1. $s = 5.0\text{ m}$, waves $= 10$ } $\lambda = \frac{5.0}{10} = 0.5\text{ m}$

$f = 2\text{ Hz}$

$v = f \times \lambda = 2 \times 0.5$

$= \underline{1.0\text{ m s}^{-1}}$

2. $f = \frac{v}{\lambda} = \frac{3 \times 10^8\ \text{m}}{5 \times 10^{-7}\ \text{m s}}$

$= \underline{6.0 \times 10^{14}\text{ Hz}}$

3. $\lambda = 633$ nanometers (nm)

$= 633 \times 10^{-9}\text{ m}$

$\therefore f = \frac{v}{\lambda} = \frac{3 \times 10^8\ \text{m}}{633 \times 10^{-9}\ \text{m s}}$

$= \underline{4.7 \times 10^{14}\text{ Hz}}$

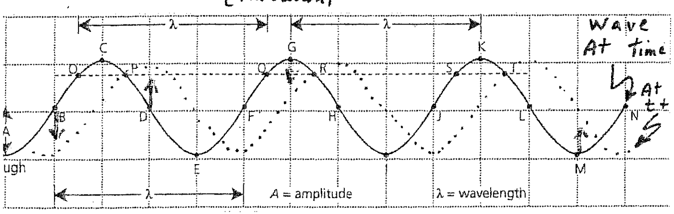
4. $v = f \times \lambda = 300\text{ Hz} \times 5.0\text{ m}$

$= \underline{1.5 \times 10^3\text{ m s}^{-1}}$

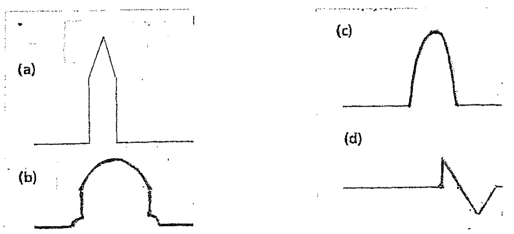
$T = \frac{1}{f} = \frac{1}{300\text{ Hz}}$

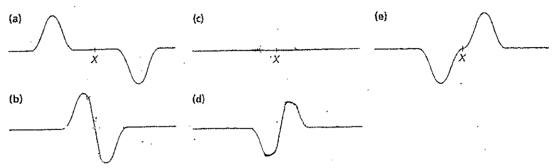
$= \underline{3.3 \times 10^{-3}\text{ s}}$

5. The solid line shows the wave at $t = 0$. The dotted line shows it a short time later. From these lines it can be seen that B is going down, P up (then down), D up, G down, M up.



6.





Point x is a node : it does not move

(a) From graph: amplitude $= \underline{20\text{ cm}}$

(b) From graph: period $= \underline{0.6\text{ s}}$

(c) $f = \frac{1}{T} = \frac{1}{0.6} = \underline{1.7\text{ Hz}}$

(a) From graph: $\lambda = \underline{80\text{ cm}}$

(b) " " amplitude $= \underline{15\text{ cm}}$

(c) $v = f \times \lambda$

$\therefore f = \frac{v}{\lambda} = \frac{80}{80} = \underline{1\text{ Hz}}$

10. (a) amplitude $= 20\text{ cm}$

(b) $\lambda = 40\text{ cm}$

(c) $v = \frac{d}{t} = \frac{50\text{ cm}}{0.2\text{ s}}$

$= \underline{250\text{ cm s}^{-1}}$

11. The pulse travells faster.

12. In a transverse wave the medium moves at right angles to the direction of propagation. In a longitudinal wave particles of the medium move in the same direction as the direction of propagation

13. (a) Transverse

(b) Movement of the medium is at right angles to the direction of propagation.

(c) amplitude

14. (a) Transverse

(b) Longitudinal

15. The wavelength of a transverse wave is the minimum distance between two points on the wave that are in phase. For a longitudinal wave, the wavelength is the distance between the middle of adjacent compressions or rarefactions.

