

Radio waves to gamma rays: uses and risks

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Test answers (mark scheme)

Model answers with mark allocations follow. Award marks for equivalent wording, and give error carried forward when a wrong earlier value is used correctly in a later calculation.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS4-4, HS-PS4-5

Question 1 Order (2 marks)

Gamma rays, X-rays, ultraviolet, visible, infrared, microwaves, radio waves.

Marking: 2 marks for all correct; 1 mark if only one pair is swapped.

Question 2 Radio wavelength (3 marks)

a. $3.0 \times 10^8 \text{ m/s}$

b. $\lambda = c \div f = 3.0 \times 10^8 \div 1.20 \times 10^6 = \mathbf{250 \text{ m}}$

Marking: 1 mark for the speed; 1 mark for the equation with values; 1 mark for the answer (the answer mark can be earned only with 3.0×10^8). Total 3 marks.

Question 3 Choosing waves (2 marks)

Infrared: remote control or heater, because objects absorb and emit it as heat. X-rays: medical imaging, because they pass through soft tissue but are absorbed by bone. **Any correct use with matching property.**

Marking: 1 mark for each use with its property.

Question 4 Ionising radiation (3 marks)

- a. Radiation with enough energy to remove electrons from atoms, forming ions.
- b. **Ultraviolet (high end), X-rays, gamma rays** (any two).
- c. Cancer, cell damage or mutation (any one).

Marking: 1 mark for each part.

Question 5 Ultraviolet damage (3 marks)

Ultraviolet has a higher frequency than visible light, so its photons carry more energy and can damage skin cells and DNA, causing burns or cancer. The farmer can wear a hat and

long sleeves and use sunscreen with a high protection factor.

Marking: 1 mark for higher energy or ionising damage; 1 mark for each correct precaution.

Question 6 Weather radar (2 marks)

Total distance = speed $\times$ time = $3.0 \times 10^8 \times 4.0 \times 10^{-5} = 1.2 \times 10^4$ m. The pulse goes there and back, so the cloud is **6.0×10^3 m** (6.0 km) away.

Marking: 1 mark for 1.2×10^4 m; 1 mark for halving.

Question 7 Missing regions (2 marks)

- a. A is **microwaves**; B is **ultraviolet**.
- b. **Gamma rays**

Marking: 1 mark for both names; 1 mark for gamma rays.

Question 8 Phones and X-rays (3 marks)

Ionising needs each wave to carry enough energy to remove an electron from an atom. The energy carried increases with frequency. Microwaves have a low frequency, so their energy is too small to remove electrons; X-rays have a very high frequency and can.

Marking: 1 mark for the idea of removing electrons; 1 mark for energy depending on frequency; 1 mark for microwaves lower, X-rays higher.