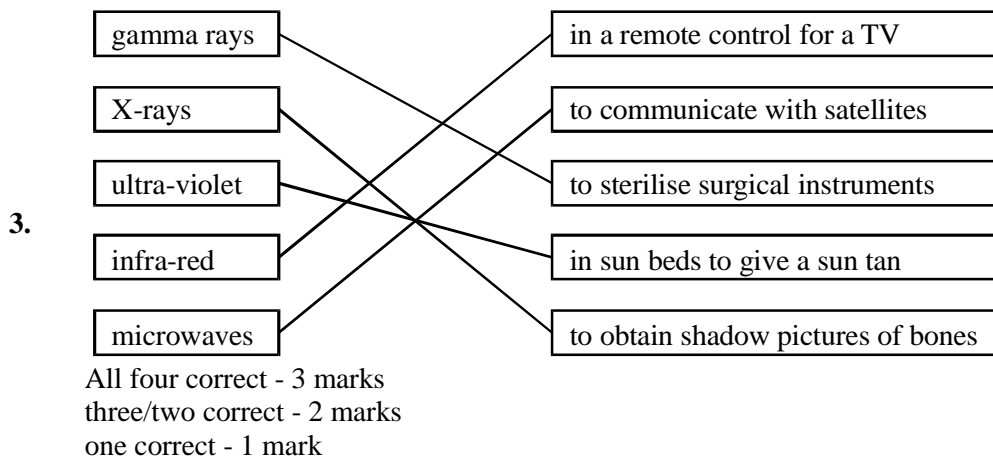


## ELECTROMAGNETIC WAVES

1. (a) wavelength increases;  
frequency decreases; 2
- (b) Any two from:  
1. gamma ray;  
2. X-ray;  
3. ultraviolet;  
4. microwaves; 2
- (c) correct use for named wave;  
one mark each correct detail;; 3
- eg microwaves - used to cook food;  
- reference to absorption of microwaves;  
- causing heating;
- [7]

2. (a) infra-red; 1
- (b) heating/cooking/remote control/any appropriate use;  
[Answer to this part must be a correct use of the answer given in part (a)] 1
- [2]



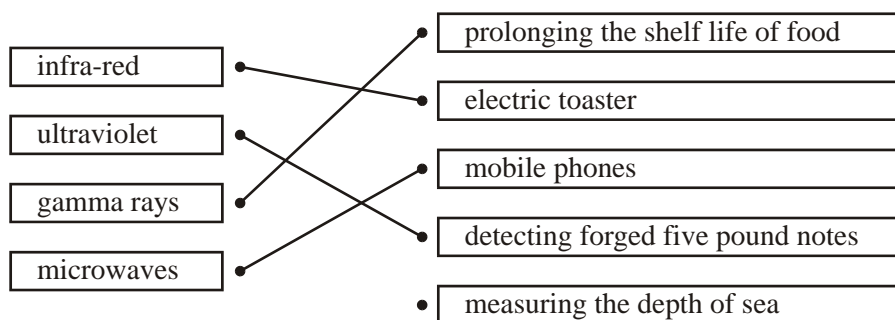
4. (a) Any two from:  
1. all transverse waves;  
2. all travel at the speed of light;  
3. can all travel in a vacuum; 2
- (b) (i) red; 1  
(ii) violet/blue; 1
- (c) (i) sun tan/security marking of equipment; 1  
(ii) kill cancerous cells/sterilising medical equipment/  
treating cancer; 1
- (d) ultraviolet - skin cancer;  
gamma - radiation/burns/cancer/destroys cells; 2
- [8]



5. (a) (i) microwave; 1  
(ii) ultraviolet; 1  
(iii) looking at broken bones / any **correct** use; 1  
(iv) cell damage / cancer / sterility / damage to unborn babies; 1  
(v) Any two from: 2  
1. transverse;  
2. same speed (in vacuum);  
3. travels in a vacuum;
- [Accept any **correct** wave property]
- (b) at least three waves shown (after the gap);  
diffracted (arc spreading out) – no flat bits;  
no change in wavelength; 3
- (c) **Either** a suggestion to include:  
1. light is not diffracted / light travels in straight lines;  
2. not a wave / a particle;  
**or** a suggestion to include two from:  
1. light is a wave;  
2. wavelength is very small;  
3. gap too large; 2
- plus 1 communication mark for use of a suitable structure and style  
of writing 1

[12]

6.



