

GCSE Combined Science: Trilogy

Worksheet: Properties of electromagnetic waves 2

TIME 35 min	TOTAL 31 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
-----------------------	--------------------------	------------------------------	-----------------------------------

Topics: Properties of electromagnetic waves 2

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

Some types of electromagnetic radiation can be hazardous to human body tissue.

0 1 . 1

Which **two** types of electromagnetic radiation are ionising?

Tick (✓) **two** boxes.

Gamma rays

☐

Infrared

☐

Microwaves

☐

Visible light

☐

X-rays

☐

[2 marks]

0 1 . 2

Give **one** harmful effect of ultraviolet radiation on the skin.

.....

.....

[1 mark]

0 1 . 3

Gamma rays are produced by changes in one part of an atom.

Which part?

Tick (✓) **one** box.

The electrons

☐

The nucleus

☐

The outer shell

☐

[1 mark]

0 1 . 4

Give **one** harmful effect of X-rays on body tissue.

.....

.....

[1 mark]

0 2

0 2 . 1

What is meant by ionising radiation?

.....

.....

[1 mark]

0 2 . 2

Which of these is a unit used to measure radiation dose?

Tick (✓) **one** box.

Becquerel

☐

Hertz

☐

Sievert

☐

Watt

☐

[1 mark]

0 2 . 3

State whether the risk of harm from a radiation dose generally increases or decreases as the size of the dose increases.

.....

.....

[1 mark]

0 3

A sunbed uses lamps that emit ultraviolet radiation to tan the skin.

0 3 . 1

Give **two** risks of using a sunbed.

.....

.....

.....

.....

[2 marks]

0 3 . 2

A leaflet states that 10 minutes on a sunbed gives about the same ultraviolet dose as 1 hour in strong midday sunshine.

A person uses the sunbed for 25 minutes, twice a week.

Calculate the number of hours of strong midday sunshine that give the same ultraviolet dose as one week of these sunbed sessions.

.....

.....

.....

.....

Time = hours

[2 marks]

0 3 . 3

Some sun creams absorb ultraviolet radiation.

Explain how using this type of sun cream reduces the risk of harm.

.....

.....

.....

.....

[2 marks]

0 3 . 4

A radiographer takes many X-ray images each day. The radiographer stands behind a lead screen when the X-ray machine is switched on.
Explain why.

[2 marks]

0 4

Mobile phone masts send signals using microwaves and radio waves. Some people have expressed concern about living near masts, even though these waves are not ionising.

0 4 . 1

Explain why microwaves and radio waves are considered much less hazardous to human tissue than ultraviolet, X-rays or gamma rays.

[2 marks]

0 4 . 2

Microwaves used in a microwave oven can still cause harm if a person is exposed to a very high intensity.
Suggest how this harm would happen, given that microwaves are non-ionising.

[2 marks]

0 5

Some airport security scanners use low-energy X-rays, which are ionising. Table 1 compares the typical radiation dose received by a person from one scan with the typical yearly dose from background radiation.

Table 1

Source	Typical dose
One scan (for the person being scanned)	0.1 μSv
Background radiation for one year	2700 μSv

0 5 . 1

A frequent traveller has 40 scans in one year.
Calculate the total dose received from these scans.

.....

.....

.....

.....

Total dose = μSv

[2 marks]

0 5 . 2

Calculate this total dose as a percentage of the yearly background dose.

.....

.....

.....

.....

Percentage = %

[2 marks]

0 6

Table 2 shows typical radiation doses from some medical procedures, together with the average dose a person in the UK receives from background radiation in one year.

1000 millisieverts (mSv) = 1 sievert (Sv)

Table 2

Source of radiation	Typical dose in mSv
Dental X-ray	0.005
Chest X-ray	0.02
CT scan of the head	2.0
CT scan of the abdomen	8.0
Background radiation for one year	2.7

0 6 . 1

Give the dose from a CT scan of the abdomen in sieverts.

.....

.....

.....

Dose = Sv

[1 mark]

0 6 . 2

Calculate how many chest X-rays would give the same total dose as one CT scan of the head.

.....

.....

.....

Number of chest X-rays =

[1 mark]

0 6 . 3

What does a radiation dose measure?

