

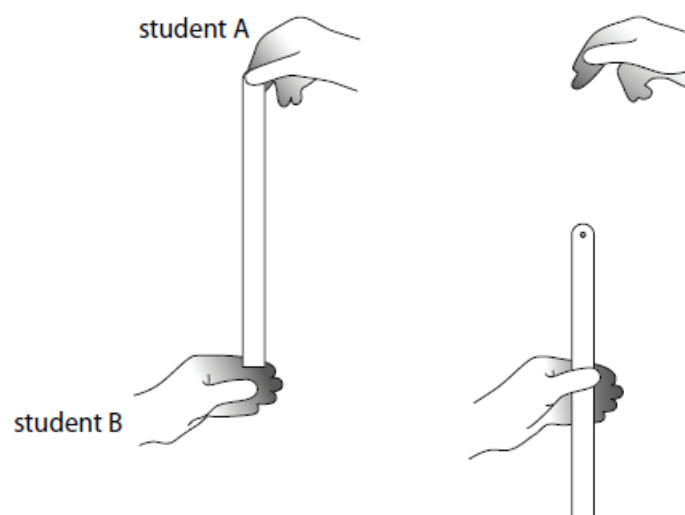
8 Figure 10 shows two students investigating reaction times.

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 with his left hand.

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



**Figure 10**

(a) Give a reason why it is better to have the 0 cm mark at the bottom of the ruler rather than at the top.

(1)

(b) Give a reason why two students are needed for this investigation.

(1)

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

Figure 11 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 11

(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

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

(2)

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

(2)

1 

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2 

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

(2)

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**(Total for Question 8 = 12 marks)**

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Question number	Answer	Mark
8(a)	Idea of a direct reading (without calculation)	(1)

Question number	Answer	
8(b)	If student B drops the ruler, they are not really measuring their own reaction time as they know when ruler has been dropped	(1)

Question number	Answer	Additional guidance	Mark
8(c)(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
8(c)(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
8(d)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): <ul style="list-style-type: none"><li>25.5 is an anomalous result (1)</li><li>(because) it is much further away from the mean than the other results (1)</li></ul>	ignore 19	(2)

Question number	Answer	Mark
8(e)	<ul style="list-style-type: none"> <li>• Take more readings (1)</li> <li>• Idea that a third student should also measure the reaction time (1)</li> </ul>	(2)

Question number	Answer	Additional guidance	Mark
8(f)	<p>An answer that combines the following points to provide a logical description of the plan/method/experiment:</p> <ul style="list-style-type: none"> <li>• using a larger group of students/large population of students (1)</li> <li>• and measure how their reaction time varies with age/height (1)</li> </ul>	allow any suitable variable	(2)

