PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

PHYSICS



MARK SCHEME

TOPIC 5: LIGHT AND THE ELECTROMAGNETIC SPECTRUM (PAPER 1)

SCORE	PERCENTAGE
/98	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. Pearson Edexcel has not endorsed, approved or been involved in the production of it. Pearson Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

Pearson Edexcel publishes its past papers, mark schemes and examiner reports. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Mark Scheme

Q1.

Question Number	Answer	Mark
(i)	**D** refraction **The only correct answer is D** *A 'deflection' is an incorrect distracting description* *B 'incidence' is incorrect, that would be angle X* *C 'reflection' is incorrect, no reflection being shown in the diagram*	**(1)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	any pair of coordinates selected from the line (1) in range → 0.6(0) to 0.7(0) (1)	e.g. 20 and (13 or 14) or 10 and (6 or 7) ignore any units given award full marks for a correct answer without working	**(2)** AO 2 1

Question Number	Answer	Additional guidance	Mark
(iii)	an explanation linking: repeat (1) different angles / more values of X (1) for larger angles / values of X (1)	 allow 'more measurements' / 'repeat experiment' / collect more data > 20°	**(3)** AO 3 3a

(**Q15 1SC0/1PF, June 2018**)

Q2.

Question Number	Answer	Mark
(i)	**D** refraction **is the only correct answer** *A 'deflection' is an incorrect distracting description* *B 'incidence' is incorrect, that would be angle X* *C 'reflection' is incorrect, no reflection being shown in the diagram*	**(1)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	any pair of coordinates selected from the line (1) in range → 0.6(0) to 0.7(0) (1)	e.g. 20 and (13 or 14) or 10 and (6 or 7) ignore any units given award full marks for a correct answer without working	**(2)** AO 2 1

Question Number	Answer	Additional guidance	Mark
(iii)	an explanation linking: repeat (1) different angles / more values of X (1) for larger angles / values of X (1)	 allow 'more measurements' / 'repeat experiment' / collect more data > 20°	**(3)** AO 3 3a

(**Q01 1SC0/1PH, June 2018**)

Q3.

Question Number	Answer	Additional guidance	Mark
	(Jupiter is) 5 times (further away) (1) radio waves and light waves travel at the same speed (in space) (1)	 All electromagnetic (EM) waves travel at the same speed accept attempt to use consistent speed (of light) to calculate two distances	**(2)**

(**Q06b 1SC0/1PH, June 2019**)

Q4.

Question Number	Answer	Mark
(i)	**A ray box** ***B*** *is not correct because a ruler does not produce a beam of white light* ***C*** *is not correct because a measuring cylinder does not produce a beam of white light* ***D*** *is not correct because an ammeter does not produce a beam of white light*	**(1)** **AO1**

Question Number	Answer	Mark
(ii)	**C green** ***A*** *is not correct because red appears at the start of the spectrum* ***B*** *is not correct because orange appears in the middle of the spectrum* ***D*** *is not correct because violet appears at the end of the spectrum*	**(1)** **AO1**

(**QU01a 1SC0/1PF, June 2022**)

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)** **exp**

	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

(**Q06d 1SC0/1PH, June 2019**)

Q6.

Question number	Indicative content	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. AO1 **Comparison** X–rays: high frequency / short wavelength / ionising / high energy Radio waves: low frequency / long wavelength / not ionising / low energy **X ray are used** • in medical diagnosis, to find broken bones, damage to lungs • radiotherapy • treatment of cancer • airport security • revealing counterfeit art	**(6)** **AO1**

	X-rays are emitted when electrons change energy levels because • electrons in lower energy levels can absorb energy • the electrons move to higher energy levels • when the electrons return to a lower energy level • the electrons lose energy as radiation. • the electrons need to lose a large amount of energy • (so that) they emit x-ray radiation of high energy/frequency • **Radio waves are used** • broadcasting television • broadcasting radio • communications • satellite transmissions • mobile phones • radar	

	Radio-waves are emitted when • electrons oscillate in electrical circuits **oscillations are** • current (flow of electrons) that continually change direction • current flows up and down in a (transmitting) aerial • alternating current (AC) • this generates radio waves in the air around the aerial • the frequency of the radio waves corresponds to the oscillation frequency **N.B. No credit is given for:** **Electrons within an atom go through energy changes** **OR** **Radio waves are produced in electrons in circuits** **These phrases are in the stem of the question**	