16. $v = f \times \lambda$

velocity of wave; frequency; wavelength

17. (a) 10 waves/5 s $\therefore f = \frac{10}{5} = \underline{2\text{ Hz}}$

$T = \frac{1}{f} = \underline{0.5\text{ s}}$

$v = f \times \lambda = 2 \times 50\text{ cm}$

$= \underline{1\text{ m s}^{-1}}$

(b) (i) The frequency of the wave and hence the wavelength would change.

(ii) The velocity would remain the same.

(c) The speed of the wave in the spring can be changed by stretching or relaxing the spring

18. (a) For the pulse to be reflected upside down, the second spring must be heavier than the first.

(b) Some of the wave will be transmitted to the second spring. This wave will be in phase with the original wave.

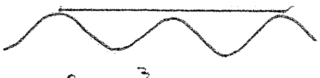
19. A standing wave is produced when waves of the same frequency and amplitude are created at each end of a spring.

20. (a) maximum amplitude $= 2 \times$ amplitude

$= 2 \times 10 = \underline{20\text{ cm}}$

(b) Nodes are $\frac{1}{2}\lambda$ apart $= \frac{1}{2} \times 20 = \underline{10\text{ cm}}$

21. $\lambda = \frac{4}{2}$ m



$T = \frac{20}{3}$ s $\therefore f = \frac{3}{20}$

$v = f \times \lambda = \frac{3}{20} \times \frac{4}{2}$

$= \underline{0.3 \text{ m s}^{-1}}$

22. $v = f \times \lambda$

$\therefore \lambda = \frac{v}{f} = \frac{340 \text{ s m}}{300 \text{ s}}$

$= \underline{1.1 \text{ m}}$

23. Error: swap "λ" and "f" in Q23.

$v = 3 \times 10^8 \text{ m s}^{-1}$

$f = 5 \times 10^5$ Hz to 3×10^7 Hz

$\lambda = \frac{v}{f}$ $\therefore \lambda = \frac{3 \times 10^8}{5 \times 10^5}$ to $\frac{3 \times 10^8}{3 \times 10^7}$

$= \underline{600 \text{ m}}$ to $\underline{10 \text{ m}}$

24. (a) $\lambda = \frac{v}{f} = \frac{340}{550}$

$= \underline{0.62 \text{ m}}$

(b) $f = \underline{550 \text{ Hz}}$

(c) $\lambda = \frac{v}{f} = \frac{1450 \text{ m s}}{550 \text{ s}}$

$= \underline{2.6 \text{ m}}$

25. From the graph: (a) 4 cm (b) 20 cm

(c) $f = 10$ Hz

$T = \frac{1}{f} = \frac{1}{10} = \underline{0.1 \text{ s}}$

(d) $v = f \times \lambda = 10 \times 0.2 = \underline{2 \text{ m s}^{-1}}$

26. (a) P : longitudinal S : transverse

L : transverse

(b) $f = \frac{v}{\lambda} = \frac{3000}{10} = \underline{300 \text{ Hz}}$

27. (a) As the pulse moves to the right A and B will move downwards

(b) A and B move in the direction of the wave

28. · The first pulse is reflected back in phase at the barrier between B and C

· The pulse travels on in B, in phase.

· The second pulse has been reflected at the barrier between B and C out of phase $\therefore$ B is less dense than C

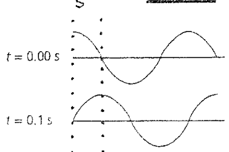
· $\underline{\text{Density } A > B \quad C > B}$

29. (a) The wavelength is the distance between any 3 nodes: A − E, C − G etc or between any 3 antinodes: B − F

(b) Nodes: A, C, E, G, I, K (c) Antinodes: B, D, F, H, J, L

(d) $A \rightarrow F = 1\frac{1}{4}\lambda \therefore \lambda = 5 \text{ m} \times \frac{4}{5} = \underline{4 \text{ m}}$

