Answers to examination-style questions

Answers	Marks	Examiner's tips
(b) as the polarising filter is rotated through 360° the intensity transmitted will vary between maxima and minima (or light and dark) there will be two maxima (and two minima) in each 360° rotation	1 1	Light is transmitted through both filters when their transmission axes are parallel to each other. When the transmission axes are at 90° to each other, the second filter no longer transmits light. A polarising filter always appears slightly grey because it absorbs all incident light except the component that is aligned with its own transmission axis.
4 (a) transverse waves can be polarised	1	Longitudinal waves cannot be polarised because the particle vibration is the same as the direction of travel.
(b) any correct example, e.g. waves on strings, waves on the surface of water, any type of electromagnetic wave	1	You need to know examples of both longitudinal and transverse waves. Waves **through** water would be longitudinal. Electromagnetic waves include light and all the other waves in the electromagnetic spectrum.
(c) *Relevant points include:* • in transverse waves the vibrations take place perpendicular to the direction of energy transfer • in longitudinal waves the vibrations take place in the same direction as the energy transfer • polarisation restricts the vibrations to one plane by absorbing the vibrations at right angles to this plane • longitudinal waves cannot be polarised because the vibrations have to take place for energy to be transmitted	3	You could clarify much of this answer with some clearly labelled sketches. Electromagnetic waves such as light consist of an electric vector which is at right angles to a magnetic vector. Polarising filters work by absorbing the component of the electric vector in a particular plane. A vector has no component at right angles to its own direction, hence this perpendicular component of the electric vector is transmitted by the filter. The transmitted (plane polarised) component of the light could then be absorbed by a second polarising filter that had its transmission axis at right angles to the first filter.
5 (a) a longitudinal wave	1	You are told at the outset that this is a sound wave, and the diagram shows particles moving in the wave's direction of travel.

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	(b)	BB': an arrow to the left CC': an arrow to the right both arrows the same length as AA' (or length of AA' > BB' > CC')	1 1	Distance AC is one wavelength, meaning that A and C move in phase. Distance AB is half a wavelength, consequently B moves 180° out of phase with A and C. If there is no absorption (or no spreading out) the displacements will have the same magnitude. If there is absorption (or spreading out) these magnitudes will decrease along the wave.
	(c)	particles in the transmitting medium are made to vibrate longitudinally these cause nearby particles to vibrate in the same direction	1 1	**Alternatively**, regions of compression (or rarefaction) produce other regions of compression (or rarefaction) further along the wave.
6	**(i)**	wavelength = 0.80 m	1	The distance between adjacent nodes is $\lambda/2$. This stationary wave has three loops.
	(ii)	use of $c = f\lambda$ gives $f = \frac{c}{\lambda} = \frac{200}{0.80} = 250$ Hz	1	You could be awarded this mark for applying an incorrect value of λ from **(i)** in correct physics here.
	(iii)	use of $T = \frac{1}{f}$ gives time period of vibrations $T = \frac{1}{250} = 4.0 \times 10^{-3}$ s 3.0 ms corresponds to $\frac{3}{4}$ of a full vibration string shown on diagram as a straight line, along the undisturbed position	1 1 1	First you have to work out the meaning of 3.0 ms as a multiple (or fraction) of the time period. In half of a full vibration, the string will have moved to the position shown in the diagram by the dotted line. In a further quarter of a vibration, it will have returned to the central position.
7	**(a)**	distance travelled by wave = 2 × 18 = 36 m speed of sound = $\frac{\text{distance}}{\text{time}} = \frac{36}{0.11}$ $= 330$ m s^{-1}	1 1 1	The echo is caused by the reflection of the sound waves from the wall. The waves travel at constant speed to the wall and back again. This is a useful pointer to what happens in **(b)**.
	(b)	stationary waves are formed in air by the superposition of two waves these are the wave travelling towards the wall and its reflection from the wall minima are formed by destructive interference at points where the two waves are continuously in antiphase	1 1 1	Whilst moving towards the wall, the observer will notice maxima and minima of intensity at fixed positions in the air. The maxima are at the antinodes of the stationary wave and the minima at nodes. You are only asked to explain how the **minima** of intensity occur.