Question Number	Answer		Mark
1(a)	Use of $v = f\lambda$ f = 7.3 Hz [accept 7.3 s^{-1}, do not accept fractions] Example of calculation f = 330 m s^{-1} / 45 m f = 7.3 Hz	**(1)** **(1)**	**2**
1(b)	Diffraction / it diffracts **Either** an explanation of diffraction in general: Idea that the waves spread out (not bending) OR a diagram showing diffraction **OR** An explanation of why the tiger is heard: diffraction is significant for an obstacle (not a gap) of a size similar to the wavelength OR a diagram showing diffraction over a hill	**(1)** **(1)**	**2**
	Total for question		**4**

Question Number	Answer		Mark
2(a)	Tick in Ultrasound box only	**(1)**	**1**
2 (b)	A polarised wave is when the oscillations/vibrations are in one plane only which includes direction of travel (of the wave). **Or** A polarised wave is when the oscillations/vibrations are in one direction only which is perpendicular to the direction of travel (of the wave). **Or** Describes polarisation as a process where oscillations/vibrations in many planes are reduced to oscillations/vibrations in one plane [References to displacement are only acceptable in the context of varying displacement] Longitudinal waves oscillate/vibrate in one direction which is the direction of travel of the wave / parallel to the direction of travel of the wave.	**(1)** **(1)**	**2**
	Total for question		**3**

Question Number	Answer	Mark
3(a)	Use of sin $i \times v_2 = \sin r \times v_1$ **(1)** $r = 90^o$ at critical angle **(1)** critical angle = 75º **(1)** Acceptable alternative: Use of $_1\mu_2 = v_1 / v_2$ **(1)** State sin $c = 1 / \mu$ **(1)** $c = 75^o$ **(1)** ($\mu = 1.036$, but look out for effects of rounding on calculated angle) <u>Example of calculation</u> sin c /1 = 1.96/2.03 $c = 75^o$	**3**
3(b)	It will be reflected (back into the core) / totally internally reflected **(1)** Reflection back into core may be shown on the diagram (allow e.c.f for value of c from (a))	**1**
3(c)	Most of the light will undergo repeated (total internal) reflection **Or** most light continually strikes at greater than the critical angle **Or** **(1)** minimal light is lost through refraction Light reaches the bottom of the curtain **Or** Rays hitting the bottom will **(1)** escape **Or** light hits the bottom at less than the critical angle	**2**
	Total for question 18	**6**

Question Number	Answer	Mark
4(a)	Use of $v=f\lambda$ with c = 3.00×10^8 ms^{-1} (1) kHz to Hz (1) wavelength = 1520 m (1) (accept 1500 m) <u>Example of calculation</u> $\lambda = 3 \times 10^8$ ms^{-1}/198000 λ = 1515 m	**3**
4(b)*	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) Correct mention of diffraction (not defraction) (1) Large(r) wavelengths give large(r) diffraction or vv/ diffraction is the spreading of wave(fronts) (1) This idea applied to the context i.e.related to a building or hill, referencing size **and** lack of 'shadow'/more complete coverage (1)	**3**
	Total for question 12	**6**

Question Number	Answer	Mark
5(a)	Oscillations/vibrations occur in any number of directions/every direction (1) which are perpendicular to the direction of wave travel /wave propagation/energy transfer (do not accept direction of wave) (1) **OR** Oscillations/vibrations may occur in more than one plane (2) (references to particles loses 1st mark marks can be scored from a labelled diagram)	**2**
5(b)*	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) Use of polarising filter /Polaroid (not just filter) (1) Rotation/turning of the filter (1) After 90º rotation (block) intensity changes (1) (Use of two filters and relative rotation 1 mark only)	**3**
5(c)	Reflected light OR light from ice is (partially) polarised (1) (Polarising) filters/lenses/glasses are at right angles to (the plane of polarisation of) the light (1) [1st mark must be about the reflected light being polarised] (Answers which say that the sunglasses are polarising the light score 0/2)	**2**
	Total for question 16	**7**

Question Number	Answer	Mark
6(a)	Unpolarised light oscillates/vibrates in many planes/ directions while polarised oscillates/vibrates in one plane/direction only OR labelled diagram	**1**
(b)	Filters at 90 º to the (polarised) reflected light. sunglasses cut out the reflected light/polarise light/glare But not the light from the fish OR light from fish is unpolarised.	**1** **1** **1**
(c)	Sound is a longitudinal wave OR sound is not a transverse wave OR oscillations in one direction already OR only transverse waves can be polarised.	**1**
	Total for question	**5**

Question Number	Answer	Mark
7(a)	**Coherent:** Waves of constant phase relationship **Standing wave:** no (net) transfer of energy OR pattern of nodes and antinodes OR points of maximum displacement and zero displacement	**1** **1**
(b)	**QOWC** **Work must be clear and organised in a logical sequence** Calculation to show a path of 24 cm or 42 cm OR paths of 2λ and 3.5 λ Path difference is 1 ½ λ OR divide path difference by 12 Waves at X in antiphase /180º out of phase/π radians out of phase destructive interference **Example of answer** One path length = 18 cm + 6 cm = 24 cm Other path length = 30 cm + 12 cm = 42 cm Path difference = 42cm – 24 cm = 18 cm Number of wavelengths = 18/12 = 1.5	 **1** **1** **1** **1**
(c)	Food moves through hot and cold spots Over time period all parts of food receive similar amount of energy.	**1** **1**
	Total for question	**8**

Question Number	Answer	Mark
8(a)	**Diagram:** Smaller wavelength before gap Less diffraction and same wavelength	 **1** **1**
(b)	Two sets of concentric circles equal spacing Identification of a line of points of destructive interference Identification of a line of points of constructive interference	**1** **1** **1** **1**
(c)(i)	Attempt to use inverse relationship (e.g. 1.2 × 0.60 =constant) Separation =1.8 mm **Example of answer** 1.2 = constant / 0.6 Constant = 0.72 Spacing = 0.72/ 0.4 = 1.8 mm	**1** **1**
(ii)	(Initially bands) will get close together Eventually gap too large for overlap to occur, no fringes seen OR reference to fringes produced providing overlap still occurs	**1** **1**
	Total for question	**10**