

GCSE Physics

Worksheet: Background radiation

TIME 30 min	TOTAL 29 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Background 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.

0 1

Background radiation is around us all of the time.

0 1 . 1

Give **two** natural sources of background radiation.

.....

.....

.....

.....

[2 marks]

0 1 . 2

Give **one** man-made source of background radiation.

.....

.....

[1 mark]

0 1 . 3

Radiation dose is measured in sieverts (Sv).
1000 millisieverts (mSv) = 1 sievert (Sv)
The average annual radiation dose for a person in the UK is about 2.7 mSv.
Give 2.7 mSv in sieverts.

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

Dose = Sv

[1 mark]

0 2

0 2 . 1

Which of these is **not** a natural source of background radiation?
Tick (✓) **one** box.

- Radon gas ☐
- Cosmic rays ☐
- Medical X-rays ☐
- Rocks and soil ☐

[1 mark]

0 2 . 2

What is meant by background radiation?

.....
.....

[1 mark]

0 3

A student measured the background count three times using a Geiger–Müller tube. Each count lasted 10 minutes.

The results were 212, 198 and 207 counts.

0 3 . 1

Calculate the mean background count rate in counts per minute.
Give your answer to 3 significant figures.

.....

.....

.....

.....

Background count rate = counts per minute

[2 marks]

0 3 . 2

Explain why the student repeated the measurement and counted for a long time.

.....

.....

.....

.....

[2 marks]

0 3 . 3

The student then placed a radioactive source near the tube and measured a count rate of 145 counts per minute.
Calculate the count rate due to the source.

.....

.....

.....

Count rate = counts per minute

[1 mark]

0 3 . 4

On another day the student measured the background count rate in a different building and got a higher value.
Suggest **one** reason why.

.....

.....

[1 mark]

0 4

0 4 . 1

A student measures the background count rate five times, for one minute each time, and gets slightly different values on each attempt.
Explain why the readings are not identical, and suggest how the student could obtain a more reliable estimate of the true background count rate.

.....

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.....

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.....

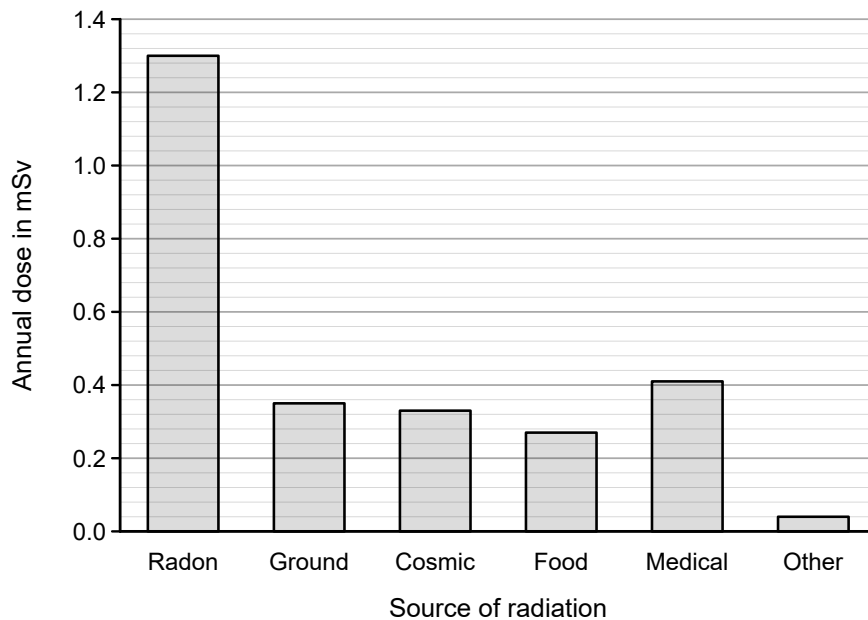
[3 marks]

0 5

Figure 1 shows estimates of the average annual radiation dose received by a person in the UK from different sources.

Ground = gamma rays from the ground and buildings; Food = food and drink; Other = sources such as fallout from weapons testing and the nuclear industry.

Figure 1



0 5 . 1

Which source gives the largest annual dose?

.....

.....

.....

.....

[1 mark]

0 5 . 2

The total average annual dose is 2.70 mSv.
Use Figure 1 to calculate the percentage of the total annual dose that comes from radon.
Give your answer to 2 significant figures.

.....

.....

.....

.....

Percentage = %

[2 marks]

0 5 . 3

Radon is a radioactive gas released from rocks such as granite.
Suggest why the average annual dose from radon is higher in some parts of the UK than in others.

.....

.....

.....

.....

[2 marks]

0 5 . 4

Suggest why the annual dose from medical sources is very different for different people.

.....

.....

[1 mark]

0 6

Airline pilots receive a higher dose of radiation than most people. At the height at which aircraft fly, the dose from cosmic rays is about 0.005 mSv per hour.

0 6 . 1

Suggest why the dose from cosmic rays is higher at the height at which aircraft fly than at ground level.

[1 mark]

0 6 . 2

A pilot flies for 700 hours in one year.

Calculate the dose from cosmic rays that the pilot receives while flying in that year.

