

GCSE Physics

Worksheet: Uses of nuclear radiation

TIME 25 min	TOTAL 26 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Uses of nuclear radiation

NAME	CLASS	DATE
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- 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.

01

01.1	Give one way that nuclear radiation is used in medicine to explore internal organs.
[1 mark]	

01.2	Give one way that nuclear radiation is used in medicine to control or destroy unwanted tissue.
[1 mark]	

0 2

0 2 . 1

Which **two** of the following are uses of nuclear radiation in medicine?

Tick (✓) **two** boxes.

Exploring internal organs using a radioactive tracer

☐

Destroying cancer cells (radiotherapy)

☐

Measuring body temperature

☐

Measuring blood pressure

☐

[2 marks]

0 2 . 2

A radioactive tracer is injected into a patient. The radiation is detected by a camera outside the body.

Which type of radiation should the tracer emit?

Tick (✓) **one** box.

Alpha

☐

Beta

☐

Gamma

☐

[1 mark]

0 2 . 3

Give **one** reason for your answer.

.....

.....

[1 mark]

0 3

0 3 . 1

Nuclear radiation is used in medicine to control or destroy unwanted tissue. Which of these is an example of this use?

Tick (✓) **one** box.

Radiotherapy to treat a cancerous tumour

☐

Using a tracer to check how well the kidneys are working

☐

Taking an X-ray photograph of a broken bone

☐

Using ultrasound to scan an unborn baby

☐

[1 mark]

0 3 . 2

A radioactive tracer is used to explore an internal organ.
Which of these is the most suitable half-life for the tracer?
Tick (✓) **one** box.

A few seconds

☐

A few hours

☐

A few years

☐

Thousands of years

☐

[1 mark]

0 4

Technetium-99m is used as a medical tracer. It is injected into a patient and collects in the organ being examined. A camera outside the body detects the radiation emitted.
Technetium-99m emits gamma rays and has a half-life of 6 hours.

0 4 . 1

Explain why an isotope that emits gamma rays is used as a tracer.

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[2 marks]

0 4 . 2

Explain why a half-life of 6 hours is suitable for a tracer.

.....

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.....

[2 marks]

0 4 . 3

Explain why an isotope that emits alpha particles would not be suitable as a tracer.

.....

.....

.....

.....

[2 marks]

0 5

A doctor wants to check whether both of a patient's kidneys are working. A gamma-emitting tracer is injected into the patient's blood. A working kidney takes the tracer out of the blood, and the tracer then leaves the body in the patient's urine. Detectors outside the body measure the count rate from each kidney for 30 minutes.

0 5 . 1

Suggest how the count rate from a kidney that is **not** working would be different from the count rate from a healthy kidney.

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[2 marks]

0 5 . 2

After the scan, the patient is asked to drink plenty of water and to wash their hands carefully after using the toilet, for the next day.
Explain why.

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.....

.....

[2 marks]

0 6

A tumour deep inside a patient's body can be treated with a narrow beam of gamma rays from outside the body. The beam is aimed at the tumour from several different directions.

0 6 . 1

Explain why gamma rays are used rather than alpha particles or beta particles.

.....

.....

.....

.....

[2 marks]

0 6 . 2

Explain why the beam is aimed at the tumour from several different directions.

.....

.....

.....

.....

[2 marks]

0 6 . 3

Give **one** risk of radiotherapy for the patient.

.....

.....

[1 mark]

0 7

Some tumours are treated by placing a small, sealed radioactive source inside the body, right next to the tumour, for a few minutes. The source is then removed.

0 7 . 1

Explain why this treatment damages less healthy tissue than aiming radiation at the tumour from outside the body.

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.....

.....

[2 marks]

0 7 . 2

Explain why the patient is not radioactive after the source has been removed.

.....

.....

[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 Physics · Worksheet: Uses of nuclear radiation · 26 marks

Question 1 (2 marks)

01.1 [1 mark]

Answer: A radioactive tracer is injected or swallowed, and the radiation it emits is detected outside the body to show how an organ is working.

- a radioactive tracer is put into the body (e.g. injected or swallowed) and the radiation it emits is detected outside the body, to show how an organ is working / to form an image of the organ (1)
-

01.2 [1 mark]

Answer: Radiotherapy, e.g. aiming gamma rays at a tumour to kill the cancer cells.

