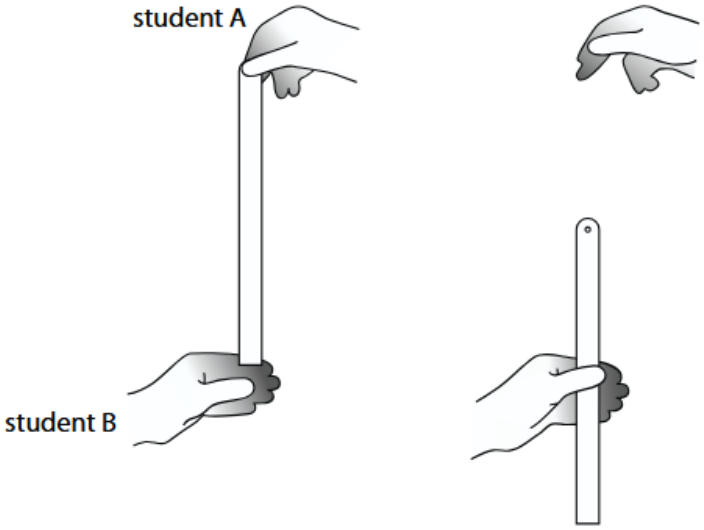

Figure 4

(a) The students took five results for the left hand and five results for the right hand.

Figure 5 shows their results.

which hand	distance dropped (cm)					
	trial 1	trial 2	trial 3	trial 4	trial 5	average
left	10.1	25.5	18.4	14.6	11.7	14
right	17.5	16.1	19.4	18.6	20.2	.....

Figure 5

(i) Calculate the average distance dropped for the right hand.

Give your answer correct to 2 significant figures.

(2)

distance = ... cm

(ii) Calculate the average time for the left hand.

Use the equation

$$\text{time}^2 = \frac{\text{distance}}{500}$$

(2)

average time = ... s

(b) Explain whether any of the readings are anomalous.

(2)

(c) Give **two** ways that the students can improve the quality of their data other than ignoring anomalous results.

(2)

1

2

(d) Describe how the students could develop their investigation to investigate how reaction time changes with another variable.

(2)

(Total for Question 4 = 10 marks)

Question number	Answer	Additional guidance	Mark
4(a)(i)	Calculating the mean (1) 18.36 Rounding to 2 s.f. (1) 18 (cm)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Additional guidance	Mark
4(a)(ii)	Rearrangement (1) $t = \sqrt{\frac{\text{distance}}{500}}$ Substitution and answer (1) time = 0.17 (s)	award full marks for correct numerical answer without working allow answers which round to 0.17, e.g. 0.1673	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • 25.5 is an anomalous result (1) • (because) it is much further away from the mean than the other results (1)	ignore 19	**(2)**

Question number	Answer	Mark
4(c)	• Take more readings (1) • Idea that a third student should also measure the reaction time (1)	**(2)**

Question number	Answer	Additional guidance	Mark
4(d)	An answer that combines the following points to provide a logical description of the plan/method/experiment: • using a larger group of students/large population of students (1) • and measure how their reaction time varies with age/height (1)	allow any suitable variable	**(2)**