

Electromagnetic Waves Uses & Danger 3 MS

Question 1			
question	answers	extra information	
(a)	20000	accept any unambiguous indication	
(b)	kilohertz	credit misspellings credit '1000 hertz' or '1000 Hz' accept 1000 oscillations/beats/waves <u>per second</u>	1
(c)(i)	cleaning (e.g. something delicate such as a watch)	or quality control/flaw detection credit any appropriate extra Specification response e.g. sonar	1
(c)(ii)	pre-natal (scanning)	do not credit just 'scanning'/medical scanning credit any appropriate extra Specification response e.g. destruction of (kidney) stones or cleaning teeth	1
(d)	8 (μ s)		1
(e)	distance (1) between the <u>boundary</u> and the detector (1)	accept 'between the <u>boundary</u> and the source' accept any correct use of speed = distance/time	2
(f)	examples publish/tell doctors/the public (1) ... their evidence/results/	allow a wide variety of appropriate responses valid point (1)	2

	research/data (1) carry out more research/ tests (1) ... to make sure/check reliability (1)	appropriate example/ qualification/expansion/etc. (1) allow just 'stop using them/ultrasonic waves' (1) allow using them (only) for industrial purposes (1)	
Total			9
Question 2			
(a)	sound / mechanical / longitudinal (wave) any one from: <ul style="list-style-type: none"> • above 20 000 hertz / 20kHz • above (human) audible range • cannot be heard by humans 		1 1
(b)	either particles / molecules / fluid vibrate(s) (1) (and) knock particles of dirt off the jewellery (1) or by the process of cavitation (1) which breaks up / releases dirt from		2
		accept 'formation and collapse of tiny bubbles'	

	the surface (1)		
(c)	<p>either</p> <p>two appropriate points gain 1 mark each</p> <p>or</p> <p>one appropriate point (and) appropriate qualification / amplification</p>	<p>either both pro or both con or one of each</p> <p>examples other mammals (sufficiently) similar to humans (1) so results appropriate (1)</p> <p>unethical to experiment on humans (1) so it is better to experiment on mice (1)</p> <p>knowledge / techniques will benefit humans (1) and also other animals (1)</p> <p>experiments were justified because ultrasound has proved useful (1)</p>	2
(c)	<p>either</p> <p>two appropriate points gain 1 mark each</p> <p>or</p> <p>one appropriate point (and) appropriate qualification / amplification</p>	<p>either both pro or both con or one of each</p> <p>examples other mammals (sufficiently) similar to</p>	2

		humans (1) so results appropriate (1)	
		unethical to experiment on humans (1) so it is better to experiment on mice (1)	
		knowledge / techniques will benefit humans (1) and also other animals (1)	
		experiments were justified because ultrasound has proved useful (1)	
Total			6
Question 3			
(c)(i)	substance reflection	correct order essential	1 1
(c)(ii)	detector		1
Total			3
Question 4			
(a)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.		6
0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)

<p>No relevant / correct content .</p>	<p>There is a basic description of either wave OR What happens to either wave when they enter the body. However there is little other detail.</p>	<p>There is either: A clear description of BOTH waves OR A clear description as to what happens to BOTH waves inside the body OR A clear description of ONE of the waves with clear detail as to what happens to either wave inside the body.</p>	<p>There is a detailed description of BOTH of the waves AND A detailed description as to what happens to EITHER wave inside the body.</p>
	<p>Examples of the points made in the response:</p> <p><u>Description of an X-ray</u></p> <ul style="list-style-type: none"> • X-rays are electromagnetic waves / part of the electromagnetic spectrum • X-rays are (very) high frequency (waves) • X-rays are (very) high energy (waves) • X-rays have a (very) short wavelength • Wavelength (of X-rays) is of a similar size to (the diameter of) an atom • X-rays are a transverse wave • X-rays are ionising radiation 	<p>do not allow a description of a property – eg X-rays travel through a vacuum / at the speed of light</p> <p>correct description acceptable – oscillations / vibrations are perpendicular (at 90°) to direction of energy transfer</p>	

	<p><u>Description of ultrasound</u></p> <ul style="list-style-type: none"> ultrasound has a <u>frequency</u> above 20 000 (hertz) <p>OR</p> <ul style="list-style-type: none"> ultrasound is above / beyond the human (upper) limit (of hearing) ultrasound is a longitudinal wave <p><u>Statement(s) as to what happens to Xrays inside the human body:</u></p> <ul style="list-style-type: none"> X-rays are absorbed by bone X-rays travel through / are transmitted by tissue / skin <p><u>Statement as to what happens to ultrasound inside body:</u></p> <ul style="list-style-type: none"> ultrasound is (partially) reflected at / when it meets a boundary between two different media travel at different speeds through different media 	<p>accept ultrasound cannot be heard by humans</p> <p>correct description acceptable – oscillations / vibrations (of particles) are parallel (in same direction) to direction of energy transfer</p>	
(b)	<p>(because the X-rays) are <u>ionising</u></p> <p>(they will) damage cells</p> <p>or</p>	<p>accept a description of what ionising is</p> <p>instead of cell, any of these words can be used:</p>	<p>1</p> <p>1</p>

