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IGCSE PHYSICS 0625 · TOPICAL PAST PAPERS

Electromagnetic Spectrum — Paper 1

Worked Answer Key (Multiple Choice)

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Electromagnetic Spectrum — Paper 1 · Worked Answer Key

These are **Megalecture worked answers** for the topical multiple-choice compilation on the **Electromagnetic Spectrum (IGCSE Physics 0625, Paper 1)**. Every answer below was solved from first principles by the Megalecture team. Keep in mind the spectrum order from longest wavelength / lowest frequency to shortest wavelength / highest frequency: **radio** → **microwave** → **infra-red** → **visible light** → **ultra-violet** → **X-rays** → **gamma rays**. All electromagnetic waves are **transverse** and travel at the same speed (3.0×10^8 m/s) in a vacuum/air, related by $c = f\lambda$. Use this key to mark your work and to see the one-line reasoning behind each correct letter.

Q #	Exam reference	Answer	Brief working / reason
1	5054/11 M/J/11 Q24	A	Microwaves are used for cooking (and satellite/mobile communication). Crack detection uses X-rays, sun-tan uses UV, fluorescent tubes use UV — so the only microwave use is cooking vegetables .
2	5054/11 M/J/12 Q23	A	Snell's law: $\sin r = \sin i/n = \sin 40^\circ / 1.46 = 0.6428/1.46 = 0.440 \rightarrow r = \sin^{-1}(0.440) = 26^\circ$. (The ray bends toward the normal on entering the denser glass, so $r < i$.)
3	5054/12 M/J/12 Q25	D	A sunbed uses ultra-violet radiation to tan the skin. (Grill = infra-red, intruder alarm & TV remote = infra-red.)
4	5054/11 M/J/13 Q22	C	All electromagnetic waves travel at the same speed in air (3.0×10^8 m/s), so this is the same for every X-ray. Frequency and wavelength vary across the X-ray band; amplitude depends on intensity.
5	5054/11 M/J/14 Q26	C	Going up the spectrum, wavelength falls. Microwaves have a longer wavelength than visible light — true. (A false: gamma < UV. B false: IR > radio in frequency. D false: same speed.)
6	5054/12 M/J/14 Q27	A	All electromagnetic waves are transverse . They <i>can</i> travel through a vacuum, do <i>not</i> share one frequency, and are absorbed by lead — so only A is correct.
7	5054/12 M/J/15 Q28	A	Television transmission to/from satellites uses microwaves , which pass through the atmosphere with little energy loss.
8	5054/11 M/J/16 Q24	B	Microwaves penetrate the atmosphere without significant loss of energy , which is why they are used for satellite links. (A false: radio > microwave wavelength. C false: same speed. D describes a microwave oven, not satellite use.)
9	5054/11 M/J/16 Q25	B	Gamma-rays are highly ionising and are used in radiotherapy for killing cancerous cells (and sterilising). Fluorescent tubes = UV, pre-natal scanning = ultrasound, sunbeds = UV.

