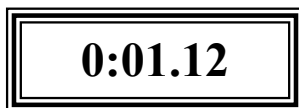


1. A student wants to measure her friend's reaction time.

(a) She gives her friend a stopwatch.

(i) He starts and stops the stopwatch. The display shows the following reading.



Record this reading.

..... seconds
(1)

(ii) She tells him to switch the stopwatch on and off as quickly as possible to measure his reaction time. He does this six times and records the following readings:

0:00.22 0:00.19 0:00.17 0:00.16 0:00.16 0:00.15

1. Describe the trend that these readings show.

.....
.....
(1)

2. State why this is an unsuitable method for measuring reaction time.

.....
.....
.....
(1)



(b) The student tries another method for measuring reaction time. The rule is released by the student and is then caught by her friend. Figure 1 shows the rule before it is released. Her friend's hand is opposite the 30 cm mark on the rule.

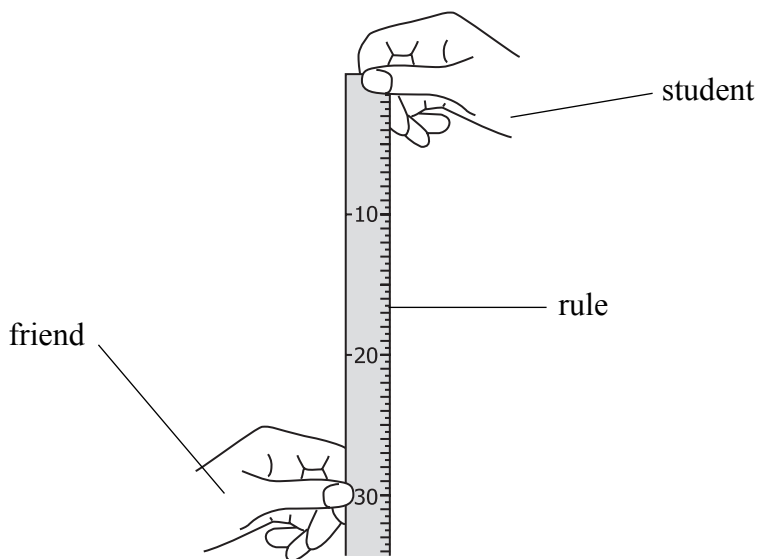


Figure 1

Figure 2 shows the position of her friend's thumb when he has caught the rule.

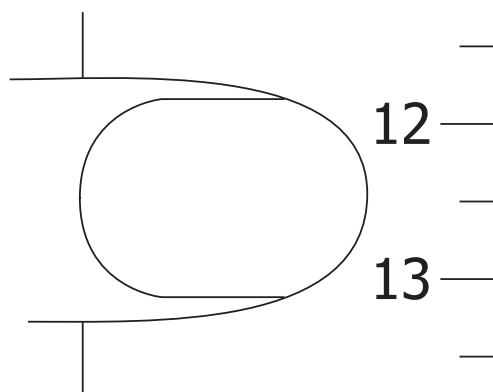


Figure 2

Calculate the distance in cm through which the rule has fallen.

Distance = cm
(3)



- (c) The student needs to find the time taken for the rule to fall this distance. She uses a tickertape timer and the rule as shown in Figure 3. The rule is released and the timer makes a dot on the tickertape every 0.020 seconds.

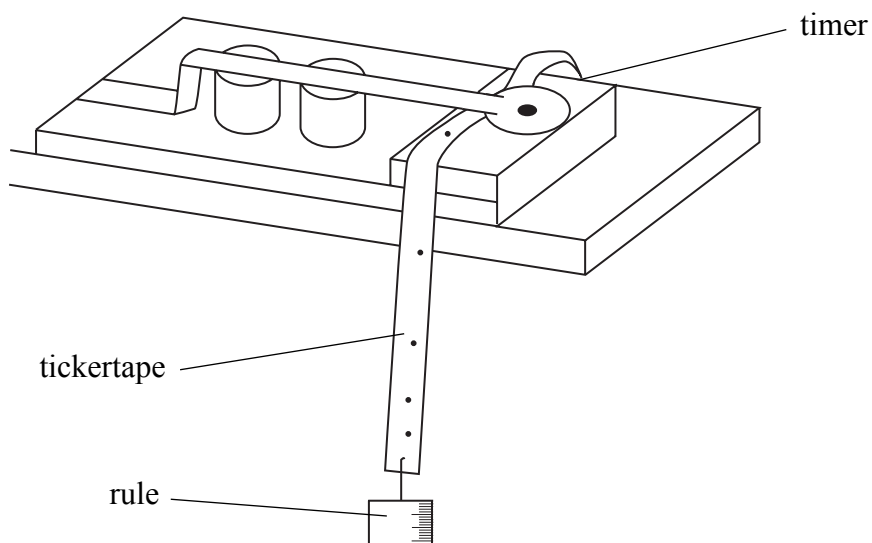


Figure 3

Part of the tape is shown in Figure 4.