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3–4	Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5–6	Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Additional Guidance	General additional guidance – the decisions 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 bottom of that level
	0	No rewardable material	
Level 1	1-2	Additional guidance Elements of physics present i.e. isolated knowledge of principles, **two** unconnected statements	Possible candidate response any use of X rays any use of radio waves any comparison electrons are around the nucleus a current is electrons (moving) electrons oscillate
Level 2	3-4	Additional guidance Some knowledge of principles with limited detail on use and a comparison or process	Possible candidate response any use of x-rays and of radio waves with limited detail and one of: a comparison or electrons lose energy to emit X-rays or electrons oscillate in circuits
Level 3	5-6	Additional guidance Detailed knowledge of principles on use with logical connections made about one process	Possible candidate response Use of X-rays and of radio waves with detail and one of: electrons lose energy to change to lower energy level and emit energy as X–rays or electrons oscillate in circuit and currents move up and down in aerials to generate radio waves

(**QU06c 1SC0/1PH, June 2022**)

Q7.

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**

(**Q01c 1SC0/1PF, Nov 2021**)

Q8.

	Answer	Additional guidance	Mark
(i)	x-ray(s)	allow X x no mark if more than one wave given e.g. x-rays and gamma rays scores 0	**(1)** **AO1**

	Answer	Additional guidance	Mark
(ii)	infrared	allow any recognisable spelling IR ir no mark if more than one wave given e.g. infrared and gamma rays scores 0	**(1)** **AO1**

	Answer	Additional guidance	Mark
(iii)	infrared	allow any recognisable spelling IR ir no mark if more than one wave given e.g. infrared and gamma rays scores 0	**(1)** **AO1**

	Answer	Additional guidance	Mark
(iv)	gamma (rays)	allow any recognisable spelling γ no mark if more than one wave given e.g. gamma rays and UV scores 0	**(1)** **AO1**

(**QU01b 1SC0/1PF, June 2022**)

Q9.

	Answer	Additional guidance	Mark
	example 1 e-m wave (1) corresponding result of energy transfer (1) example 2 e-m wave (1) corresponding result of energy transfer (1)	e.g. radio waves: communication, oscillations (of electrons) in wires microwaves: cooking, communications and satellite transmissions, internal heating of body cells, increase KE/vibration of water molecules infrared: cooking, thermal imaging, optical fibres, television remote controls, skin burns ultraviolet: security marking, fluorescent lamps, detecting forged bank notes and disinfecting water, damage to surface cells and eyes, skin cancer x-rays: observing the internal structure of objects, airport security scanners and medical x-rays, mutation or damage to cells in the body, cancer gamma rays: including sterilising food and medical equipment, and the detection of cancer and its treatment, mutation or damage to cells in the body, cancer additional effect for visible light scores 1 mark e.g. : including vision, photography and illumination	**(4)** **AO1**

(**QU04c 1SC0/1PH, June 2023**)

Q10.

Question number	Answer	Additional guidance	Mark
	a description to include two of the following: increases (at first) (1) reaches a peak (1) (then) decreases (1)	 is brightest at **410** (nm)	**(2)**

(**Q01c 1SC0/1PF, Nov 2020**)

Q11.

Question Number	Answer	Additional guidance	Mark
	a description including: UVA **mostly** transmitted OR **some** absorbed (1) UVB **some** transmitted OR **mostly** absorbed (1) UVC **not** transmitted OR **mostly** absorbed OR **some** reflected (1) correct relationship of absorption/ transmission to wavelength / □ (1)	 UVA **mostly** travels through accept **less** transmitted than UVA **more** absorbed than UVA or UVB wavelength decreasing (with) absorption increasing OR longer wavelengths transmit more □ / abs / trans inc / dec / inc dec / inc / dec	**(4)**

(**Q06c 1SC0/1PH, June 2019**)

Q12.

Question number	Answer	Additional guidance	**Mark**
	A description including two from: trace / mark where the ray went into and out of(through) the glass block / line on either side of glass block(1) (remove block) join entry and exit points (of ray of light) (1) use the protractor to measure the angle between the refracted/drawn ray and the normal (1)	accept 90° line etc.	**(2)**

(**Q03b 1SC0/1PH, Nov 2020**)

Q13.