- radiotherapy, e.g. gamma rays aimed at a tumour to kill cancer cells / a radioactive source placed inside the body next to a tumour / radioactive iodine used to destroy part of an overactive thyroid gland (1)
-

Question 2 (4 marks)

02.1 [2 marks]

Correct: Exploring internal organs using a radioactive tracer; Destroying cancer cells (radiotherapy)

02.2 [1 mark]

Correct: Gamma

02.3 [1 mark]

Answer: Gamma rays pass out of the body to the camera and are only weakly ionising.

- it can pass out of the body to reach the camera / it is the least ionising, so it causes the least damage to cells (1)
-

Question 3 (2 marks)

03.1 [1 mark]

Correct: Radiotherapy to treat a cancerous tumour

03.2 [1 mark]

Correct: A few hours

Question 4 (6 marks)

04.1 [2 marks]

Answer: Gamma rays pass right out of the body to the camera, and they are only weakly ionising.

- gamma rays are very penetrating, so they pass out of the body and reach the camera (1)
 - gamma rays are weakly ionising, so they cause little damage to cells (1)
-

04.2 [2 marks]

Answer: Long enough to complete the scan, but short enough that the activity soon becomes very low, keeping the dose small.

- it is long enough for the tracer to reach the organ and for the images to be taken (1)
 - it is short enough that the activity falls quickly after the scan, so the patient receives only a small dose (1)
-

04.3 [2 marks]

Answer: Alpha particles would not get out of the body to the camera, and their strong ionisation would damage the tissue.

- alpha particles would be absorbed in the body, so they could not be detected by the camera outside (1)
 - alpha particles are strongly ionising, so they would damage the cells around the tracer (1)
-

Question 5 (4 marks)

05.1 [2 marks]

Answer: A healthy kidney's count rate rises and then falls as the tracer passes through it; a kidney that is not working gives a count rate that stays low.

- the count rate from a healthy kidney rises as it takes in the tracer and then falls as the tracer passes out in the urine (1)
- the count rate from a kidney that is not working stays low, because it does not take in the tracer (1)

Notes: Allow 'keeps rising and does not fall' for a blocked kidney for the second mark.

05.2 [2 marks]

Answer: The urine contains the radioactive tracer: drinking water removes it from the body sooner, and careful hand-washing stops contamination spreading.

- the tracer leaves the body in the urine, so the urine is radioactive (1)
 - drinking water flushes the tracer out of the body sooner (reducing the patient's dose), and hand-washing stops radioactive contamination spreading to other people or surfaces (1)
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Question 6 (5 marks)

06.1 [2 marks]

Answer: Only gamma rays can penetrate deep enough to reach the tumour; alpha and beta would be absorbed on the way.

- gamma rays are very penetrating, so they can reach a tumour deep inside the body (1)
- alpha and beta particles would be absorbed by the skin / tissue before reaching the tumour (1)

06.2 [2 marks]

Answer: The beams all cross at the tumour, giving it a large dose, while each area of healthy tissue receives only a small dose.

- the tumour receives radiation from every direction, so it receives a large dose (enough to destroy the cells) (1)
- each region of healthy tissue is in the beam from only one direction, so it receives a much smaller dose (1)

06.3 [1 mark]

Answer: Healthy cells may be damaged.

- healthy cells / tissue may be damaged or killed (1)
- the radiation may cause (another) cancer later (1)
- side effects such as tiredness / sickness / sore skin / hair loss (1)

Any 1 of the points above.

Question 7 (3 marks)

07.1 [2 marks]

Answer: Right next to the source, the tumour absorbs most of the radiation; radiation from outside would pass through healthy tissue on the way.

- the tumour is very close to the source, so it absorbs most of the radiation / receives a large dose (1)
- radiation from outside the body would have to pass through healthy tissue to reach the tumour, damaging that tissue (1)

07.2 [1 mark]

Answer: The sealed source is removed, so no radioactive material stays in the body: the patient was irradiated, not contaminated.

- the source is sealed and is removed, so no radioactive material is left in the body — the patient was irradiated, not contaminated (1)