Do not write outside the box

0 2 Body analysis scales use the electrical resistance of a person's legs to estimate the percentage of water in the person's body.

Figure 3 shows body analysis scales.

Figure 3

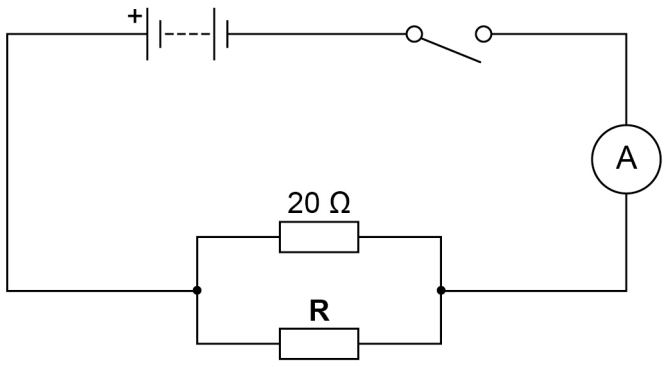
The person's legs contain both solid tissue and water.

A student used resistors to model the solid tissue and water.

The student connected a 20 Ω resistor in parallel with a resistor, **R**.

Figure 4 shows the circuit diagram.

Figure 4



0 2 . 1 To determine the total resistance of both resistors, a voltmeter must be connected into the circuit.

Complete **Figure 4** to show where the voltmeter should be connected.

[1 mark]

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0 2 . 2 The student calculated the total resistance of the two resistors.

The student's answer was 26 Ω.

Explain why the student's answer **cannot** be correct.

[2 marks]

Use the Physics Equations Sheet to answer questions **02.3** and **02.4**.

0 2 . 3 Write down the equation that links current (I), resistance (R) and potential difference (V).

[1 mark]

0 2 . 4 When the total resistance of the resistors was 7.5 Ω the current in the circuit was 480 mA.

Calculate the potential difference across the two resistors.

[3 marks]

Potential difference = _____ V

The student investigated how the resistance of **R** affected the total resistance of the circuit.

Table 1 shows the results.

Table 1

Resistance of R in ohms	Total resistance of the circuit in ohms
5.0	4.0
10.0	6.7
15.0	8.6
20.0	10.0
25.0	11.1

Some of the results are plotted in **Figure 5**.

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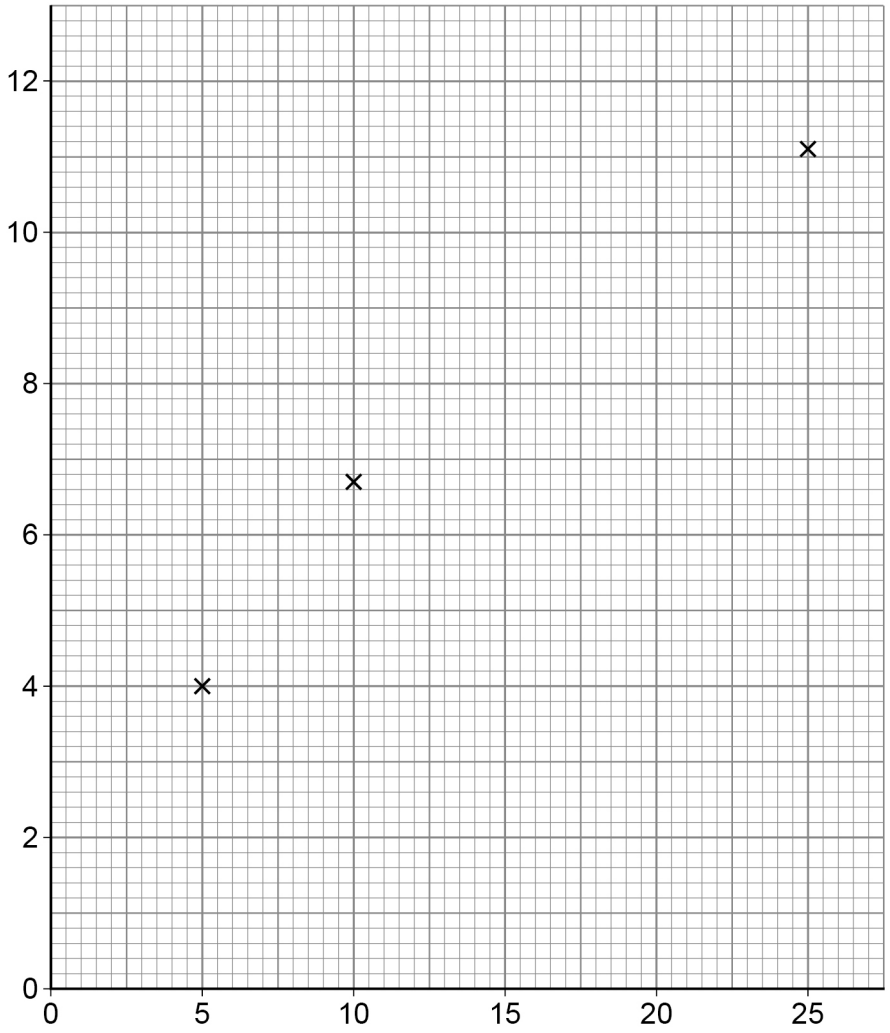
Figure 5



0 2 . 5 Complete **Figure 5**.

You should:

- label both axes
- plot the two remaining values from **Table 1**
- draw the line of best fit.