Question number	Answer	Additional guidance	Mark
	a description of method to include **four** from: draw around the block (1) shine a ray on the block (1) mark/draw/trace where the ray enters (1) mark/draw/trace where the ray exits (1) join point of entry to point of exit (1)	 point the ray box at the block can credit from drawing with glass block and ray box/light box labelled mark/draw/trace incident ray mark/draw/trace emerging ray allow 'draw light rays' for 1 mark if mp3 and mp4 not scored	**(4)** **AO1.2**

(**QU03a 1SC0/1PH, June 2025**)

Q14.

	Answer	Acceptable answers	Mark
(i)	a suggestion from any **two** of the following: (areas of the hand) show • Patches / (shaded) areas / brightness / colour(s) (1) • Indication of temperature / heat (1)	 blood flow / veins / arteries / named part of hand thermal / hot / cold / warm / cool / hotter / colder / warmer / cooler any colour identified as hot or cold / any part of the hand identified as hot	**(2)**

		or cold (2) **Ignore**germs / bacteria / nerves	
(ii)	an explanation linking **two**of the following: X-rays {mutate / damage / harm / ionise} cells or DNA (1) the {energy / frequency / wavelength / penetration} is different (1) Correctly identified difference (1)	{kills/destroys} cells / causes cancer / tumours / ionising Penetrates the skin / body x-rays have {more energy / high(er) frequency / {short(er) / low(er)} wavelength / great(er) penetration} (2) RA for infrared **Ignore**power	**(2)**

(**Q05 1SC0/1PF, June 2013**)

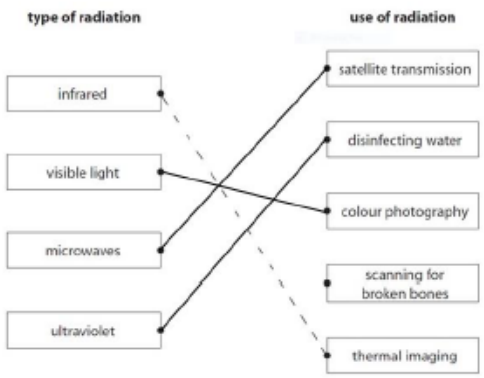
Q15.

		Indicative Content	
QWC	*	A discussion including some of the following points Possible dangerous e-m radiations Microwaves Infrared Ultraviolet (UV) X-rays gamma rays Correctly linked to Internal heating of body cells (microwaves) Skin burns (infrared) Damages skin cells/sunburn (UV) Damages eyes (UV) Can cause skin cancer (UV) Can cause cataracts (UV) Damage to cells inside the body(X-rays) Mutate/ kill cells in the body (gamma) Damages DNA (X-rays and gamma rays) Link to frequency As the frequency increases/wavelength decreases (microwave -> gamma) the waves become more penetrating and do more damage/danger as they h more energy.	
Level	**0**	No rewardable content	

1	**1 - 2**	• a limited description e.g. gives at least 2 correct radiations and links both to correct damage OR at least 2 correct radiations named with link to correct damage from one and idea that frequency is linked to damage OR just has link between higher frequency and more damage/dangerous e.g. infrared burns your skin and X-rays can damage cells. OR X-rays have a higher frequency than microwaves and can cause cancer OR Higher frequencies cause more damage to cells. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. gives most of the correct radiations and links to correct damage, at least one with detail of the damage that is caused OR links two to detail of the damage, AND has a link between frequency and energy/danger e.g. Microwaves are absorbed by water in body cells. UV can cause skin cancer and damages your eyes. Xrays and gamma rays can damage cells inside your body OR Gamma and X-rays can penetrate deep into the body. Gamma does most damage as it has the highest frequency. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description e.g. gives most of the correct radiations with links to detail of the damage AND explains the link between frequency and energy/danger. e.g Microwaves heat up the water in cells. UV can cause cataracts. Gamma rays are the most penetrating and can mutate cells inside the body because they have the highest frequency. • The answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(**Q35 1SC0/1PH, June 2013**)

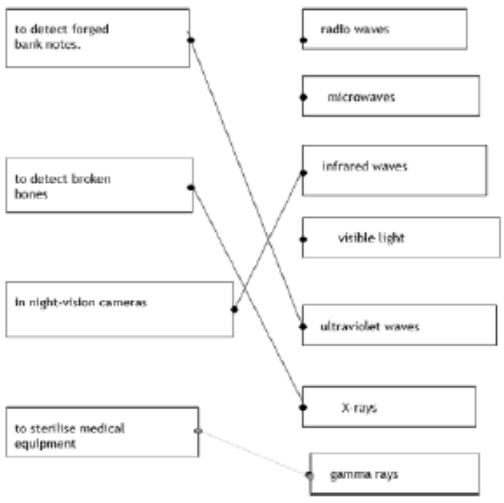
Q16.