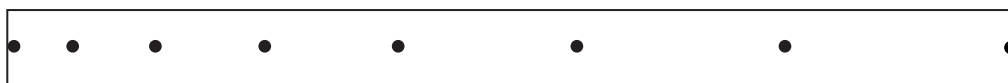


Figure 4

- (i) Record the number of spaces between the dots.

..... **(1)**

- (ii) Calculate the time in seconds represented by this part of the tape.

.....

Time = s **(2)**

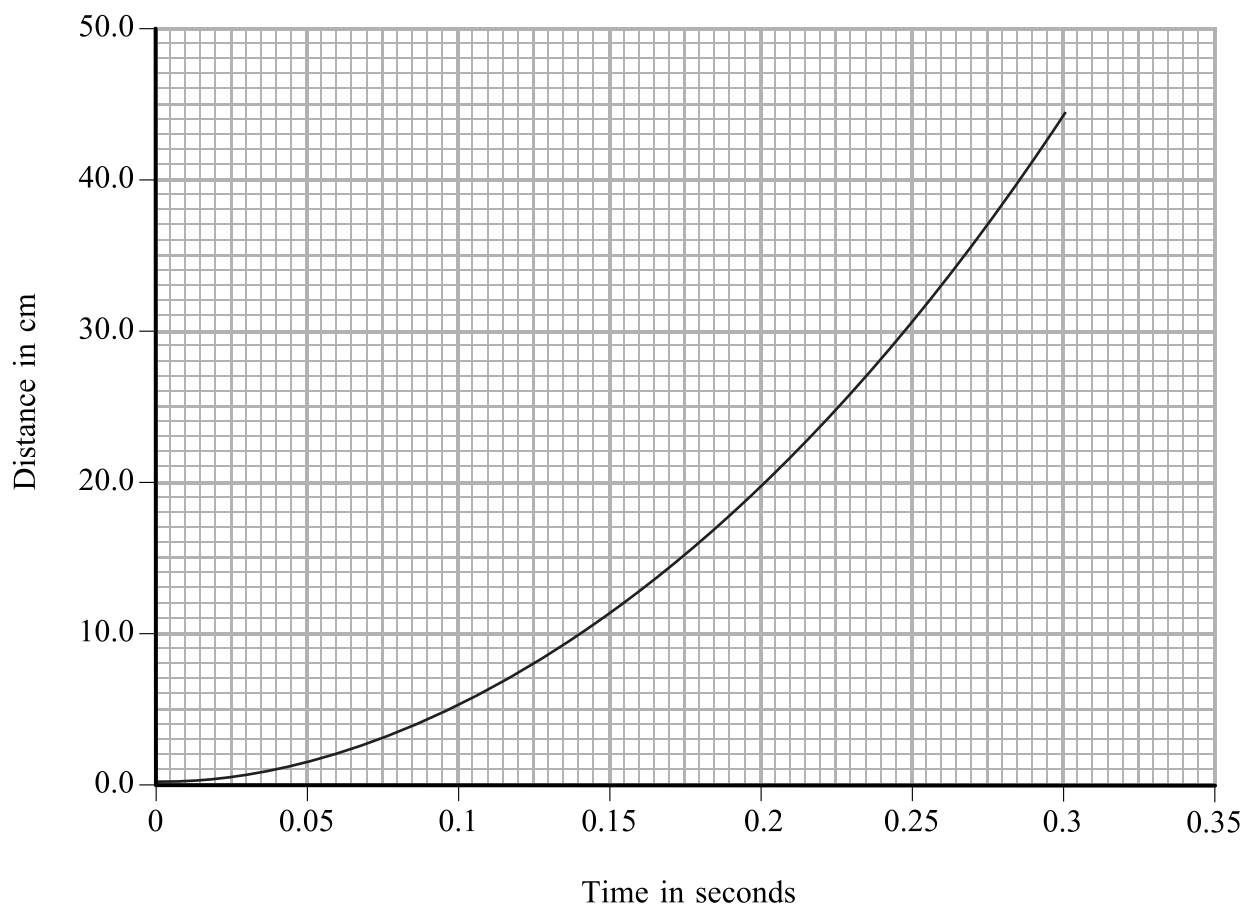
- (iii) How can you tell from the tape that the rule is accelerating?

