Mark scheme

Electromagnetic spectrum

Physics 0625 · Questions from Paper 3 and Paper 4

Total marks

70

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
4	6	7	7	7	9	6	8	7	9	**70**

Question 1 [4]

1 **(a)** infra-red B1

(b) infra-red B1

(c) X-rays B1

(d) microwaves B1

[Total: 4]

Question 2 [6]

2(a)	microwaves (after radio waves)	**B1**
	X-rays (after ultraviolet)	**B1**
2(b)	(use of infrared) any **one** from: electric grills, short range communications such as remote controllers for televisions, intruder alarms, thermal imaging, optical fibres, (heating) solar panels	**B1**
	(use of ultraviolet) any **one** from: security marking, detecting fake bank notes, sterilising water / food	**B1**
2(c)	(infrared can cause) (skin) burns	**B1**
	(ultraviolet can cause) damage to (surface / skin) cells / eyes OR skin cancer OR can cause eye conditions e.g. cataracts	**B1**

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Question 3 [7]

3(a)(i)	microwaves	1
3(a)(ii)	3.0×10^8 (m / s)	1
3(a)(iii)	ultraviolet or X-rays or gamma/γ-rays	1
3(b)(i)	X-rays any one from: detecting broken bones/damaged teeth or detecting/treating cancer	1
	gamma: any one from: detecting/treating cancer or sterilising (hospital) equipment/food	1
3(b)(ii)	any **two** from: ionising radiations/high frequency/high energy (e-m radiation) (may) damage or mutate cells/DNA (may) cause radiation burns	2

Question 4 [7]

4(a)(i)	infra-red	B1
4(a)(ii)	frequency	B1
4(b)(i)	any two different applications from: • (medical) imaging **OR** detecting fractures in bone **OR** specific example e.g. CT scan / imaging teeth at dentist • detecting faults in metal • security imaging e.g. airport security checks of bags • cancer treatment	B2
4(b)(ii)	any two from: • behind a screen **OR** lead apron • large distance from X-ray beam • monitoring of **OR** restricting exposure • low dosage **OR** limit exposure time • monitor frequency of x-ray sessions • other people not allowed in room when X-ray being taken • avoid when pregnant	B2
4(b)(iii)	same speed	B1
		Total: 7

Question 5 [7]

5(a)(i)	top – visible light	B1
	bottom – microwaves	B1

5(a)(ii)	any **two** from: transverse wave travel at same speed do not need a medium	B2
5(b)(i)	X-rays	B1
5(b)(ii)	infrared	B1
5(b)(iii)	microwaves	B1

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Question 6 [9]

6(a)(i)	(1st box/next to visible) ultraviolet (rays)	B1
	(2nd box/next to gamma) X-rays	B1
6(a)(ii)	detection and treatment of cancer OR imaging/gamma photography OR (space) telescopes OR sterilisation of food/medical equipment	B1
6(a)(iii)	statement: (radiations arrive) at same time	M1
	reason: (because they have) same speed (in a vacuum)	A1
6(b)(i)	use of peaks to find time interval	C1
	0.2 (s)	A1
6(b)(ii)	frequency = number of pulses per s	C1
	5 (Hz)	A1

Question 7 [6]

7(a)(i)	3.0×10^8 m / s	B1
7(a)(ii)	radio (waves)	B1
7(a)(iii)	infra-red (radiation) X-rays **or** Röntgen rays	B1 B1
7(b)(i)	less energy wasted **or** danger (to people nearby)/harmful	B1
7(b)(ii)	satellite communication / television **or** mobile / cell telephones **or** other sensible use (e.g. radar)	B1
	Total	6

Question 8 [8]

8(a)	any **two** from: remote controls (infrared) sensors / alarms specific electrical appliances thermal imaging	B2
8(b)	Any **three** from • shielding of operator behind screen / lead apron / out of room AND to absorb radiation • shielding of other parts of patient with lead / shielding of other parts of patient AND to absorb radiation • distance from source AND reduces intensity / amount of radiation / exposure • limit time of exposure / not too frequent / max number of X-rays per year AND to limit dose • limit strength / intensity of X-ray beam AND to limit dose	B3
8(c)(i)	**1** 3×10^8 m / s	B1
	2 3×10^8 m / s	B1
8(c)(ii)	> 20 000 Hz	B1

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Question 9 [7]

9(a)	use of electromagnetic radiation: Bluetooth headset; thermal imaging; photography of people's faces; sterilising medical equipment region of electromagnetic spectrum: gamma rays; radio waves; infrared; visible light all correct 2 marks 1 or 2 correct 1 mark	**B2**
9(b)	3.0×10^8 m / s	**B1**
9(c)(i)	0.12 m	**A3**
	(mid-point of frequency range identified as) 2.44 (GHz)	C1
	$v = f\lambda$ **OR** (λ =) v / f **OR** (λ =) $3.0 \times 10^8 / 2.44 \times 10^9$ **OR** (λ =) 1.2×10^N	C1
9(c)(ii)	(radio waves / signal) lose energy / get weaker / lose (signal) strength (passing through walls) owtte	**B1**

Question 10 [9]

10(a)	(wavelength =) 0.16 m	**A2**
	$v = f\lambda$ **OR** (λ =) v / f **OR** (λ =) $3 \times 10^8 / 1.9 \times 10^9$	C1
10(b)	(microwaves) only need short aerials / antennas	**B1**
	(microwaves) penetrate (some) walls	**B1**

10(c)(i)	labelled diagram of digital (signal) with blocks of high (1) and low (0) **AND** labelled diagram of analogue with continuously variable signal	**B1**
	digital (signal) consists of <u>two</u> values owtte	**B1**
	analogue (signal) varies over a range (of values) owtte	**B1**
10(c)(ii)	any **two** from: • faster (data) transmission rate **OR** data can be compressed • data / signal transmitted over long(er) distances (as signal can be regenerated) • noise easily removed (from signal / data) **OR** signal can be regenerated	**B2**

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