Question Number	Answer	Additional guidance	Mark
(i)		award one mark for each correct line up to three marks reject for a mark two lines starting or ending at the same box	(3) AO1

Question Number	Answer	Mark
(ii)	C ultraviolet A (infrared), B (microwaves) and D (visible light) all have frequencies below that of ultraviolet	(1) AO1

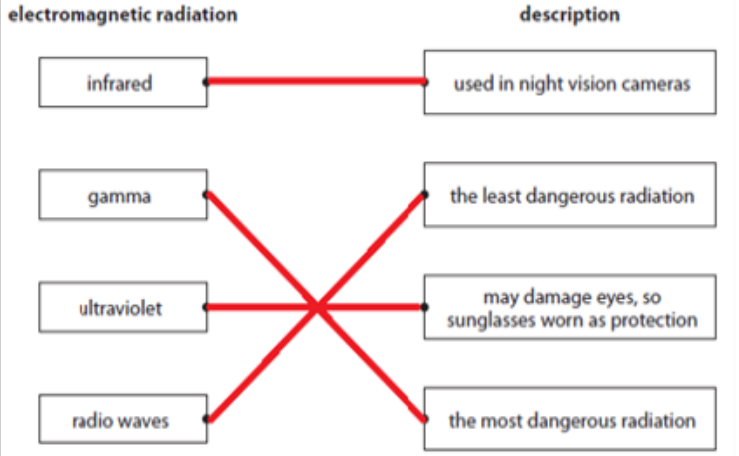
(**QU01a 1SC0/1PF, June 2023**)

Q17.

Question number	Answer	Additional guidance	Mark
		award 1 mark for each line from the three left-hand boxes more than one line from a box loses the mark for that box	(3)

(**Q01a 1SC0/1PF, Nov 2020**)

Q18.

Question number	Answer	Additional guidance	Mark
		1 mark for one line correct 2 marks for two or three lines correct 3 marks for four lines correct. if more than one line is drawn from or to a box, do not credit any of those lines	**(3)** **AO1.1**

(**QU01a 1SC0/1PF, June 2025**)

Q19.

	Answer	Acceptable answers	Mark
(a)(i)	☒ **B** seven		**(1)**
(a)(ii)	☒ **C** red, orange, yellow		**(1)**
(b)	ultraviolet → detecting forged bank notes gamma rays → cooking microwaves → detecting cancer three correct (2) one or two correct (1)		**(2)**
(c)(i)	a suggestion from any **two** of the following:		**(2)**

	(areas of the hand) show • Patches / (shaded) areas / brightness / colour(s) (1) • Indication of temperature / heat (1)	blood flow / veins / arteries / named part of hand thermal / hot / cold / warm / cool / hotter / colder / warmer / cooler any colour identified as hot or cold / any part of the hand identified as hot or cold (2) **Ignore**germs / bacteria / nerves	
(c)(ii)	an explanation linking **two**of the following: X-rays {mutate / damage / harm / ionise} cells or DNA (1) the {energy / frequency / wavelength / penetration} is different (1) Correctly identified difference (1)	{kills/destroys} cells / causes cancer / tumours / ionising Penetrates the skin / body x-rays have {more energy / high(er) frequency / {short(er) / low(er)} wavelength / great(er) penetration} (2) RA for infrared **Ignore**power	**(2)**

(**Q01 1SC0/1PF, June 2013**)

Q20.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	Gamma/ γ (wave(s)/ ray(s)/radiation)	X-rays/ radiation	**(1)**
(a)(ii)	Any two from It fluoresces (1) UV (radiation) transfers/gives energy to ink/ink absorbs energy from UV (radiation) (1) (energy from UV is)(re-)radiated/(re)- emitted by ink at lower frequency/as (visible) light	 fluorescent Ink/it absorbs UV (light/radiation) Ignore UV is reflected as visible light Ignore luminous	**(2)**

