

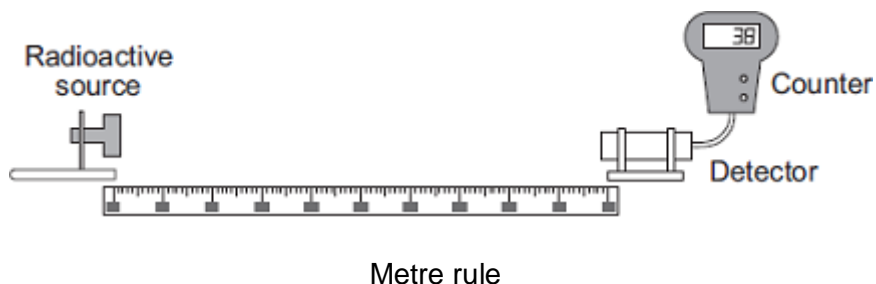
Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Q1.

A teacher used the equipment shown in the diagram to measure the count rate at different distances from a radioactive source.



Metre rule

(a) Her results are shown in **Table 1**.**Table 1**

Distance in metres	Count rate in counts per minute	Corrected count rate in counts per minute
0.4	143	125
0.6	74	56
0.8	49	31
1.0	38	20
1.2	32	14
1.4	28	10
1.6	18	0
1.8	18	0
2.0	18	0

The background count rate has been used to calculate the corrected count rate.

(i) What is the value of the background count rate?

Background count rate = _____ counts per minute

(1)

(ii) What information does the corrected count rate give?

(1)

(iii) The radioactive source used in the demonstration emits only one type of radiation.

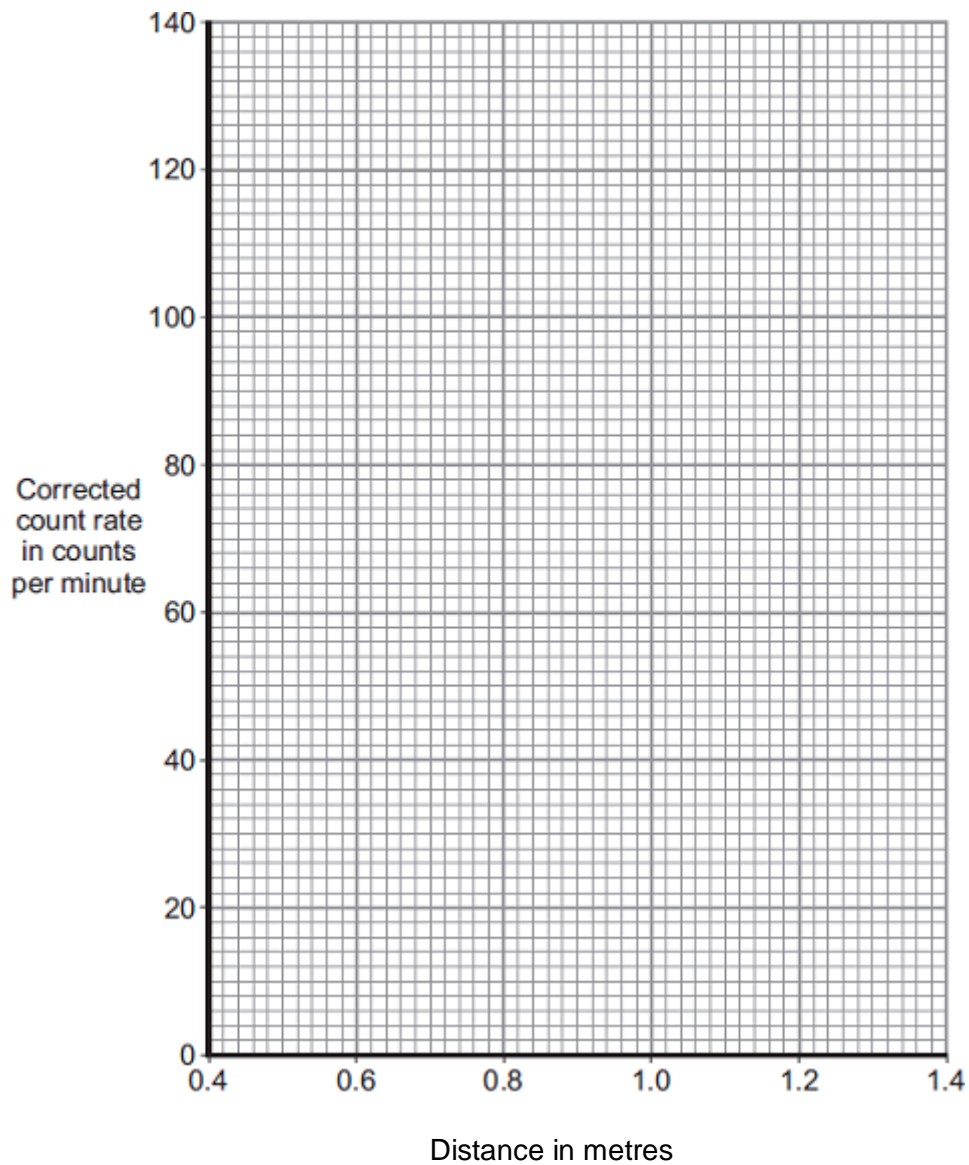
The radioactive source is **not** an alpha emitter.

