Electromagnetic Spectrum

Total marks:16

Q1.

A person warms their hands in front of a hot fire as shown in Figure 2.

(Source: © Andreas Saldavs/Shutterstock)

Figure 2

Use words from the box to complete the following sentences.

chemical	infrared	radio	thermal	ultraviolet

(2)

The electromagnetic waves that the fire mostly emits are
..... waves.

These waves transfer ..... energy to the hands.

(Total for question = 2 marks)

Q2.

Figure 1 shows the parts of the electromagnetic spectrum.

gamma rays	x-rays	**J**	visible	**K**	micro-waves	**L**

Figure 1

(i) Which row of the table names the parts **J**, **K** and **L** of the electromagnetic spectrum?

(1)

		J	K	L
☒	**A**	infrared	radio	ultraviolet
☒	**B**	radio	infrared	ultraviolet
☒	**C**	ultraviolet	infrared	radio
☒	**D**	ultraviolet	radio	infrared

(ii) All electromagnetic waves can travel in a vacuum.

Which of these is the same for all electromagnetic waves travelling in a vacuum?

(1)

☒ **A** amplitude
☒ **B** frequency
☒ **C** speed
☒ **D** wavelength

(Total for question = 2 marks)

Q3.

Figure 8 shows a section of the electromagnetic spectrum.

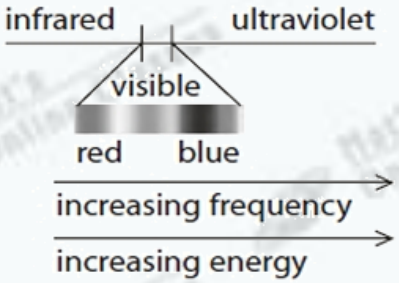

Figure 8

(i) State **one** type of electromagnetic radiation that has a higher frequency than ultraviolet.

(1)

.....

(ii) One star is blue and another star is red.

Explain why an astronomer expects the blue star to be hotter than the red star.

(2)

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(Total for question = 3 marks)

Q4.

Some television remote controls use infrared radiation and other remote controls use radio waves.

Explain why an infrared remote control may not switch on the television from behind an armchair but a radio wave remote control always will.

(2)

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(Total for question = 2 marks)

Q5.

Radio waves and gamma radiation are at opposite ends of the electromagnetic spectrum.

Compare how these two electromagnetic radiations are produced.

(6)

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(Total for question = 6 marks)

Q6.

Some sunglasses have photochromic lenses.

Photochromic lenses are clear when the lenses are indoors but they darken in bright sunlight to reduce the effects of the sunlight.

Photochromic lenses react to ultraviolet light.

Suggest a benefit of making the lenses go dark with ultraviolet light.

(1)

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(Total for question = 1 mark)

Mark scheme:

Q1.

Question number	Answer	Additional guidance	Mark
	infrared (1) thermal (1)	must be in first sentence space must be in second sentence space award 2 marks for answers in this **order**	**(2)** **AO2**

Q2.

Question number	Answer	Additional guidance	Mark
(i)	C ultraviolet | infrared | radio A is incorrect infrared should be in K, radio should be in L and ultraviolet in J, B is incorrect radio should be in L and ultraviolet should be in K D is incorrect radio should be in L and infrared in K		**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
(ii)	C speed amplitude, frequency and wavelength are not the same for all EM waves		**(1)** **AO1**

Q3.

Question Number	Answer	Additional guidance	Mark
(i)	one of: X-ray(s) (1) gamma (rays) (1)	 X γ any other waves mentioned contradicts	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	an explanation linking **two** from: blue (star) emits light at higher energy (than red) blue has shorter wavelength/ higher frequency than red so blue star has higher (surface) temperature than red	 or reverse arguments	(2)

Q4.

Question Number	Answer	Additional guidance	Mark
	an explanation linking: infrared is absorbed / blocked (by the armchair / objects) / cannot pass through **OR** radio waves can go through (the armchair/objects) (1) **WITH** (infrared and radio have) different wavelengths / frequencies OR infrared requires 'line-of-sight' (idea) OR radio waves do not require 'line-of-sight' (idea) OR diffraction (idea) (1)	stopped transmitted accept comparison	**(2)**

Q5.

Question Number	Answer	Mark
	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. 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.	**(6)**
	AO1 strand 1 (6 marks) • radio waves are (often) produced intentionally (by humans) • gamma rays are (often) produced spontaneously / randomly • radio waves are produced by (free) electrons • radio waves are produced by oscillating (free) electrons / alternating current (ac) • radio waves are produced in electrical circuits / aerials • gamma rays may result from radioactive decay • gamma rays produced in the nucleus • gamma rays produced by energy changes / rearrangement in the nucleus • gamma rays produced to stabilise the nucleus • gamma rays produced in annihilations (PET scanning etc) • gamma rays may be produced as a result of (nuclear) fission or fusion	

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

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	Additional guidance isolated fact(s) about one radiation	Possible candidate responses gamma rays are (often) produced spontaneously / randomly
Level 2	3–4	Additional guidance 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	Possible candidate responses radio waves produced in wires and gamma produced in nucleus radio waves produced by AC in wires
Level 3	5–6	Additional guidance 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)	Possible candidate responses radio waves produced by electrons oscillating in wires; gamma produced by annihilation of electrons interacting with positrons

Q6.

Question Number	Answer	Additional guidance	Mark
	suggestion to include **one** from (ultraviolet/UV) is (the most) harmful to the eyes (1) protects eyes from damage/harm (from UV rays) (1)	 (UV) can damage eyes protects against cataracts/cancer accept makes it more comfortable in bright sunlight	**(1)**