.....

..... **(1)**



(iv) Using the whole tape, the student measures the distance from the first dot to each of the other dots. She then plots the graph of distance against time as shown below.



1. Write down your calculated distance from (b).

Distance = cm

2. Use the graph and this distance to find the reaction time, in seconds, of the student's friend.

Time = s
(1)

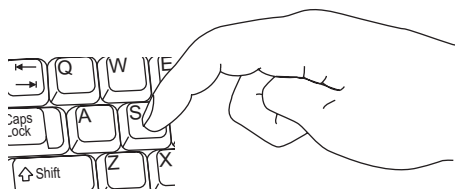
(Total 11 marks)

Q1

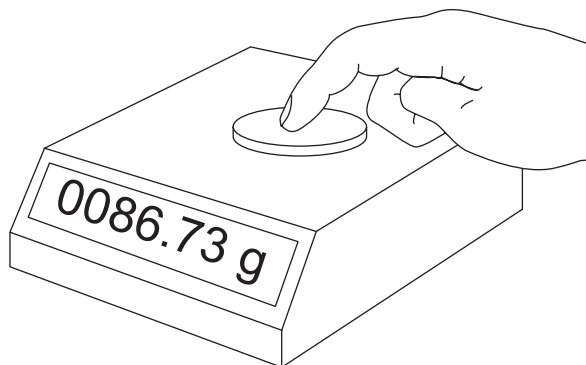
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2. (a) After typing on his computer keyboard for several hours, a student experiences a pain in one of his fingers. He decides to calculate the pressure exerted by his finger when typing. He uses a balance to find the force exerted by his finger. He presses a key on the keyboard and then presses the top of a balance with the same force.



finger pressing key



finger pressing balance

- (i) Record the reading on the balance to the nearest gram.

Reading = g
(1)

- (ii) State two reasons why the reading will not be the same as the force of the finger on the key.

1

.....

2

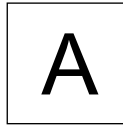
.....

(2)



- (b) From the Internet, the student finds that a force of 0.73 N is needed to press a key on his keyboard.

The diagram below shows one of the square keys. It is drawn full-scale.



- (i) Measure the key and calculate its area in cm².

Area of key = cm²
(2)

- (ii) Calculate the pressure in N/cm² exerted by the student's finger on this key. Give your answer to an appropriate number of significant figures.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

.....
.....

Pressure = N/cm²
(3)

- (iii) Explain why your number of significant figures is appropriate.

.....
.....

(1)

(Total 9 marks)

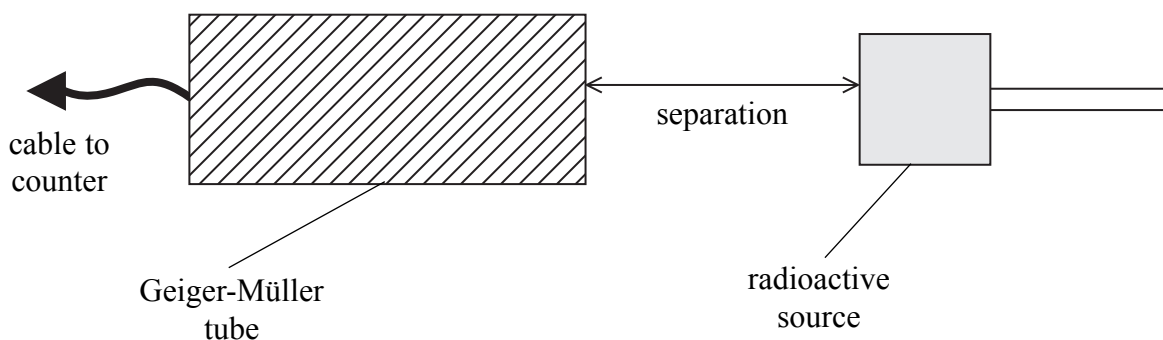
Q2



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3. A teacher demonstrates how the count rate detected by a Geiger-Müller tube and counter depends on the separation of the front of the tube and the radioactive source. The source emits alpha particles only.