How can you tell from the data in the table?

(1)

(iv) Plot a graph of corrected count rate against distance for distances between 0.4 m and 1.4 m.

Draw a line of best fit to complete the graph.



(3)

- (v) The 'half-distance' is the distance a detector has to be moved away from a radioactive source for the corrected count rate to halve.

A student has the hypothesis:

A radioactive source has a constant 'half-distance'.

Table 1 has been repeated for your information.

Table 1

Distance in metres	Count rate in counts per minute	Corrected count rate in counts per minute
0.4	143	125
0.6	74	56
0.8	49	31
1.0	38	20
1.2	32	14
1.4	28	10
1.6	18	0
1.8	18	0
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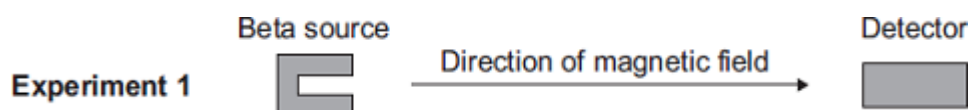
Use **Table 1** to determine if the hypothesis is correct for this radioactive source.

You should use calculations in your answer.

(3)

- (b) A teacher places a beta source and a detector in a magnetic field.

The arrangement of the magnetic field is shown.



The teacher repeated the experiment with the magnetic field in a different direction.



A set of results is shown in **Table 2**.

Table 2

Distance between source and detector in metres	Count rate in counts per minute without magnetic field	Count rate in counts per minute in Experiment 1	Count rate in counts per minute in Experiment 2
0.8	48	48	32

- (i) Describe **and** explain the effect of the magnetic field on the count rate detected by the detector.

(2)

- (ii) The experiment is repeated with a different distance between the source and the detector.

Table 3 shows the repeated results.

Table 3

Distance between source and detector in metres	Count rate in counts per minute without magnetic field	Count rate in counts per minute in Experiment 1	Count rate in counts per minute in Experiment 2
1.8	19	18	20

Explain these results.

(2)
(Total 13 marks)

Q2.

In 2011 an earthquake caused severe damage to a nuclear power station in Japan.

The damage led to the release of large amounts of radioactive iodine-131 ($^{131}_{53}\text{I}$) into the atmosphere.

(a) The table gives some information about an atom of iodine-131 ($^{131}_{53}\text{I}$).

Complete the table.

mass number	131
number of protons	53
number of neutrons	

(1)

(b) Complete the sentence.

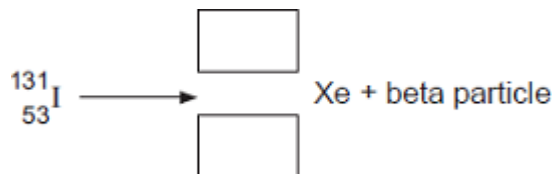
The number of protons in an atom is called the proton number or the _____ number.

(1)

(c) An atom of iodine-131 decays into an atom of xenon (Xe) by emitting a beta particle.

(i) The decay of iodine-131 can be represented by the equation below.

Complete the equation by writing the correct number in each of the **two** boxes.



(2)

(ii) A sample of rainwater contaminated with iodine-131 gives a count rate of 1200 counts per second.

Calculate how many days it will take for the count rate from the sample of rainwater to fall to 75 counts per second.

Half-life of iodine-131 = 8 days

Show clearly how you work out your answer.

_____ days

(2)

- (iii) If people drink water contaminated with iodine-131, the iodine-131 builds up in the thyroid gland. This continues until the thyroid is saturated with iodine-131 and cannot absorb any more. The radiation emitted from the iodine-131 could cause cancer of the thyroid.

In Japan, people likely to be drinking water contaminated with iodine-131 were advised to take tablets containing a non-radioactive isotope of iodine.

Suggest why this advice was given.

(2)

(Total 8 marks)