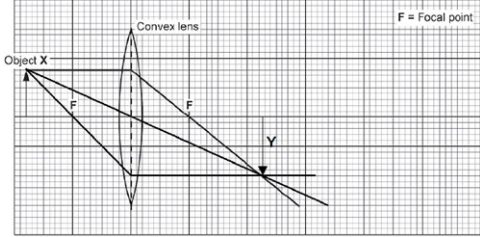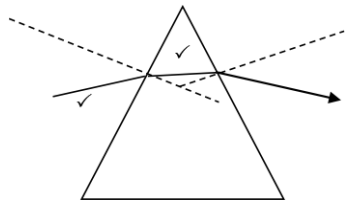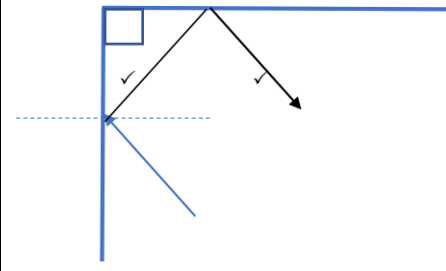# Mark scheme – Wave Interaction (H)

	Question		Answer/Indicative content	Marks	Guidance
1			**B** ✓	**1 (AO1.2)**	**Examiner's Comments** Higher ability candidates were able to correctly apply their knowledge of refraction through a prism (option B). Most lower ability candidates chose one of the distractors and were unable to explain why violet light is refracted more than red light.
			Total	**1**	
2			**D** ✓	1 (AO2.2)	
			Total	**1**	
3	a		There is no (known) risk associated with ultrasound / ultrasounds are safer than X-rays / X-rays pass through soft tissue (so would not detect the kidney) / X-rays are ionising (radiation) ✓	1 (AO1.1)	**ALLOW** X-rays used to detect bones/pass through kidney **ALLOW** ultrasound detects soft tissue/organs
	b	i	0.0022 (m) ✓	1 (AO2.2)	
		ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.0 × 10^6 (Hz) award 4 marks** (Rearrange: frequency =) speed / wavelength **OR** (f =) 4500 / 0.0022 ✓ (f =) 2 045 455 (Hz) ✓ (f =) 2 000 000 (Hz) ✓ (f =) 2.0 × 10^6 (Hz) ✓	4 (AO1.2) (AO2 x 2.1) (AO1.2)	**ALLOW** ecf from **(i)** **ALLOW** three marks for 2.0 MHz **ALLOW** a mark for their answer to 2 significant figures **ALLOW** a mark for their answer in standard form
	c		Decreases ✓ Stays the same ✓	2 (AO2 × 2.1)	
	d	i	(Partial) reflection/absorption at the front of the kidney ✓ (Partial) reflection at the back of the kidney ✓	2 (AO2 × 2.1)	Both of the marking points can be awarded by a suitably clear diagram (or additional drawings on the given diagram) **ALLOW** 1 mark maximum for just reflection/bounces back

		ii	Measure the <u>time</u> between reflections ✓ Use distance = ½ x speed x time (to find the size) ✓	2 (AO2 × 2.2)	**ALLOW** distance = speed x time and mention of time halve
			Total	**12**	
4	a	i	**Either** ray (centre ray or focal ray) drawn as indicated below ✓ Image upside down **AND** in the correct place ✓	2 (AO2 × 2.2)	**ALLOW** just one ray drawn If no rays drawn (or incorrect) but image is inverted, slightly larger and roughly in the correct place then award this mark **IGNORE** position of Y (if arrow is in the correct place) **ALLOW** tolerance of +/- 2 squares for image position
	b		A (red) filter is needed ✓ (The red filter) absorbs all colours/frequencies/wavelengths except red (light) ✓	2 (AO2 × 2.1)	**ALLOW** The red filter absorbs blue and green (light/frequency/wavelength) (but not red) **ALLOW** the filter transmits red light <u>only</u> / <u>only</u> lets red (light/frequency/wavelength) through
			Total	**4**	
5	a	i	(Filter X lets through) red, orange and yellow ✓	1 (AO 3.2b)	**DO NOT ALLOW** any extra colours
		ii	(Filter Y absorbs) orange and yellow ✓	1 (AO 3.2b)	**DO NOT ALLOW** any extra colours
	b	i	**Any one from:** Red (wall) absorbs all colours (in the light except red) ✓ (The wall) only reflects red light ✓	1 (AO 2.1)	**ALLOW** there is no red in the coloured light to reflect / AW **ALLOW** (wall) cannot reflect other colours (of light) **Examiner's Comments** Over half of the candidates were able to answer this question correctly. Incorrect answers involved misconceptions about the

				'coloured lights mixing' to give black or the lights being transmitted by the wall.
	ii	**Any two from:** green ✓ blue ✓ indigo ✓ violet ✓ cyan ✓	1 (AO 2.1)	**DO NOT ALLOW** orange / yellow / magenta
c	i	Ray of green light focused between lens and F_R ✓	1 (AO 1.2)	
	ii	green has shorter wavelength or higher frequency (than red) / shorter wavelengths refract more / show a larger change in speed / green light slows down more (than red light) / AW / ORA ✓	1 (AO 2.1)	**IGNORE** green (light) refracts more **IGNORE** just green (light) slows down **Examiner's Comments** Question 18e assessed candidates' knowledge of the refraction of different colours of light through a convex lens. It was evident that the majority of candidates did not know that green light would focus between the lens and FR because it has a shorter wavelength and therefore refracts more.
	iii	long sighted ✓ (Because lens is) convex/focusing/converging ✓	2 (AO 3.1a) (AO 3.2b)	Mark independently **Examiner's Comments** This question discriminated well. Most candidates successfully identified that the lens was suitable for correcting long-sight and the more able could also explain that it was because the lens was convex.
d		Diagram showing correct refractions 	2 (AO 2x1.2)	If diagram is incorrect, maximum of one mark from: any rising line in air before the prism ✓ a line in the prism close to horizontal by eye and joining the exit ray ✓ **IGNORE** any arrows on rays **Examiner's Comments** This question proved very difficult for most candidates. Although some candidates could accurately draw the ray of light as it travelled through the glass prism, only the more able gained 2 marks.

e			2 (AO 2×1.2)	One mark for each correct reflection of about 90o by eye IGNORE any arrows on rays
		Total	**12**	