Waves – Questions – (2) A Phys. i

Velocity of waves – sound + EM

Data

1 ms = 1 millisecond = $\frac{1}{1000}$ s = 0.001 = 1×10^{-3} s

V_{sound} in air = 330 m/s

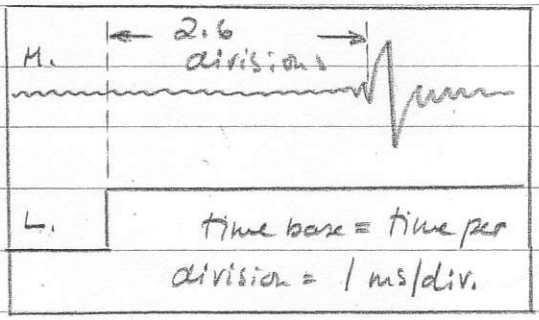
in water = 1500 m/s.

$V_{EM\ waves} = 3 \times 10^8$ m/s (in air or vacuum).

1. In a lab. experiment to measure the velocity of sound, the CRO display shows the delay between loudspeaker (L) emitting a pulse, and microphone (M) receiving it. The distance between L and M is 87 cm. What value does this give for V_{sound}? (4)

for Q.1.

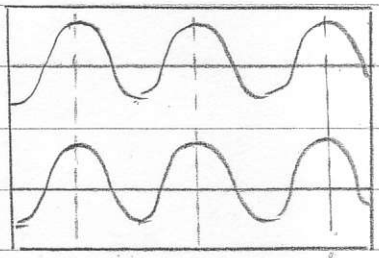
2. In another experiment, the student gets the display shown. She moves the microphone (M) through 12 whole wavelengths, a distance of 90.0 cm. The signal generator scale shows a frequency of 4.2 kHz



(a) What value for V_{sound} does the student get? (4)

(b) Sketch the CRO display when M is moved through 6.5 wavelengths. (2)

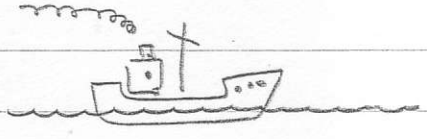
for Q.2



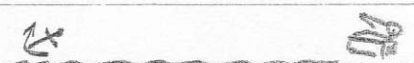
(c) How many times in the experiment are the two waves (i) in phase (ii) antiphase? (2)

(d) The signal generator is checked and found to read too low. The true frequency is 5% higher. What is the true frequency, and the more accurate value for V_{sound}? (4) [12]

3. A trawler is searching for fish using ultrasonic depth sounding. A pulse is sent out, and 2 echoes are heard ... (i) after 0.8 s and (ii) after 1.2 s.



(a) Copy + label the diagram, showing the sound waves. (2)



(b) What are the depths of the fish and the sea? (5) [7]

Thu 9.9.99

4. A bat can detect an object to an accuracy of 1 cm. If the minimum distance detectable is one wavelength, what is the bat's sound frequency? (2)

Waves — Answers — 2

A Physics

1. time delay = $2.6 \times 1 = 2.6$ ms $= 2.6 \times 10^{-3}$ s ①

$V = d/t = 87 \times 10^{-2}$ ① $/ 2.6 \times 10^{-3} = 334.6$ ① m/s = 335 m/s 1/4

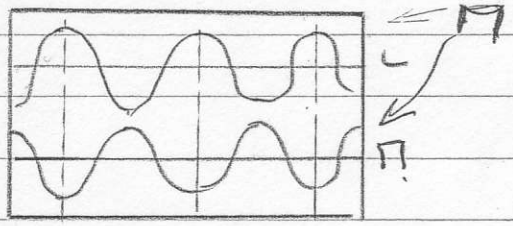
3 S.F. – on

2. (a) 12 λ = 90.0 cm → $\lambda = 90/12 = 7.5$ cm $= 7.5 \times 10^{-2}$ ① m { more than Q.

f = 4.2 kHz = 4,200 Hz ①.

$V = f\lambda$ ① $= 4{,}200 \times 7.5 \times 10^{-2} = 315$ ① m/s (4)

(b)



moved through 6½ wavelengths

L and Π waves are perfectly antiphase

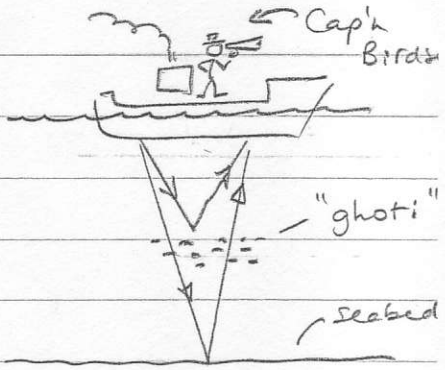
(c) (i) in phase .... 13 times (once to start, plus 12)

(ii) antiphase .... 12 times

(d) f true = 4,200 Hz + 5% = $4{,}200 \times \frac{105}{100}$ ① = 4410 ① Hz

V accurate = $f_{true}\lambda$ ① = $4410 \times 7.5 \times 10^{-2} = 330.75$ ① = 331 m/s (4) (

3. (a) see diagram → (2)



(b) Full. $d = vt$ ① gives distance travelled by sound pulse in time t sec.

So $d = 1500 \times 0.8$ ① ← shorter time

$= 1200$ ① m.

But the sound goes both ways (there + back again.)

so the depth of the fish is 600 ① m

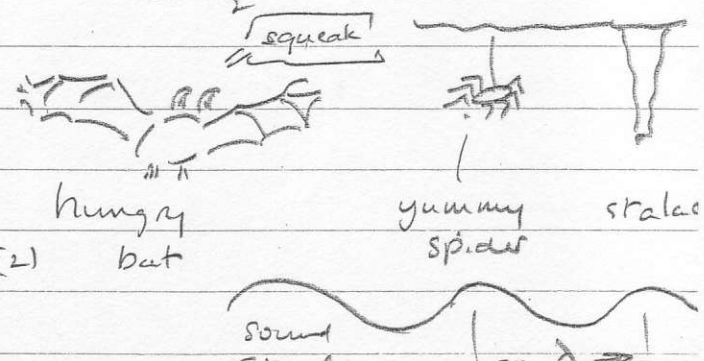
Depth of sea bed $d_{sea\ bed} = 1500 \times \frac{1.2}{2} = 900$ ① m (5)

4. Use $V = f\lambda$ ①

So $f = V/\lambda = 330/1 \times 10^{-2}$

$= 33\,000$ Hz

So bat's frequency = 33 ① kHz (2)



/50	Q...	1	2	3	4	
10.98	out of	/4	/12	/7	/2	= /25