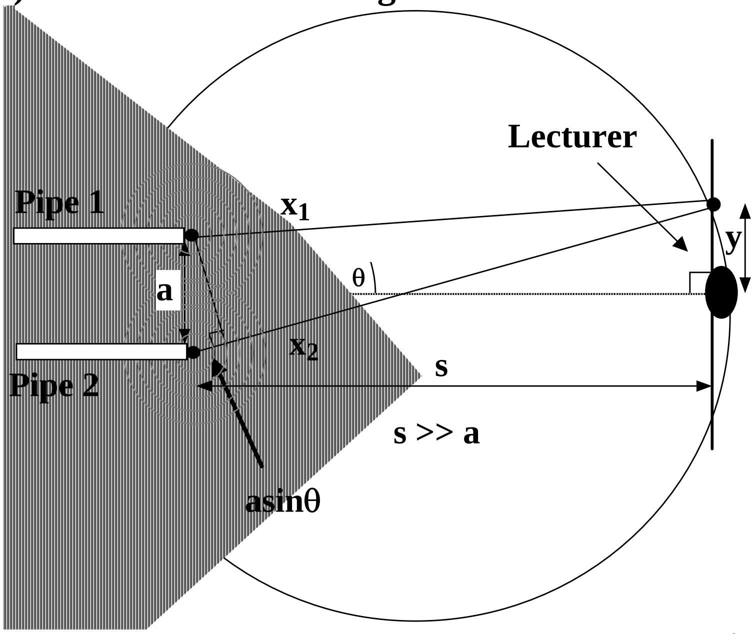
Vibrations & Waves Classwork 4 – (Solutions)

i) It's the same as Young's slits:



For constructive interference: $x_2 - x_1 = m\lambda$

For: $s >> a$ => $x_2 - x_1 = a\sin\theta$

$\sin\theta = m\lambda/a$

$s >> a$ => $\sin\theta \approx \theta = m\lambda/a$

ii) $y/s = \tan\theta \approx \theta$

For constructive interference: $y = sm\lambda/a$

On either side of physicist: m = ±1

$y = 10 \times 1 \times 0.2/1 = 2.0m$

b) i) $\lambda_n = 2d/n$ **where** ***n = 1, 2, 3, 4, 5 6, ……***

Hence if same frequency as ripples => Same wavelength

=> $\lambda = 0.2m$

$n = 2d/\lambda_n = 2 \times 0.7 / 0.2 = 7$

=> 7th mode

ii) For standing waves on water in the rectangular box, can have a *node* or *antinode* at centre of box

Circles => From symmetry considerations must have *antinode* at centre of bowl

Circular standing waves: $\lambda_n = 2d/n$

For *antinode* at x = d/2 in centre of bowl => n = 2, 4, 6, 8… .

7th mode cannot occur

(c)i)

Initially pulse has not dispersed – it still exists.

Velocity of pulse => group velocity: $v_g = \frac{d\omega}{dk}$

Phase velocity: $v = \frac{\omega}{k} = \sqrt{g/k}$

=> $\omega = \sqrt{gk}$

Group velocity => $v_g = \frac{d\omega}{dk} = \frac{1}{2}\sqrt{\frac{g}{k}} = \frac{1}{2}\sqrt{\frac{g\lambda}{2\pi}}$

Pulse peaked at wavelength of 0.25m.

=> Pulse velocity: v_g = 0.315 ms^{-1}

ii)

$v = \sqrt{g/k} = \sqrt{\lambda g/2\pi}$

Phase velocity of 0.1m waves: 0.399 ms^{-1}

Phase velocity of 0.4m waves: 0.799 ms^{-1}

Goes 10m =>

Arrival time of 0.1m waves: 25.06s

Arrival time of 0.4m waves: 12.53s

iii)

When 0.4m waves arrive, distance travelled by 0.1m waves = 5.0m

Initial pulse width: 0.3m

Current pulse width: 5m

=> The pulse has dispersed.