[3 marks]

0 2 . 6 What resistance of **R** would give a total resistance of 4.4 Ω?

Use **Figure 5**.

[1 mark]

Resistance of **R** = _____ Ω

Turn over ►

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The body analysis scales initially show a reading of 0.0 kg.

When the student steps onto the scales the reading is 64.8 kg.

The student steps off the scales and then immediately steps back on.

The scales now show a reading of 64.1 kg.

0 2 . 7 Complete the sentence.

[1 mark]

The difference between the two values given by the scales is due

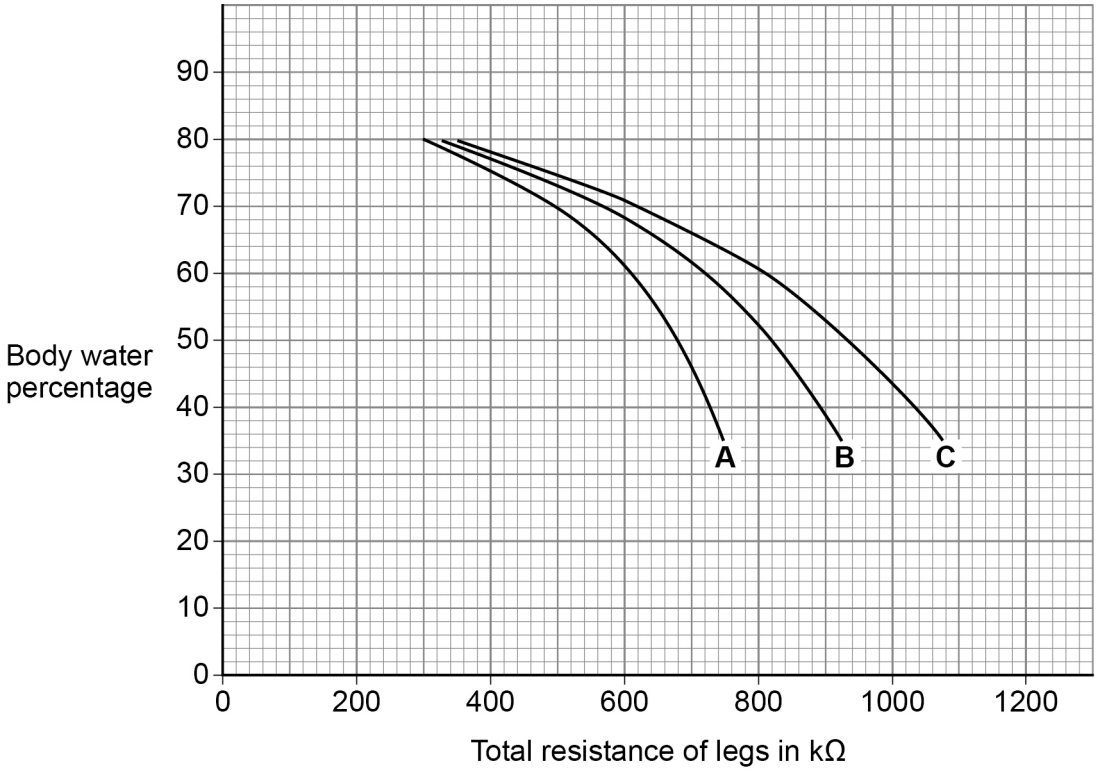
to a _____ error.

0 2 . 8 The height of the student is programmed into the scales.

The scales place the student into a category, **A**, **B** or **C**, based on height and mass.

Figure 6 shows how the scales use the category and the total resistance of the legs to determine the body water percentage.

Figure 6



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The total resistance of the student's legs is 600 kΩ. A healthy body water percentage is between 45% and 65%.

The different measurements of the mass of the student mean that the student could be in either category **A** or category **B**.

Evaluate if the student has a healthy body water percentage.

[3 marks]

15

Turn over for the next question

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	voltmeter symbol correct and connected across the resistors		1	AO1 6.2.1.3 6.2.1.1 6.2.1.4 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	the total resistance must be less than 20 Ω	allow the total resistance cannot be more than 20 Ω	1	AO2
	because the total resistance of the resistors (in parallel) is less than the resistance of the smallest resistor	allow the total resistance of the resistors (in parallel) is less than either resistor	1	AO1 6.2.2 6.2.1.3 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	potential difference = current × resistance **or** $V = IR$		1	AO1 6.2.1.3 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	480 mA = 0.48 A		1	AO2 6.2.1.3
	$V = 0.48 \times 7.5$	allow a correct substitution of an incorrectly / not converted value for current	1	RPA15
	$V = 3.6$ (V)	allow an answer consistent with their incorrectly / not converted value for current	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	x-axis labelled resistance of R in Ω **and** y-axis labelled total resistance (of resistors) in Ω		1	AO2 6.2.1.3 RPA15
	both points plotted correctly	points must be plotted within ½ small square	1	
	curved line of best fit drawn	allow a curved line of best fit which ignores an outlier	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	reading from graph consistent with their line of best fit	allow an answer within ½ small square	1	AO3 6.2.1.3 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	random		1	AO3 6.2.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	in category A the body water percentage is 61% in category B the body water percentage is 68% if in category A they have a healthy body water percentage **and** if in category B they have an unhealthy body water percentage	allow a value for A between 60% and 62%	1 1 1	AO3 6.2.1.3

Total Question 2	**15**