Dose = mSv

[2 marks]

0 6 . 3

Give **one** other occupation in which a person may receive a higher radiation dose than average.

[1 mark]

0 6 . 4

The annual dose limit for people who work with radiation is 20 mSv.

The average annual dose from background radiation is 2.7 mSv.

Explain whether the pilot's dose is a cause for concern.

[1 mark]

0 7

Table 1 shows the average annual radiation dose received by a nuclear power plant worker from different sources.

Table 1

Source	Dose in mSv
Natural background	2.7
Medical	0.4
Occupational (work-related)	1.9
Other	0.2

0 7 . 1

Calculate the worker's total annual dose.

.....

.....

.....

Total dose = mSv

[1 mark]

0 7 . 2

Calculate the percentage of the worker's total dose that is occupational.
Give your answer to 3 significant figures.

.....

.....

.....

.....

Percentage = %

[2 marks]

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: Background radiation · 29 marks

Question 1 (4 marks)

01.1 [2 marks]

Answer: Rocks (and the radon gas released from them) and cosmic rays.

- rocks / the ground / building materials (1)
- cosmic rays (from space) (1)
- radon gas (from rocks) (1)
- food and drink / radioactive isotopes inside our bodies (1)

Any 2 of the points above.

01.2 [1 mark]

Answer: Fallout from nuclear weapons testing.

- fallout from nuclear weapons testing (1)
- nuclear accidents (1)
- medical uses of radiation (e.g. X-rays) (1)
- waste / discharges from the nuclear industry (1)

Any 1 of the points above.

01.3 [1 mark]

Answer: 0.0027 Sv

- 0.0027 (Sv) (1)
-

Question 2 (2 marks)

02.1 [1 mark]

Correct: Medical X-rays

02.2 [1 mark]

Answer: The low-level ionising radiation present all around us all the time, from natural and man-made sources.

- the (low-level) ionising radiation that is present all the time, all around us, from natural and man-made sources (1)
-

Question 3 (6 marks)

03.1 [2 marks]

Answer: 20.6 counts per minute

- mean count = $(212 + 198 + 207) \div 3 = 205.7$ (1)
- count rate = $205.7 \div 10 = 20.6$ (counts per minute) (1)

03.2 [2 marks]

Answer: Decay is random, so counts vary; counting for longer and repeating gives a more reliable mean.

- radioactive decay is random, so the number of counts varies (1)
- a longer time / repeats give a more accurate / representative mean value (1)

03.3 [1 mark]

Answer: 124 counts per minute

- $145 - 20.6 = 124$ (counts per minute) (1)

Notes: Allow ECF from the background count rate.

03.4 [1 mark]

Answer: The building may be made of, or built on, rocks such as granite that release more radiation and radon.

- the building is made of / built on different materials or rocks (e.g. granite) (1)
- there is more radon in the air in that building (e.g. less ventilation) (1)

Any 1 of the points above.

Question 4 (3 marks)

04.1 [3 marks]

Answer: Background radiation is random, so counts vary between measurements; taking a mean of several readings (or counting for longer) gives a more reliable estimate.

- radioactive decay (and background radiation) is random, so the number of counts in a fixed time varies from one measurement to the next (1)
 - this random variation is expected, and is not evidence of a mistake in the method (1)
 - the student could take a mean of several repeat readings (or count for a longer total time), which reduces the effect of this random variation on the estimate (1)
-

Question 5 (6 marks)

05.1 [1 mark]

Answer: Radon

- radon (1)

05.2 [2 marks]

Answer: 48%

- $1.30 \div 2.70 \times 100$ (1)
- 48 (%) (1)

Notes: Allow 47–49% (from reading 1.28–1.32 mSv).

05.3 [2 marks]

Answer: Some areas have more granite, which releases radon, so there is more radon in the air and in homes there.

- the type of rock is different in different places / some areas have more granite (rocks that release radon) (1)
- so more radon gets into the air / into homes in those areas (1)

05.4 [1 mark]

Answer: Some people have far more X-rays, scans or radiation treatments than others.

- some people have many more medical scans / X-rays / treatments involving radiation than others (1)
-

Question 6 (5 marks)

06.1 [1 mark]

Answer: There is less air above to absorb the cosmic rays.

- there is less atmosphere above the aircraft to absorb the cosmic rays (1)

06.2 [2 marks]

Answer: 3.5 mSv

- 700×0.005 (1)
- 3.5 (mSv) (1)

06.3 [1 mark]

Answer: A radiographer in a hospital.

- hospital worker using radiation / radiographer (1)
- nuclear power station worker (1)
- miner (1)
- astronaut (1)

Any 1 of the points above.

06.4 [1 mark]

Answer: Not a major concern: about 6.2 mSv a year in total, well below the 20 mSv limit.

- no: the total of about 6.2 mSv ($3.5 + 2.7$) is well below the 20 mSv limit (although any dose slightly increases the risk) (1)

Question 7 (3 marks)

07.1 [1 mark]

Answer: 5.2 mSv

- 5.2 (mSv) (1)

07.2 [2 marks]

Answer: 36.5%

- $(1.9 \div 5.2) \times 100$ (1)
- 36.5 (%) (1)

Notes: Allow ECF from the total dose calculated.