- (a) Measure the separation of the detector and the source.

Separation = cm
(1)

- (b) (i) Before the source is put in place, the teacher takes three readings of background count rate in counts per minute.

28, 25, 28

Calculate the average background count rate in counts per minute.

.....

Average background count rate = counts per minute
(1)

- (ii) A student takes three further readings of the background count rate.

29, 52, 28

State what is wrong with the student's data and suggest what might have caused this.

.....

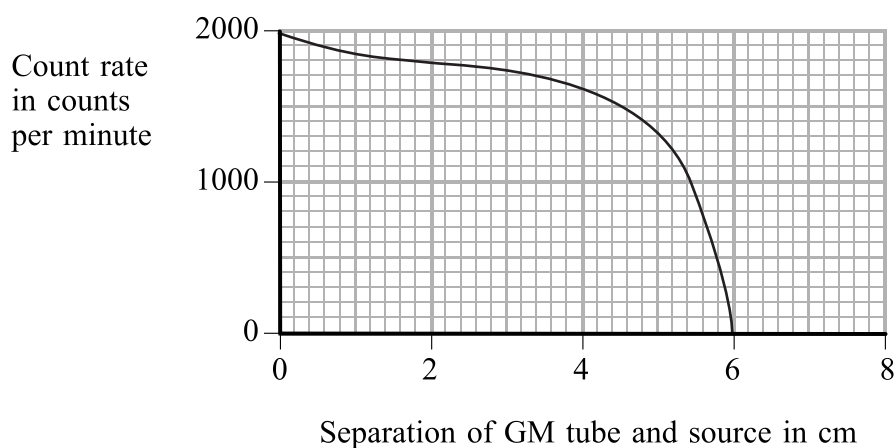
.....

.....

(2)



(c) The graph shows the results of the experiment.



(i) State the range in cm of these alpha particles.

Range = cm
(1)

(ii) Describe how you would use the apparatus to get these results.

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(5)



(d) (i) Which **one** of the following is a sensible safety precaution in this experiment?
Put a cross (☒) in the correct box.

- performing the experiment in a darkroom
- placing the students behind a lead screen
- switching off all fans
- using tweezers to handle the radioactive source

(1)

(ii) Explain why each of the other three is not a sensible safety precaution in this experiment.

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.....

(2)

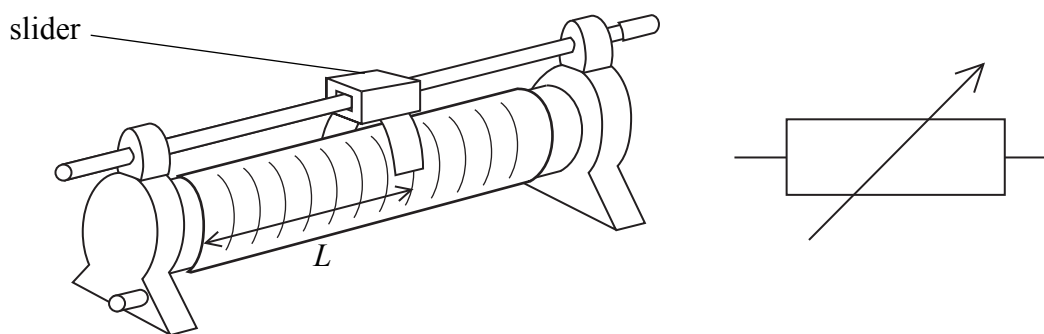
(Total 13 marks)

Q3

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4. The diagram shows a rheostat (variable resistor) together with its circuit symbol.



The slider can be moved. When the distance L is changed, the resistance of the rheostat is changed. The maximum value of L is 19 cm.
A student investigates how the current I in the rheostat depends on the length L .

(a) In the space below draw a circuit diagram for this investigation.

(2)

(b) (i) State one extra item of equipment, not shown on your diagram, that the student would need.

