Waves 2 - Answers

1.

(a)(i)	λ = distance between neighbouring crests/ troughs (WTTE) {*do not accept 'length of one wave'*}		B1
(ii)	f =	number of waves/ cycles/ vibrations per second (WTTE) passing a point OR produced by the wave source (WTTE)	B1 B1
(iii)	v =	distance travelled by the wave per second (WTTE) {*do not accept v = 'distance / time' OR v=fλ*}	B1 **[4]**
		{*allow labelled diagrams used to define terms*}	
(b)		In 1 second f waves are produced each of length λ (WTTE) (hence) distance travelled by first wave in 1 second = $f \times \lambda$ (hence) $v = f \times \lambda$	B1 B1 B1 **[3]**
		{*allow any other valid proof:* *e.g. v = d/t ---- B1; where d = wavelength AND t = period AND* and since t = 1/f $\Rightarrow$ v = fλ	B1 B1
(c) (i)		valid scales labelled on displacement axis AND time axis smooth sinusoidal {*generously judged*} wave drawn amplitude correctly shown: 1.2 cm above and below time axis period (0.04s) correctly shown with at least 2 full cycles drawn	B1 B1 B1 B1 **[4]**
(ii)		wave source vibrates in the same direction as the wave (WTTE) {*allow 'vibrates/moves backwards and forwards' but not just 'source vibrates'*}	B1 **[1]**
(iii)		Frequency = 1/period $\lambda = v/f = 340 \times 0.02$ λ = **6.8** m	C1 C1 A1 **[3]**

2.

(a)		the spreading out of wavefront/waves {*do not allow "spreading out of light/sound" "bending of light/waves"*}	B1
		when they pass through a gap (OR pass an obstacle)	B1 **[2]**
(b)(i)		a straight strip (OR bar OR ruler) is vibrated vertically OR up and down (in the water)	B1 B1 **[2]**
(ii)		increase the frequency (of the waves/wave source) OR use a shallower depth of water	B1 **[1]**
(c)(i)		semicircular wavefronts drawn no change in λ : i.e approx. same λ before & after gap	B1 B1 **[2]**
(ii)		less diffraction occurs wavefronts only slightly curved at edges (WTTE) (OR diagram) { *full marks may be scored from a valid diagram*}	B1 B1 **[2]**
(iii)		Wavelength of light much smaller than most normal gaps	B1 **[1]**

3.

(a)(i) longitudinal = vibrations in **same direction as wave** (WTTE) B1

transverse = vibrations at **90° to wave direction** (WTTE) B1 **[2]**

{accept any word implying vibration e.g. oscillations / movements}
{Allow 1 mark only for longitudinal = compressions and rarefaction
AND transverse = crests and troughs}
Allow 1 mark for imprecise comparison e.g. using the word 'travel'}

(ii) ANY THREE valid phenomena: B1 + B1 + B1: e.g. **[3]**
REFLECTION REFRACTION DIFFRACTION
INTERFERENCE OR Superposition' OR 'Coherence' OR Standing waves
Allow "both convey/transfer energy" but reject "both obey v=fλ" or both have a frequency, wavelength or velocity

(iii) **POLARISATION** B1

relevant diagram: e.g. showing unpolarised radiation with vibrations in many planes OR plane polarised light blocked by a polariser at 90° B1

explanation: e.g. statement/diagram showing polarised radiation

OR explanation of why polarisation is impossible for longitudinal waves B1 **[3]**

(b)(i) each wave/cycle occupies **4** (squares or cm) C1
{allow "wavelength" = 4cm}

which represents **40 ms** (OR period = 40 ms) C1

frequency = (1/0.04) = **25** Hz A1 **[3]**

{0.025Hz scores 2 marks if valid reasoning is offered above}

(ii) trace **more spread out** stated or implied B1

idea of '**time shorter or speed of trace faster**' B1

only ¼ **of a wave** shown on the screen B1 **[3]**
OR wave now 10 times longer (WTTE)

(iii) $v = f\lambda$ C1

$\lambda = 330/25$ {allow ecf from (i)} C1

= **13.2** m A1 **[3]**

4.

(a)(i)	plane polarised light **vibrates (allow travels) in one plane only** ***{Look for reference to 'one plane' of oscillation and reject 'direction'}***	B1	[1]
(ii)	only transverse waves can be polarised (WTTE) sound waves are longitudinal OR "not transverse" (WTTE)	B1 B1	[2]
(b)	evidence of knowledge of full/max transmission - when polaroid is parallel to the light's plane of polarisation {or vibrations} no transmission when polaroid is at right angles to light's plane of polarisation {or vibrations} ***{Do not allow answers that merely describe the shape of the graph given}***	B1 B1	[2]
(c)	Any valid example: e.g. Radio waves, microwaves valid method of detection: e.g. aerial, microwave detector(!)	M1 A1	[2]

5.

(a)	**spreading out** of waves (into a 'shadow region') (WTTE) when the waves meet an aperture or obstacle (WTTE)	M1 A1	[2]
(b)	**narrow gap**: **almost full semicircles (no straight section)** with gap at centre	B1	
	wide gap: **virtually straight (must have some straight section)** with gap at centre	B1	
	wavelength shown to be **constant** – generously judged by eye OR same λ labelled before & after aperture on either diagram	B1	[3]

6.

(i)	correct sketch: **same shape** shifted to the **right** ***At least one full cycle must be drawn***	B1	[1]
(ii)	arrows showing X↑, Z↓ ***Award marks as shown irrespective of wave drawn by cand. but look for the new positions of X and Z shown on the cand's new wave position.***	B1 + B1	[2]
(iii)	wavelength = 2 x 0.24 = 0.48m recall of $v=f\lambda$ v = 3.6 x 0.48 = **1.73** m s^{-1} ***Allow ecf for candidate's value of λ; eg λ= 0.24m v = 0.865 m/s scores 2 marks***	B1 C1 A1	[3]
(iv)	1. wave speed **NO CHANGE**	B1	
	2. wavelength is shortened to a new value of **0.24 m OR is halved** ***{allow ecf for cand's value from (iii)}***	C1 A1	[3]

7.

(a)	*Longitudinal* any valid example e.g. sound /ultra sound (accept 'P waves' but reject "Earthquake") *Transverse* any valid example e.g. light / microwaves etc./ emwaves / any emradiation (accept sea waves or ripple-tank waves but not "water waves")	B1 B1	[2]
(b)(i)	frequency = number of waves/vibrations/oscillations/cycles per unit time {allow "per second"}	B1	[1]
(ii)	period = time taken for 1 complete cycle/wave/vibration/oscillation {allow 1/f, provided f has been correctly defined above}	B1	[1]
(c)(i)	4×10^{-5} m { not 4 or 4×10^{5}}	B1	[1]
(ii)	air particle vibrates (seen or implied in remainder of answer) in the same direction as the wave (WTTE) {allow left to right, backwards and forwards, longitudinally but NOT up and down} description of motion during any full cycle (allow ecf for transverse) *{do not penalise reference to random thermal motion of air molecules}*	B1 B1 B1	[3]