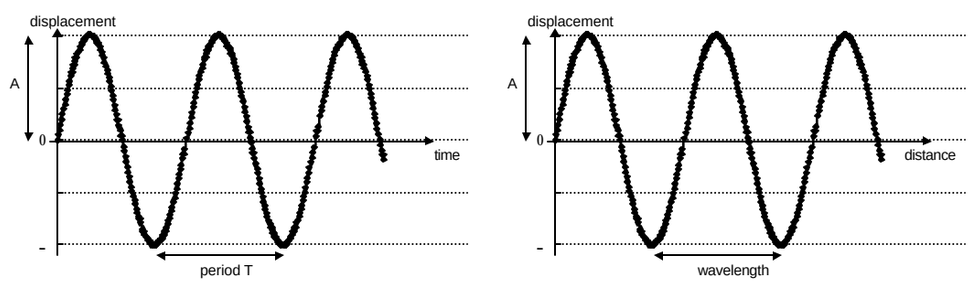
P.119 (28, 31, 40)

28. (a) Transverse waves with different planes of vibration are unpolarized. Polarization means making these transverse waves transmit in one plane of vibration only.

(b) By viewing a road sign through a piece of polaroid and rotating the Polaroid through 90^o. If the reflected light is polarized, it will not pass through the Polaroid at certain angle. If the reflected light is unpolarized, it will be visible at all angles.

31. (a) (i) In a transverse progressive wave, the particle oscillates in the plane perpendicular to the direction of propagation of the wave.

(ii)



(iii) By definition, $\text{speed} = \dfrac{\text{distance travelled}}{\text{time taken}}$

The time taken for a waveform to travel a distance of one wavelength λ is given by its period T.

$\therefore$ speed of wave, $v = \dfrac{l}{T} = \dfrac{l}{\frac{1}{f}} = fl$

(b) The principle of superposition suggests that when two waves are superimposed, the resultant displacement at any point is the vector sum of all individual displacements at that point.

(c) (i) The resultant amplitude at X will be 2A.

(ii) 1. After time t=0.125s,

number of waveforms from S_1 that passes X= f_1 t = 500 x 0.125 = 62.5

$\therefore$ it is a trough.

number of waveforms from S_2 that passes X= f_2 t = 504 x 0.125 = 63

$\therefore$ it is a crest.

$\therefore$ A trough meets a crest at X at time t=0.125s.

2. The resultant amplitude at X will be zero.

3. Between t = 0 to t = 1s, a continuous variation of the resultant amplitude will be heard. It will vary from maximum to zero and back to maximum through 4 cycles.

(d) (i) Two waves are said to be coherent if they have the same frequency and a constant phase difference.

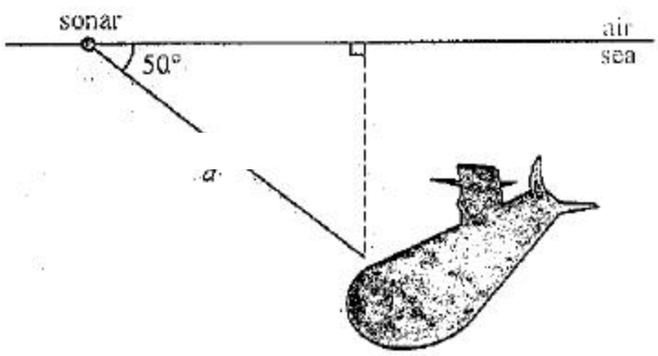
(ii) When two sources are not coherent, they will be in phase at one instant and in anti-phase at the next instant. However, if their frequencies are only slightly different, the change in phase angle will be slow and identifiable. A variation of

the resultant amplitude could be heard.

40. (a) By $v = f\lambda_{sea}$, $1500 = (25 \times 10^3)\lambda_{sea}$

$\lambda_{sea} = 0.06$ m

(b)

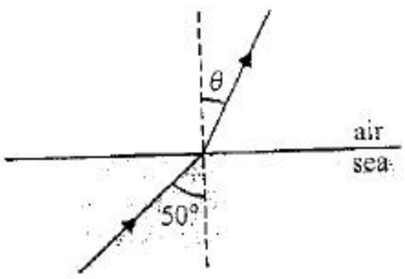


By $s = vt$, $2d = 1500(0.15)$

$d = 112.5$ m

Hence, the vertical distance of the submarine below the sea surface
$= d \sin 50°$
$= 112.5 \times \sin 50°$
$= 86.180$ m

(c)



By $\frac{v_1}{v_2} = \frac{\sin\theta_1}{\sin\theta_2}$, $\frac{v_{air}}{v_{sea}} = \frac{\sin\theta_{air}}{\sin\theta_{sea}}$

$\frac{340}{1500} = \frac{\sin\theta}{\sin 50°}$

$\sin\theta = \frac{17}{75}\sin 50° = 0.1736367404$

$\theta = 9.999°$

Note: The speed in sound is positively related to the density of the medium, while that of light is **negatively** related to the optical density of the medium.

(d) No.
Total internal reflection only occurs when the wave travels from a medium in which it has a lower speed to another medium in which it has a higher speed.

(e) Microwaves are easily absorbed by water.

Note: Ultrasonic waves are used instead of sound waves due to its smaller wavelength, and hence small objects can be detected more easily.