[Do not credit two lines from one box]

[4]

7. (a) (i) higher the frequency the greater the energy / ORA; 1  
(ii) An explanation to include:  
1. can penetrate body / skin;  
[Allow absorb / enter]  
2. causing effects such as mutations, skin cancer etc /  
ionise the cells / damage cells / tissue; 2  
(iii) as the frequency increases the wavelength decreases;  
(may write  $v = \lambda \times f$ ) 1

- (b) Any two correct statements, for example:
1. ultrasound are sound waves, radio waves are electromagnetic waves;
  2. ultrasound are longitudinal, radio waves are transverse;
  3. radio waves travel at the speed of light, ultrasound are much slower;  
[Allow faster than]
  4. radio waves can travel through a vacuum, ultrasound needs a medium;
- [NB **comparison** has to be made]  
[Ignore references to uses, wavelength and frequency]

2

[6]

8. (a) ultraviolet / uv; 1
- (b) gamma (rays) /  $\gamma$ ; 1
- (c) gets longer / increases; reject wider 1
- (d) infra-red (rays) / IR; 1
- (e) An explanation to include three of;  
pulses / (radio) / (micro) waves / radar transmitted/  
/ sent out / emitted / given off by aerial; [ignore signals]  
  
reflected off the aeroplane; [reject bounces off]  
(reflected pulses) received/ detected by the aerial;  
time taken (difference) between transmission and  
detection (indicates position / flight path of aeroplane )  
/some indication of use of time (difference) /angle  
( to provide position );  
may draw on diagram – possibly 2. 3

[7]

9. (a) refraction towards normal in block; (must emerge at bottom surface)  
emergent ray correctly refracted; (approx parallel to incident) 2
- (b) (i) sunbeds/ security marking – detection of forged bank notes/  
fluorescent lamps/treatment of skin complaints/ sterilisation of  
water/hardening fillings;  
IGNORE: uv lamps 1
- (ii) uv higher frequency/visible lower frequency;  
uv shorter wavelength/visible longer wavelength;  
travel at the same speed; accept labelled diagram 2
- (c) (i) X-rays absorbed stopped/by bone;  
pass through/flesh/(soft) tissue/muscle;  
IGNORE arm/see through skin etc.  
they affect a photographic film/darken photographic plate; 3
- (ii) kills/damages cells/DNA/genes/chromosomes/cause cancer/mutations/  
infertility;  
ionisation;  
IGNORE damages tissue; 1

[9]

<b>10.</b>	(a)	television remote control to infra-red; loudspeaker to sound; sunbed to ultraviolet;	3	
	(b)	sound;	1	
	(c)	ultraviolet;	1	<b>[5]</b>
<b>11.</b>	(a)	Decreases/goes down/gets less/lower/reduces/OWTEE;	1	
	(b)	(i) Cooking/heating food/drinks/things/drying flowers/herbs/communications/satellite transmissions/send signals; (ignore messages)	1	
		(ii) sunbeds/securitymarking/fluorescent lamps/detecting forgeries/hardening fillings in teeth/checking banknotes;	1	
		(iii) sterilising/treating cancer/killing cancer cells/tracing/examining welds; (ignore cleaning surgical instruments)	1	
	(c)	Any two from: speed decreases/goes down/gets less/lowers/reduces; wavelength decreases/goes down/gets less/lowers/reduces; direction changes/bends/angle changes(accept refraction);	2	<b>[6]</b>