

GCSE Combined Science: Trilogy

Worksheet: Radioactive decay and nuclear radiation

TIME 30 min	TOTAL 30 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Radioactive decay and nuclear radiation

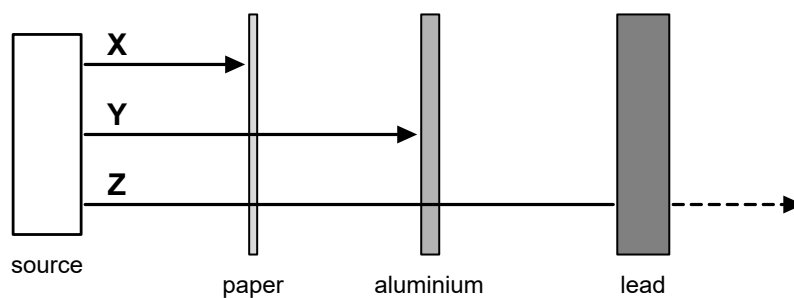
NAME _____ **CLASS** _____ **DATE** _____

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

Figure 1 shows how far three types of nuclear radiation, X, Y and Z, travel through different materials.

Figure 1



0 1 . 1

Which type of radiation is X?

.....

.....

.....

[1 mark]

0 1 . 2

Which type of radiation is Y?

.....

.....

.....

.....

[1 mark]

0 1 . 3

Which type of radiation is Z?

.....

.....

.....

.....

[1 mark]

0 1 . 4

Which type of nuclear radiation is the most strongly ionising?

.....

.....

.....

.....

[1 mark]

0 1 . 5

What is the range of alpha particles in air?

Tick (✓) **one** box.

A few millimetres

A few centimetres

A few metres

Several kilometres

☐

☐

☐

☐

[1 mark]

0 2

0 2 . 1

What is an alpha particle made of?

Tick (✓) **one** box.

Two protons and two neutrons

A high-speed electron

Electromagnetic radiation

A single neutron

☐☐☐☐

[1 mark]

0 2 . 2

What is a gamma ray?

Tick (✓) **one** box.

A helium nucleus

A high-speed electron from the nucleus

Electromagnetic radiation from the nucleus

A neutron from the nucleus

☐☐☐☐

[1 mark]

0 2 . 3

Complete the sentence.

Radioactive decay is a process, so it is not possible to predict when a particular nucleus will decay.

.....

[1 mark]

0 2 . 4

What is the unit of activity?

.....

.....

.....

.....

[1 mark]

0 3

0 3 . 1

Which material would reduce the intensity of a beam of gamma rays the most?

Tick (✓) **one** box.

A sheet of paper

☐

A few mm of aluminium

☐

Several cm of lead

☐

[1 mark]

0 3 . 2

State the material (or substance) needed to stop alpha particles.

.....

.....

.....

.....

[1 mark]

0 4

A teacher used a Geiger–Müller tube and counter to measure the count rate from a radioactive source with different absorbers between the source and the detector. The background count rate was 20 counts per minute.

Table 1 shows the results.

Table 1

Absorber	Count rate in counts per minute
None	480
Sheet of paper	478
3 mm of aluminium	95
2 cm of lead	42

0 4 . 1

What do the results show about the types of radiation emitted by the source?
Explain your answer.

.....

.....

.....

.....

.....

.....

[3 marks]

0 4 . 2

Calculate the count rate due to the source when the 3 mm of aluminium was in place.

.....

.....

.....

Count rate = counts per minute

[1 mark]

0 4 . 3

Explain why the teacher measured the background count rate.

[2 marks]

0 4 . 4

Give **one** precaution the teacher should take to reduce the risk from the source.

[1 mark]

0 5

0 5 . 1

Gamma rays are the most weakly ionising type of nuclear radiation, but they are the most penetrating.

Explain why.

[2 marks]

0 6

0 6 . 1

What is meant by ionising radiation?

[2 marks]

0 6 . 2

Alpha particles are the most strongly ionising type of nuclear radiation.
Explain why alpha particles have the shortest range in air.

.....

.....

.....

.....

[2 marks]

0 6 . 3

Which type of nuclear radiation is the least ionising?

.....

.....

.....

.....
[1 mark]

0 6 . 4

As well as alpha particles, beta particles and gamma rays, an unstable nucleus
can emit one other type of nuclear radiation.
Name it.

.....

.....

.....

.....
[1 mark]

.....

0 7

A teacher demonstrates radioactive decay using a sealed source and a Geiger-Muller tube, taking repeat readings of the count rate.