.....

.....

[1 mark]

0 6 . 4

A CT scan of the abdomen gives a dose equal to about three years of background radiation.
Suggest why a doctor may still advise a patient to have this scan.

.....

.....

.....

.....

[2 marks]

0 6 . 5

Explain why X-rays can cause cancer.

.....

.....

.....

.....

[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 Combined Science: Trilogy · Worksheet: Properties of electromagnetic waves 2 · 31 marks

Question 1 (5 marks)

01.1 [2 marks]

Correct: Gamma rays; X-rays

01.2 [1 mark]

Answer: It increases the risk of skin cancer (or causes premature ageing of the skin).

- makes the skin age prematurely / increases the risk of skin cancer (1)
-

01.3 [1 mark]

Correct: The nucleus

01.4 [1 mark]

Answer: They can cause mutation of genes, leading to cancer.

- mutation of genes / cancer (1)
-

Question 2 (3 marks)

02.1 [1 mark]

Answer: Radiation that can knock electrons out of atoms, forming ions.

- radiation that can remove electrons from atoms (or molecules), forming (charged) ions (1)
-

02.2 [1 mark]

Correct: Sievert

02.3 [1 mark]

Answer: It increases.

- increases (1)
-

Question 3 (8 marks)

03.1 [2 marks]

Answer: Premature ageing of the skin and an increased risk of skin cancer.

- the skin ages prematurely (1)
- increased risk of skin cancer (1)

Notes: Allow sunburn or damage to the eyes for one mark.

03.2 [2 marks]

Answer: 5 hours

- time on sunbed each week = $2 \times 25 = 50$ minutes (1)
 - $50 \div 10 \times 1 = 5$ (hours) (1)
-

03.3 [2 marks]

Answer: The cream absorbs ultraviolet, so less reaches the skin and the dose is smaller.

- less ultraviolet reaches / is absorbed by the skin (cells) (1)
 - so the dose to the skin is smaller (1)
-

03.4 [2 marks]

Answer: The lead absorbs X-rays; without it the radiographer's dose would build up over many images and increase the risk of cancer.

- lead absorbs X-rays, so the radiographer's dose is reduced (1)
 - the dose from many X-rays each day would add up, increasing the risk of gene mutation / cancer (1)
-

Question 4 (4 marks)

04.1 [2 marks]

Answer: Microwaves and radio waves are not ionising, so they do not cause gene mutations; X-rays and gamma rays are ionising (mutations and cancer) and UV can age the skin and increase the risk of skin cancer.

- microwaves and radio waves are not ionising: they cannot remove electrons from atoms, so they do not cause mutation of genes (1)
- X-rays and gamma rays are ionising and can cause mutation of genes and cancer / ultraviolet can cause the skin to age prematurely and increases the risk of skin cancer (1)

04.2 [2 marks]

Answer: They can heat body tissue (by transferring energy to water molecules), causing burns — a heating effect, not ionisation.

- microwaves are absorbed by water molecules in the body, transferring energy to them (1)
- this can heat body tissue, causing burns, rather than causing ionisation (1)

Question 5 (4 marks)

05.1 [2 marks]

Answer: 4 μSv

- 0.1×40 (1)
- 4 (μSv) (1)

05.2 [2 marks]

Answer: 0.15%

- $4 \div 2700 \times 100$ (1)
- 0.15 (%) (1)

Notes: Allow ECF from the total dose.

Question 6 (7 marks)

06.1 [1 mark]

Answer: 0.008 Sv

- 0.008 (Sv) (1)
-

06.2 [1 mark]

Answer: 100

- 100 (1)
-

06.3 [1 mark]

Answer: The risk of harm to the body from the radiation.

- the risk of harm from exposure of the body to radiation (1)
-

06.4 [2 marks]

Answer: The benefit of diagnosing the illness outweighs the small extra risk.

- the scan can diagnose a serious illness / give information needed for treatment (1)
 - the benefit is greater than the (small) extra risk of harm (1)
-

06.5 [2 marks]

Answer: X-rays are ionising, so they can damage DNA and cause gene mutations.

- X-rays are ionising (1)
 - they can cause mutation of genes / damage DNA in cells (1)
-