

Question number	Answer	Notes	Marks
1 (a) (i)	any two from: - MP1. travels at speed of $3 \times 10^8$ m/s; MP2. travels in a vacuum; MP3. transverse wave; MP4. transfer energy / information; MP5. can be reflected/refracted/diffracted;	travel at the same speed /speed of light	2
(ii)	B gamma rays;		1
(b) (i)	step- up;		1
(ii)	<div style="border: 1px solid red; padding: 5px; width: fit-content;"> <math display="block">\frac{\text{input (primary) voltage}}{\text{output (secondary) voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}</math> <math display="block">\frac{V_p}{V_s} = \frac{n_p}{n_s}</math> </div>	allow equation in any rearrangement	1
(iii)	substitution; rearrangement; evaluation; e.g. $\frac{230}{2000} = \frac{110}{n_s}$ $n_s = \frac{110 \times 2000}{230}$ $n_s = 960$	sub and rearrangement in either order	3
(iv)	to protect user from high voltage/eq;	allow plastic is an insulator to prevent (electric) shock	1
Total 9 marks			

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2 (a)	<p>cooking – micro(waves) OR infrared (waves);</p> <p>treating cancer – ultraviolet OR x-rays OR gamma (rays);</p> <p>identifying broken bones - x-rays;</p>	if more than one example given for each use then reject mark if any incorrect	3
(b)	C - the same speed;		1
(c) (i)	<p>drawn ray shows refraction in the correct direction (downwards) at <b>both</b> surfaces;</p> <p>drawn ray is above yellow ray and diverges from it (if ray had entered at the original point);</p>	<p>judge by eye ignore arrows and labels dependent on previous</p> <p>allow if ray drawn enters <b>parallel</b> to original ray</p>	2
(ii)	A- black;		1

Total 7 marks

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3 (a) (i)	Any one of- MP1 Speed / velocity (in a vacuum); MP2 Transverse (wave); MP3 Electromagnetic (wave); MP4 A general wave property;	e.g. reflection, refraction, diffraction, transfer energy	1
(ii)	Any two of-  Frequency; Wavelength; Energy;	Any wavelength or frequency relationship if stated must be correct	2
(b) (i)	There are more than two values;  Reference to shape/slope/ramp(s);	Accept peaks not all same height not just 1 and 0  Accept RA Ignore "analogue"	2
(ii)	MP1 More than one gap measured / averaging seen;  MP2 Value of 1.15 or 1.35 (s);	Allow 2 marks for bald answers of: 1.15 or 1.35 (s) Allow 1 mark (MP1) for bald answers of: 1.2, 1.25, 1.4, 1.55 (s)	2
(iii)	Calculation of frequency (from $f = 1/T$ );  Unit to match value; e.g. $f = 1/1.15 = 0.87$ Hz	Allow e.c.f from time value given in (b)(ii)  $1/1.35 = 0.74$	2

**Total 9 marks**