..... (1)

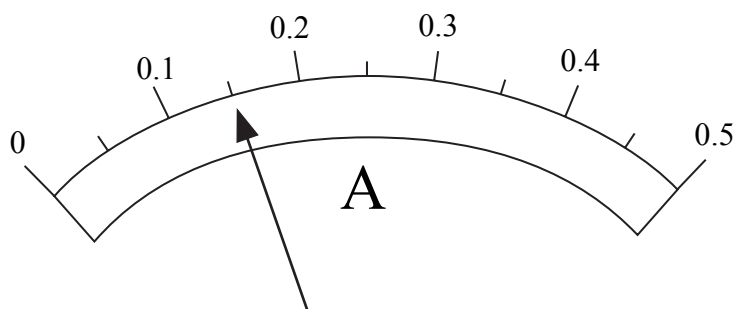
(ii) Describe how this investigation would be carried out.

.....

 (3)



(c) During the investigation, the ammeter reading was as shown below.



Record this reading.

Current = A
(1)

(d) During the investigation the student recorded the following results.

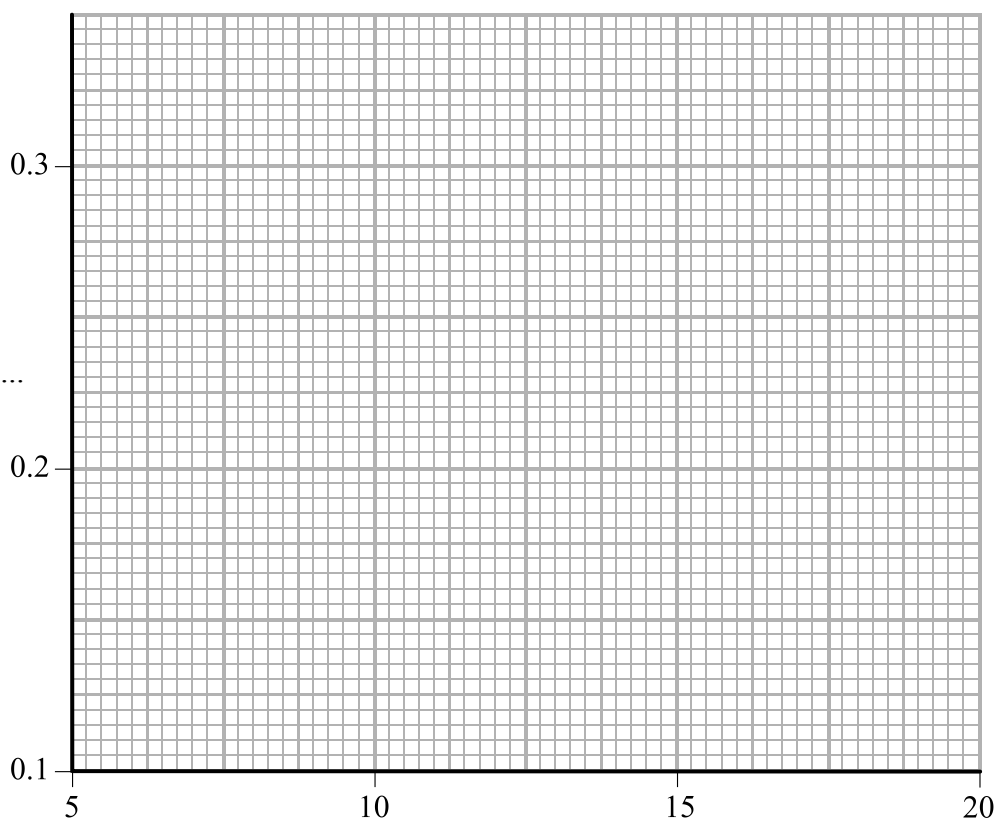
<i>19, 0.11</i>	<i>10, 0.17</i>	<i>7, 0.24</i>
<i>5, 0.33</i>	<i>6, 0.14</i>	<i>16, 0.12</i>

(i) Put these results in a table with column headings and units.

(3)



(ii) Using the grid plot a graph of current against length. Label the axes.



(3)

(iii) Circle the anomalous (unexpected) result.

(1)

(iv) Draw the best-fit curve for the remaining points.

(1)

(v) Suggest a reason for the anomalous result.

.....
.....
.....

(1)



Leave
blank

(e) Suggest why the student did not use a value of 2 cm for L during the investigation.

.....
.....
.....

(1)

Q4

(Total 17 marks)

TOTAL FOR PAPER: 50 MARKS

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