Q #	Exam reference	Answer	Brief working / reason
10	5054/11 M/J/17 Q29	C	Between ultra-violet and radio, in order of increasing wavelength , the spectrum runs visible light → infra-red → microwave. The missing piece is therefore " visible light, infra-red, microwave ".
11	5054/11 M/J/17 Q30	C	Television signals are sent to a satellite by microwaves (sound waves cannot travel through space; IR/light are not used for satellite uplinks).
12	5054/12 M/J/18 Q29	B	An optical fibre guides light by repeated total internal reflection along its core. (Magnifying glass, enlarger and projector use refraction.)
13	5054/12 M/J/18 Q30	D	Infra-red is an electromagnetic wave, so it travels at the speed of light . It is transverse (not longitudinal), non-ionising, and has a <i>lower</i> frequency than UV — so only D is correct.
14	5054/11 M/J/20 Q29	B	Red light is at the long-wavelength end of the visible band, so red light has a lower frequency than violet ($c = f\lambda$ with same c). A prism deviates red <i>less</i> ; red has the <i>longer</i> wavelength; speed in vacuum is the same.
15	5054/12 M/J/21 Q27	D	X-rays and microwaves are both electromagnetic. Sound, water waves and ultrasound are mechanical, so they are ruled out — only D contains two genuine EM members.
16	5054/11 M/J/22 Q23	C	Ultrasound is a mechanical (sound) wave, not electromagnetic. Radio waves, television signals and ultraviolet are all parts of the EM spectrum.
17	5054/11 O/N/11 Q20	C	In air all colours travel at the same speed , and red light has the greater (longer) wavelength than violet. Row C: same speed, greater wavelength.
18	5054/11 O/N/11 Q24	D	Section R has a frequency just below visible light, so R is infra-red . An infra-red application is the television remote controller . (Killing cells/sterilisation = gamma/UV; satellite TV = microwave.)
19	5054/11 O/N/13 Q22	D	Detecting cracks inside metal uses X-rays , whose frequency band in the table is 10^{18} Hz to 10^{21} Hz. The matching range is 10^{18} Hz to 10^{22} Hz .
20	5054/11 O/N/14 Q24	D	Microwaves are used for satellite television . Crack detection = X-rays, sun-tan = UV, fluorescent tube = UV — so D is the only microwave application.
21	5054/11 O/N/14 Q25	D	Sound is a mechanical wave that needs a medium, so it cannot cross the vacuum of space. Infra-red, light and radio are electromagnetic and do reach the Earth.
22	5054/12 O/N/15 Q20	D	

Q #	Exam reference	Answer	Brief working / reason
			Infra-red is electromagnetic, so it can travel in a vacuum and in gases (and in transparent solids/liquids). The statements claiming it cannot travel in a vacuum are false.
23	5054/11 O/N/16 Q28	B	Both gamma-rays and X-rays are ionising: they are used to kill cancerous cells <i>and</i> to detect cracks in metal (radiography). Microwaves and UV cannot do both.
24	5054/12 O/N/16 Q25	A	All electromagnetic waves are transverse — true. Not all transverse waves travel at 3×10^8 m/s (water waves do not); longitudinal waves can be refracted; water waves are transverse — so only A holds.
25	5054/11 O/N/17 Q23	A	Ionising + frequency higher than microwaves + invisible → high-frequency EM radiation. Of the options, only gamma rays are ionising (IR, light and radio are not). Answer: gamma rays .
26	5054/12 O/N/17 Q24	C	A sunbed uses ultra-violet , which lies just beyond visible light on the short-wavelength side. With order radio A B visible light C D gamma rays, UV sits at position C (between visible light and gamma rays).
27	5054/12 O/N/18 Q26	C	Radio waves are used in television communications . They are electromagnetic (not sound), are not used to kill cancer cells, and have frequencies <i>lower</i> than visible light — so only C is correct.
28	5054/11 O/N/19 Q25	B	All EM waves share the same speed in air, so the speed must stay 3.0×10^8 m/s . Radio waves have a <i>lower</i> frequency than the 3.0×10^9 Hz microwaves, so 3.0×10^5 Hz fits → row B .
29	5054/12 O/N/20 Q25	B	Correct uses: X-rays → killing cancerous cells ; ultraviolet → sterilising surgical instruments ; microwaves → satellite television . Only row B matches all three.
30	5054/11 O/N/21 Q24	B	A television remote control emits infrared rays . (Gamma, radio and UV are not used for short-range TV remotes.)
31	5054/12 O/N/21 Q27	C	Time = distance / speed = $300\,000 \text{ m} / (3.0 \times 10^8 \text{ m/s}) = 1.0 \times 10^{-3} \text{ s}$. (Radio signals travel at the speed of light.)

Note from Megalecture. These are original Megalecture worked solutions prepared for revision use. Watch for the recurring traps in this topic: every EM wave is **transverse** and travels at the same **speed** in a vacuum/air, only the **frequency** and **wavelength** change along the spectrum, and **sound/ultrasound** are mechanical waves that are *not* part of the electromagnetic spectrum.