	mutate cells / cause mutations / increase chances of mutations or turn cells cancerous / produce abnormal growths / produce rapidly growing cells or kill cells	DNA / genes / chromosomes / nucleus do not accept they can be dangerous (to human health) do not accept damage to soft tissue	
(c)	any one from: <ul style="list-style-type: none"> removal / destruction of kidney / gall stones repair of damaged tissue / muscle removing plaque from teeth 	accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation accept physiotherapy accept curing prostate cancer or killing prostate cancer cells cleaning teeth is insufficient	1
Total			9
Question 5			
(a)	(sound waves) which have a frequency higher than the upper limit of hearing for humans or a (sound) wave (of frequency) above 20 000 Hz	sound waves that cannot be heard is insufficient a wave of frequency 20 000 Hz is insufficient	1
(b)	640	an answer of 1280 gains 2 marks	3

		<p>allow 2 marks for the correct substitution ie 1600×0.40 provided no subsequent step</p> <p>allow 2 marks for the substitution <u>1600×0.80</u> 2 provided no subsequent step</p> <p>allow 1 mark for the substitution 1600×0.80 provided no subsequent step</p> <p>allow 1 mark for the identification that time (boat to bed) is 0.4</p>	
(c)	<p>any one from:</p> <ul style="list-style-type: none"> • pre-natal scanning / imaging • imaging of a named organ (that is not surrounded by bone), eg stomach, bladder, testicles • Doppler scanning blood flow 	<p>accept heart</p> <p>do not allow brain or lungs (either of these negates a correct answer)</p>	1
(d)	<p>advantage any one from:</p> <ul style="list-style-type: none"> • (images are) high quality or detailed or high resolution • (scan) produces a slice through the body • image can be viewed from any direction 	<p>clearer / better image is sufficient</p> <p>allow images are (always) 3D / 360°</p> <p>allow whole body can be scanned</p>	1

	<ul style="list-style-type: none"> an image can be made of <u>any</u> part (inside the body) easier to diagnose or see a problem (on the image) <p>disadvantage any one from:</p> <ul style="list-style-type: none"> (the X-rays used or scans) are <u>ionising</u> mutate cells or cause mutations or increase chances of mutations turn cells cancerous or produce abnormal growths or produce rapidly growing cells kill cells shielding is needed 	<p>allow a description of what ionising is</p> <p>allow for cells: DNA / genes / chromosomes / nucleus / tissue</p> <p>damage cells is insufficient</p> <p>can be dangerous (to human health) unqualified, is insufficient</p>	1
Total			7
Question 6			
(a)	20,000	accept 20 kilo or 20 k or 20 001	1
	an atom		1
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a 'best-fit' approach to the marking.			
0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)

no relevant content	At least one relevant statement is given for either type of wave	<p>Either a use, risk and precaution is given for one type of wave</p> <p>Or</p> <p>A medical use is given for both types of wave plus a risk or precaution for one type of wave</p>	At least one medical use is given for both types of wave linked to the risks and any precautions necessary
<p>examples of the points made in the response</p> <p><u>Medical use of X-rays</u> Any one from:</p> <ul style="list-style-type: none"> • Detecting bone fractures • Detecting dental problems • Killing cancer cells • CT scanning <p><u>Risks with X-rays</u> X-rays pose a risk / danger / hazard X-rays cause ionisation / damage to cells</p> <p>or</p> <p>mutate cells / cause mutations / increase chances of mutations or turn cells cancerous / produce abnormal growths / produce rapidly growing cells or kill cells</p>		<p>extra information</p> <p>Ignore details about how Xrays/ultrasound work</p> <p>accept any specific use of X-rays, eg</p> <ul style="list-style-type: none"> • detecting heart/lung disorders (with chest X-rays) • mammograms / breast cancer detection • detecting stones / bowel disease (with abdominal X-rays) <p>accept are harmful</p> <p>accept a description of what ionising is</p> <p>instead of cell, any of these words can be used: DNA / genes / chromosomes / nucleus</p> <p>accept (may) cause cancer</p>	
<p><u>Operator precautions with X-rays</u> The X-ray operator should go behind a (metal / glass) screen / leave the room when making an X-ray / wear a lead lined apron</p>		<p>accept appropriate precautions for the patient e.g. limit the total exposure/dose (in one year)</p>	

<p><u>Medical use of ultrasound</u> Any one from:</p> <ul style="list-style-type: none"> • Pre-natal scanning • Imaging (a named body part). • removal / destruction of kidney / gall stones • removing plaque from teeth • repair of damaged tissue / muscle <p><u>Risks with ultrasound</u> Ultrasound poses no risk / danger / hazard (to the user / patient).</p> <p>Ultrasound is not ionising</p> <p>or</p> <p>Ultrasound does not damage (human) cells</p> <p><u>Precautions with ultrasound</u> The operator needs to take no precautions when making an ultrasound scan.</p>	<p>wear a radiation badge is insufficient</p> <p>cleaning teeth is insufficient</p> <p>accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation accept physiotherapy accept curing prostate cancer or killing prostate cancer cells</p> <p>accept ultrasound is safer than using Xrays.</p> <p>this can be assumed if it is stated that ultrasound is harmless or it is safer than using x-rays or it is non-ionising</p>	
Total		8