30. The waves are out of phase by $\frac{\lambda}{4}$. Therefore the second wave has moved forward by $\frac{1}{4}\lambda$ or $1\frac{1}{4}\lambda$ or $2\frac{1}{4}\lambda$ etc. The $\underline{\text{greatest}}$ T value corresponds to $\frac{\lambda}{4}$ ie $T = 4 \times \cdot 1 = \underline{0.4 \text{ s}}$



31. (a) There are 2 oscillations in 20 s

$\therefore T = 10$ s $\therefore f = \frac{1}{10}$ Hz

From the graph: $\lambda = 16$ cm $A = 4$ cm

$v = f \times \lambda = \frac{1}{10} \times 16$

$= 1.6$ cm/s

(b) (i) moving up: C, H

(ii) moving down: A, E, F

(iii) stationary: A, G (soon to move up)

D (soon to move down)

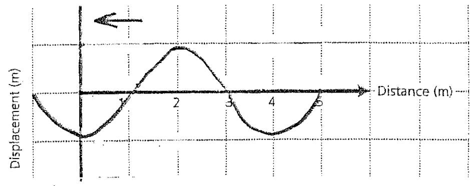
(c) C will have moved 4 cm higher.

32. (a) wavelength is distance $B \rightarrow F = 4$ m

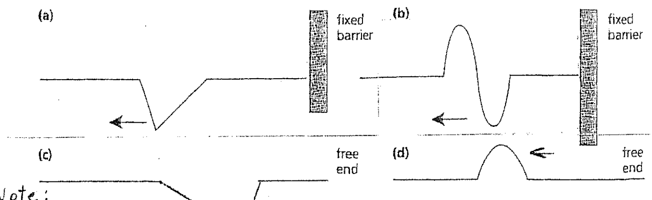
(b) $v = f \times \lambda = 10 \text{ Hz} \times 4 \text{ m}$

$= 40 \text{ m s}^{-1}$

(c) In phase: A, E and B, F.

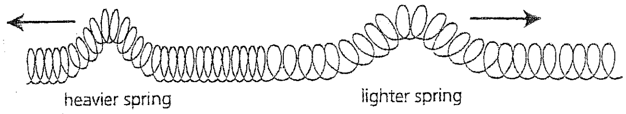


33.



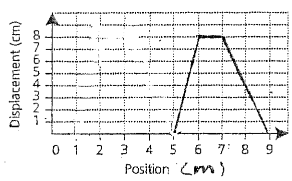
Note: "sharp" end is to the front

34 (a) (b)



(c) It will reflect from the barrier out of phase

35. (a)



(b) In 0.5 s A will be on the x axis

(c) Amplitude = 8 cm

36. (a) $\lambda = 4$ cm

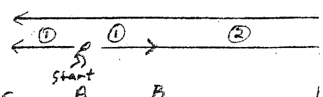
(b) $\frac{1}{2}\lambda$ passes in 0.2 s $\therefore T = 0.4 \therefore f = 2.5$ H.

(c) amplitude = 2 cm

(d) $v = f \times \lambda = 2.5/\text{s} \times 4 \text{ cm} = 10 \text{ cm/s}$

37. 1. Sound travels from A (start) to C (students) and at the same time travels from A to B.

2. Sound travels from B to D and back to C, in 0.9 s



$v = \frac{d}{t} = \frac{100 + 200}{0.9}$

$= \underline{330 \text{ m s}^{-1}}$

39. $v_{\text{salt water}} = 1450 \text{ m s}^{-1}$

$d_1 = 2x$ (to fish)

$t = 0.2$ s

$\therefore v = \frac{2x}{0.2}$ $\therefore x = 145$ m

$d_2 = 2y$ (to bottom)

$t = 0.25$ s

$\therefore v = \frac{2y}{0.25}$ $\therefore y = 181$ m

Dist. from fish to bottom $= 181 - 145 = \underline{36 \text{ m}}$