0 7 . 1

State one hazard of using a radioactive source in the classroom, and one control measure to reduce the risk.

.....

.....

.....

.....

[2 marks]

0 7 . 2

A different school, using the same type of source and the same method, gets similar count-rate readings to the teacher's class.

Which term describes results that are similar when a **different** experimenter repeats the method: repeatable or reproducible?

.....

.....

.....

.....

[1 mark]

0 7 . 3

Which term describes results that are similar when the **same** experimenter repeats the method under the same conditions?

.....

.....

.....

.....

[1 mark]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Radioactive decay and nuclear radiation
· 30 marks

Question 1 (5 marks)

01.1 [1 mark]

Answer: Alpha

- alpha (1)
-

01.2 [1 mark]

Answer: Beta

- beta (1)
-

01.3 [1 mark]

Answer: Gamma

- gamma (1)
-

01.4 [1 mark]

Answer: Alpha

- alpha (1)
-

01.5 [1 mark]

Correct: A few centimetres

Question 2 (4 marks)

02.1 [1 mark]

Correct: Two protons and two neutrons

02.2 [1 mark]

Correct: Electromagnetic radiation from the nucleus

02.3 [1 mark]

Answer: random

- random (1)
-

02.4 [1 mark]

Answer: Becquerel (Bq)

- becquerel (Bq) (1)
-

Question 3 (2 marks)

03.1 [1 mark]

Correct: Several cm of lead

03.2 [1 mark]

Answer: Paper (or skin, or a few cm of air).

- paper / skin / a few cm of air (allow thin card) (1)
-

Question 4 (7 marks)

04.1 [3 marks]

Answer: Beta and gamma, but no alpha: paper has almost no effect, aluminium removes most of the count, and the count through aluminium and lead is still above background.

- no alpha is emitted, because the paper does not reduce the count rate (significantly) (1)
- beta is emitted, because 3 mm of aluminium greatly reduces the count rate (1)
- gamma is emitted, because the count rate through the aluminium (and the lead) is still above the background count rate (1)
- the lead reduces but does not stop the gamma radiation (1)

Any 3 of the points above.

04.2 [1 mark]

Answer: 75 counts per minute

- $95 - 20 = 75$ (counts per minute) (1)
-

04.3 [2 marks]

Answer: The detector also records background radiation, which must be subtracted to find the count rate from the source.

- background radiation is always present, so the detector records it as well as the radiation from the source (1)
 - it must be subtracted from each reading to find the count rate due to the source alone (1)
-

04.4 [1 mark]

Answer: Handle the source with long tongs.

- handle the source with (long) tongs (1)
- keep the source as far from the body as possible / at arm's length (1)
- keep the time the source is out of its (lead-lined) box as short as possible (1)
- never point the source towards anyone (1)

Any 1 of the points above.

Question 5 (2 marks)

05.1 [2 marks]

Answer: Gamma rays ionise atoms far less often than alpha or beta, so they lose energy more slowly and travel further before being absorbed.

- gamma rays interact with (ionise) atoms much less often than alpha or beta particles do, for a given distance travelled (1)
 - so they lose their energy much more slowly, and can travel much further through materials before being absorbed (1)
-

Question 6 (6 marks)

06.1 [2 marks]

Answer: Radiation that knocks electrons out of atoms, turning them into ions.

- radiation that can remove electrons from atoms (1)
 - turning the atoms into (positive) ions (1)
-

06.2 [2 marks]

Answer: They ionise a lot of air molecules along their path, so they lose their energy within a few centimetres.

- alpha particles collide with and ionise many air molecules / cause a lot of ionisation along their path (1)
 - so they lose their energy quickly and are stopped after a few centimetres (1)
-

06.3 [1 mark]

Answer: Gamma

- gamma (rays) (1)
-

06.4 [1 mark]

Answer: A neutron

- neutron(s) (1)
-

Question 7 (4 marks)

07.1 [2 marks]

Answer: Hazard: exposure to ionising radiation. Control measure: use tongs, minimise time and distance, and store it shielded when not in use.

- hazard: exposure to (ionising) radiation, which can damage cells or cause cancer (1)
- control measure: hold the source with tongs, keep it as far away as possible and handle it for as short a time as possible, and store it in a lead-lined box when not in use (1)

07.2 [1 mark]

Answer: Reproducible.

- reproducible (1)

07.3 [1 mark]

Answer: Repeatable.

- repeatable (1)
-