	(1)	emits visible light	

(b)	transposition $\lambda = v/f$ (1) substitution $\lambda = 3 \times 10^8/7 \times 10^9$ (1) evaluation 0.043 (m) (1) Ignore any unit given by candidate	Subst. and transform. either order 1 mark only can be scored for correct substitution after incorrect transposition. $3 \times 10^8/7 \times 10^9$ gains 2 marks Accept any number of sig.figs. that rounds to 0.04 0.04 , 0.0428 (m) (1) Give full marks for correct answer with no working. 0.04 × any other power of 10 = 2 marks	**(3)**

		Indicative Content	
QWC	***c**	A discussion including some of the following points Possible dangerous e-m radiations Microwaves Infrared Ultraviolet (UV) X-rays gamma rays Correctly linked to Internal heating of body cells (microwaves) Skin burns (infrared) Damages skin cells/sunburn (UV) Damages eyes (UV) Can cause skin cancer (UV) Can cause cataracts (UV) Damage to cells inside the body(X-rays) Mutate/ kill cells in the body (gamma) Damages DNA (X-rays and gamma rays) Link to frequency As the frequency increases/wavelength decreases (microwave -> gamma) the waves become more penetrating and do more damage/danger as they h more energy.	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. gives at least 2 correct radiations and links both to correct damage OR at least 2 correct radiations named with link to correct damage from one and idea that frequency is linked to damage OR just has link between higher frequency and more damage/dangerous e.g. infrared burns your skin and X-rays can damage cells. OR X-rays have a higher frequency than microwaves and can cause cancer OR Higher frequencies cause more damage to cells. • the answer communicates ideas using simple language and uses	

		limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. gives most of the correct radiations and links to correct damage, at least one with detail of the damage that is caused OR links two to detail of the damage, AND has a link between frequency and energy/danger e.g. Microwaves are absorbed by water in body cells. UV can cause skin cancer and damages your eyes. Xrays and gamma rays can damage cells inside your body OR Gamma and X-rays can penetrate deep into the body. Gamma does most damage as it has the highest frequency. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description e.g. gives most of the correct radiations with links to detail of the damage AND explains the link between frequency and energy/danger. e.g Microwaves heat up the water in cells. UV can cause cataracts. Gamma rays are the most penetrating and can mutate cells inside the body because they have the highest frequency. • The answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(**Q28 1SC0/1PH, June 2013**)

Q21.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	X-ray	X	**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	(visible) light	visible (waves)	**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	radio (waves)		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(iv)	gamma / X-rays / ultraviolet	☐☐☐ X / UV	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	an explanation linking: • travel with same speed (1) • in a vacuum / in space (1)	They travel at the speed of light / same numerical speed for all	**(2)**

Question Number		Indicative Content	Mark
QWC	* **(c)**	A description including some of the following points • Harmful effects include (skin) burns, eye damage, (skin) cancer, cell damage, mutation • IR and UV are on either side of visible light (in the em spectrum) • UV has shorter wavelength than IR • UV has higher frequency than IR • higher energy (associated) with UV • IR causes (skin) burns • UV causes damage to eyes / (skin) cancer / damage to cells (not just damage to skin) / sunburn • (potential) danger increases with frequency Ignore • irrelevant information e.g. UV used to scan unborn babies	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description stating one fact about a harmful effect or frequency e.g. skin burns **OR** UV has high frequency (no comparison) • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description making a correct comparison of harmful effects **OR** a frequency comparison e.g. IR causes skin burns and UV causes (skin) cancer **OR** the higher the frequency the more harm they cause **OR** UV has a higher frequency (than IR) • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description including harmful effects of both UV and IR **AND** relating at least one to frequency e.g. UV causes skin cancer but IR (only) causes skin burns as UV has a high(er) frequency • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(**Q01 1SC0/1PF, June 2014**)

Q22.

