

Combined Science Physics Paper 1 Higher Tier: Extended Open Response question 6(d)

\*(d) Radio waves and gamma radiation are at opposite ends of the electromagnetic spectrum.

Compare how these two electromagnetic radiations are produced.

(6)

Gamma radiation is produced during radioactive decay. When a radioactive isotope wants to re-arrange its nucleus it emits gamma radiation in order to become more stable. Radiowaves are produced by oscillations in electrical circuits, the frequency and wavelength of the wave produced is dependant on the current of the circuit. The radio waves can cause oscillations in large metal rods known as ariels which absorb and emit the radiowaves. When they absorb them the ariel can also produce oscillations in a electrical circuit.

Question Number	Answer	Mark
6(d)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;"><b>AO1 strand 1 (6 marks)</b></p> <ul style="list-style-type: none"> <li>• radio waves are (often) produced intentionally (by humans)</li> <li>• gamma rays are (often) produced spontaneously / randomly</li> <li>• radio waves are produced by (free) electrons</li> <li>• radio waves are produced by oscillating (free) electrons / alternating current (ac)</li> <li>• radio waves are produced in electrical circuits / aerials</li> <li>• gamma rays may result from radioactive decay</li> <li>• gamma rays produced in the nucleus</li> <li>• gamma rays produced by energy changes / rearrangement in the nucleus</li> <li>• gamma rays produced to stabilise the nucleus</li> <li>• gamma rays produced in annihilations (PET scanning etc)</li> <li>• gamma rays may be produced as a result of (nuclear) fission or fusion</li> </ul>	(6) exp

Level	Mark	Descriptor
	0	<ul style="list-style-type: none"> <li>• No rewardable material.</li> </ul>
Level 1	1-2	<ul style="list-style-type: none"> <li>• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1)</li> <li>• Presents an explanation with some structure and coherence. (AO1)</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1)</li> <li>• Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1)</li> <li>• Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)</li> </ul>

# Summary for guidance

Level	Mark	Additional Guidance	General additional guidance – the decision within levels  e.g. – At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u>  isolated fact(s) about one radiation	<u>Possible candidate responses</u>  gamma rays are (often) produced spontaneously / randomly
Level 2	3–4	<u>Additional guidance</u>  Some understanding shown i.e. a limited comparison made including some facts about the production of each radiation  OR more detailed facts given about the production of one of them	<u>Possible candidate responses</u>  radio waves produced in wires and gamma produced in nucleus  radio waves produced by AC in wires
Level 3	5–6	<u>Additional guidance</u>  Understanding is detailed and fully developed.  detailed comparison made with linked facts about the production of each  (one radiation may have significantly more detail than the other but both should feature for level 3)	<u>Possible candidate responses</u>  radio waves produced by electrons oscillating in wires; gamma produced by annihilation of electrons interacting with positrons