	Answer	**Acceptable answers**	**Mark**
	C		**(1)**

(**Q18 1SC0/1PF, Mar 2013**)

Q23.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	C travel with the same speeds in a vacuum, have different frequencies		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	{damage to/ionise/mutate} {cells / DNA/tissue/ organs/ fetus} / cause {cancer/tumour}	kills cells/bacteria	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	Gamma, γ, 8, Y	UV, ultraviolet (rays/waves/radiation) Ignore X-rays	**(1)**

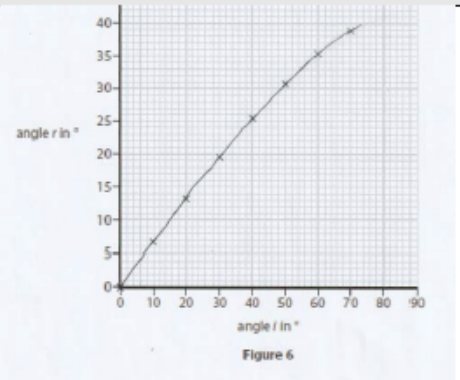
Question Number	Answer	Acceptable answers	Mark
(b)(ii)	one correct use (for UV/X-ray/gamma ray)	for example, (UV) – sunbeds, sterilise, detect banknotes (X-ray) - viewing internal organs / broken bones/airport security (gamma ray) – treat /cure cancer, kill {cells/bacteria} If one incorrect example is given, this mark is lost	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	one from: MP1 heating of (body/human/internal) {cells / organs/tissues} (1) MP2 {heating/boiling/exciting / vibrating} water (in the body) (1)	Accept heating of blood Ignore damages, burns, cancer, mutates, heating (on its own), skin	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	explanation to include any **three** of: MP1 (Phones/ they) use lower frequencies / RA (1) MP2 lower frequency: lower energy / RA (1) MP3 lower {frequency/energy} less (potential) danger / RA (1) MP4 (phones /they) emit less (intense) radiation RA (1) MP5 phones are less powerful (1)	wavelength can suitably replace frequency eg use longer wavelength condone use lower MHz (comparison needed not just values quoted) Accept lower frequency (not energy) does {less /no} {damage/harm} for 2 marks ignore references to penetration ignore references to energy replacing power here For 2 marks -The resonant frequency of water molecules is the same as the oven frequency	**(3)**

(**Q02 1SC0/1PF, June 2014**)

Q24.

Question number	Answer	Additional guidance	Mark
(i)	curve through origin, through all points – by eye (1)	 Figure 6	**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
(ii)	(***r*** =) 42(°) ± 2(°) (1)	ECF their graph	**(1)** **AO3**

Question number	Answer	Additional guidance	Mark
(iii)	Description to include two from: ***r*** increases as ***i*** increases (1) (but) not in proportion (1) increase in ***r*** becomes less (for same increase in ***i***) (1)	 ***r*** increases as ***i*** increases (but) not in even steps/not straight line/non-linear/gradient changes ***r*** always less than ***i***	**(2)** **AO3**

(**Q03a 1SC0/1PH, Nov 2021**)

Q25.

Question	Answer	Additional guidance	Mark
(i)	An explanation linking UVC/it has the smallest wavelength / highest frequency/ highest energy/most ionising (1) (it doesn't cause harm to people because) 100% absorbed by the Earth's atmosphere/no UVC reaches the Earth's surface/people (1)	 allow shortest wavelength allow smaller for smallest / higher for highest / more for most	**2** **AO3.2**

Question	Answer	Additional guidance	Mark
(ii)	wavelength 280(nm) (1) substitution and rearrangement (1) $f = \frac{3.0 \times 10^{8}}{280 (\times 10^{-9})}$ evaluation (1) 1.07×10^{15} (Hz)	allow 2.8 to any power of ten accept numbers that round up to 1.1 $\times 10^{15}$ (Hz) award 2 marks for values that round up to 1.1 to any other power of ten if no other mark scored allow substitution and rearrangement using an incorrect	**3** **AO2.1**

		wavelength for 1 mark award full marks for correct answer without working	

(**QU03a 1SC0/1PH, June 2024**)

Q26.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • the wavelength decreases because wavelength is the ratio of wave velocity to frequency (1) • and the wave velocity reduces at the boundary but the frequency remains the same (1)	allow the same number of waves per second arrive at the boundary as leave it for no change in frequency at the boundary	**(2)**

(Q06a 1SC0/1PH, SAM 2016)

Q27.

Question number	Answer	Additional guidance	Mark
	Explanation linking **three** from: (some) light is <u>reflected</u> (1) (at) the top edge (1) (some) light is <u>absorbed</u> (1) by the glass (1)	 in the air in the (glass) block credit responses in terms of attenuation/ dispersion/reflection at the second face/spreading out	**(3)** **AO2**

(Q03c 1SC0/1PH, Nov 2021)

Q28.

Question number	Answer	Additional guidance	Mark
	explanation linking two from: (damage to) cell(s) (1) (because gamma rays are) ionising / high frequency/very energetic (1) (causing / curing/diagnosing) cancer / mutation / chromosomal damage / dna damage/burns (1)	 (rapid/unwanted) division of cells	**(2)**

(**Q05d 1SC0/1PH, Nov 2020**)

Q29.

Question number	Answer	Additional guidance	Mark
	explanation linking: wave P refracts (towards the normal) (1) because P slows down (1) AND wave Q is reflected (at an equal angle from the boundary) (1) without change of speed of Q (1)	 accept 'upper layer' for 'P' accept 'wavelength decreases' accept 'bends' for 'refracts' in this instance accept 'lower layer' for 'Q' accept 'wavelength unchanged' accept 'wave Q bounces off' (at an equal angle) allow one mark for refraction and reflection if no other mark awarded	**(4)**

(**Q03c 1SC0/1PH, Nov 2020**)

Q30.

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)**

(**Q01b 1SC0/1PH, June 2019**)

Q31.

Question Number	Answer	Additional guidance	Mark
	an explanation linking: infrared is absorbed / blocked (by the armchair/objects) / cannot pass through it **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)	allow stopped transmitted accept comparison	**(2)**

(**Q05b 1SC0/1PF, June 2019**)

Q32.

Question number	Answer	Additional guidance	Mark
	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • the heating effect for the oven and the phone depends on their power (1) • and since the power of an oven is much greater than the power of a phone, the oven produces a greater heating effect (1)	allow not the same wavelength/microwaves cover a range in wavelengths	**(2)**

(**Q01b 1SC0/1PF, SAM 2016**)

Q33.

	Answer	Additional guidance	Mark
	An explanation linking **two** from: to preserve food (1) by 'killing' bacteria (1) (gamma) is (very) penetrating (and so reaches all the food). (1) sterilising (1)	 stop food going off	**(2)** **AO2**

(**Q06b 1SC0/1PH, Nov 2021**)

Q34.

Question Number	Answer	Additional guidance	Mark
(i)	an explanation linking (X-rays/they) pass through/penetrate (the bags/cases) (1) to see contents/to show objects of greater density (1)	 accept see through accept look/see inside accept see contents/check inside	**(2)** **AO1**

Question Number	Answer	Additional guidance	Mark
(ii)	an explanation linking X-rays/they are ionising (1) cause cancer/mutations (of cells/DNA) (1)	 accept harmful/dangerous accept a description of ionising accept high energy accept kill/damage cells	**(2)** **AO2**

(**QU01b 1SC0/1PF, June 2023**)

Q35.

Question Number	Answer	Mark
	B frequency increases ***A*** *is not correct because the danger does not increase with decreasing frequency* ***C*** *is not correct because all waves in the e-m spectrum have the same velocity* ***D*** *is not correct because all waves in the e-m spectrum have the same velocity*	**(1)** **AO1**

(**QU06a 1SC0/1PH, June 2022**)

Q36.

Question number	**Answer**	**Mark**
	[x] **A** — wave velocity: decreases; wavelength: decreases B is not correct because the wavelength does not increase C and are not correct because the wave velocity does not increase	**(1)** **AO1**

(**Q03b 1SC0/1PH, Nov 2021**)

Q37.

Question Number	Answer	Mark
	C red **The only correct answer is C red** **A** is not correct because blue has a shorter wavelength than red **B** is not correct because green has a shorter wavelength than red **D** is not correct because yellow has a shorter wavelength than red	**(1)**

(**Q05a 1SC0/1PF, June 2019**)

Q38.

Question number	Answer	Additional guidance	Mark
	☒ **A** blue (1) **B, C** and **D** have lower frequencies		**(1)** **AO1.1**

(**QU01b 1SC0/1PF, June 2025**)

Q39.

Question number	Answer	Mark
	☒ A blue Green, orange and yellow all have a lower frequency than blue	**(1)**

(**Q01b 1SC0/1PF, Nov 2020**)

Q40.

Question number	Answer	Additional guidance	Mark
	D a TV remote control		**(1)**

(Q01b 1SC0/1PH, SAM)