Assignment - 4

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18EX 20030

① Given,

$V_1 = 800 m/s = 0.8 km/s$

$\text{slope} = \frac{1}{V} = \frac{1}{0.8}$

$\therefore \theta_1 = \tan^{-1}(\text{slope}) = \tan^{-1}\left(\frac{1}{0.8}\right)$

$\Rightarrow \theta_1 = 51.34°$

$V_2 = 1600 m/s, = 1.6 km/s$

$\theta_2 = \tan^{-1}\left(\frac{1}{V_2}\right) = \tan^{-1}\left(\frac{1}{1.6}\right)$

$\Rightarrow \theta_2 = 32°$

$V_3 = 3000 m/s = 3 km/s.$

$\theta_3 = \tan^{-1}\left(\frac{1}{V_3}\right) = \tan^{-1}\left(\frac{1}{3}\right) = 18.43°$

$t_1 = \frac{2z_1}{V_1}\cos\theta_1 = \frac{2 \times 10}{0.8}\cos\left(\sin^{-1}\left(\frac{0.8}{1.6}\right)\right)$

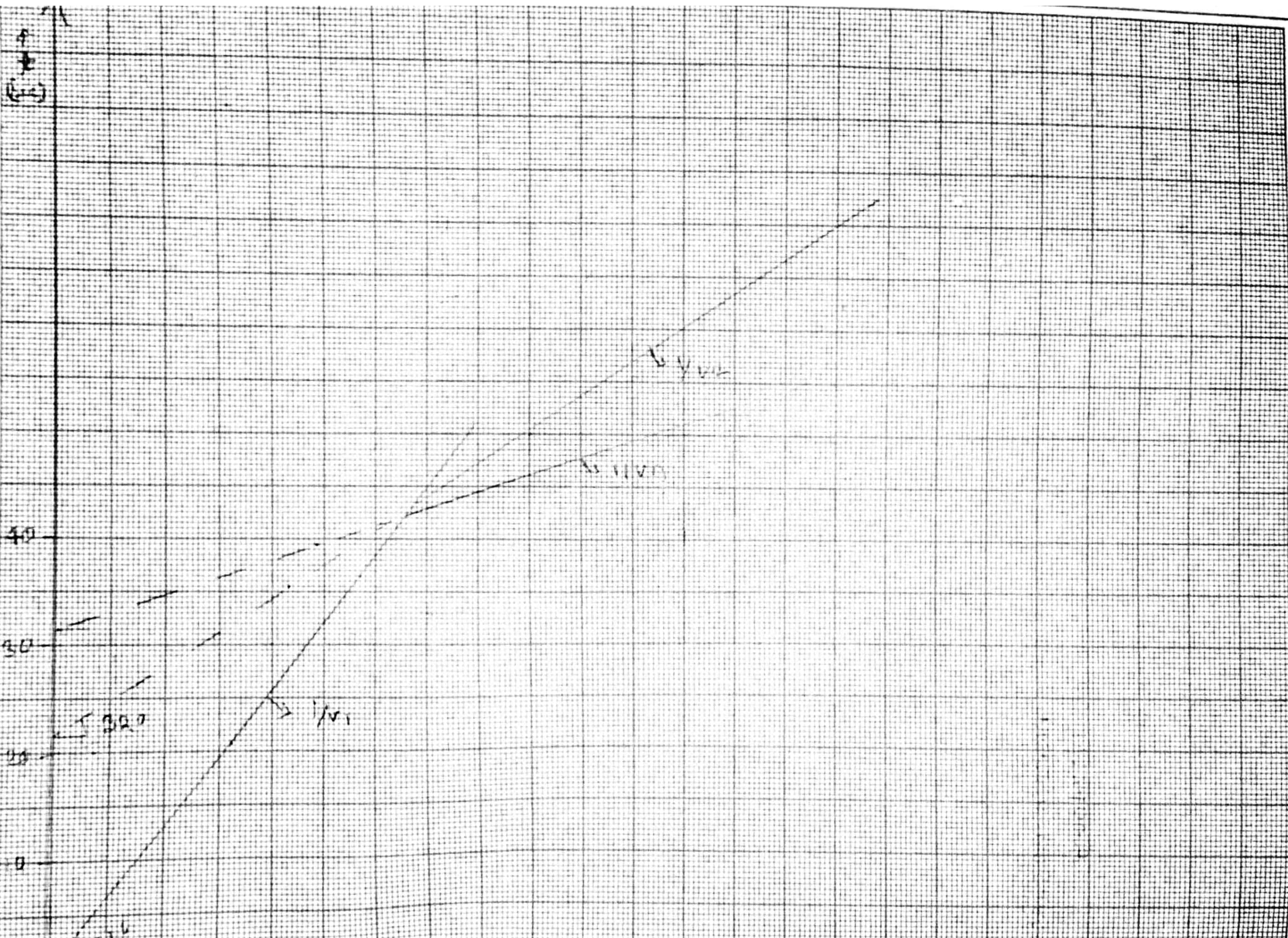
$= 21.65 s.$

$t_2 = \frac{2z_1}{V_1}\cos\theta_1 + \frac{2z_2}{V_2}\cos\theta_2$

$= t_1 + \frac{2 \times 7}{1.6}\cos\left(\sin^{-1}\left(\frac{1.6}{3}\right)\right)$

$= 21.65 + \frac{2 \times 7}{1.6}\cos\left(\sin^{-1}\left(\frac{1.6}{3}\right)\right)$

$= 29.05 s.$



② Slope $= \frac{\Delta B}{AC}$.

$$V_1 = \frac{1}{\text{slope of direct wave}}$$

$$\Rightarrow V_1 = \frac{\Delta C}{\Delta B} = \frac{30}{20} \times 10^3 \text{ m/s.}$$

$$\therefore V_1 = 1.5 \text{ km/s.}$$

$$\text{Up-dip velocity} = \frac{PQ}{QR}$$

$$= \frac{52.5}{15} \text{ km/s} = 2.5 \text{ km/s.}$$

Down-dip velocity graph

$$V_1 = \frac{\Delta B}{BC} = \frac{30}{21} \text{ km/s} = 1.43 \text{ km/s.}$$

$$\text{Dip velocity } V_d = \frac{PQ}{QR} = \frac{75}{27.5} \text{ km/s.}$$

$$= 2.73 \text{ km/s.}$$

$$2\xi = \sin^{-1}\left(\frac{1.43}{2.73}\right) = \sin^{-1}\left(\frac{1.5}{3.5}\right) = 6.21^\circ$$

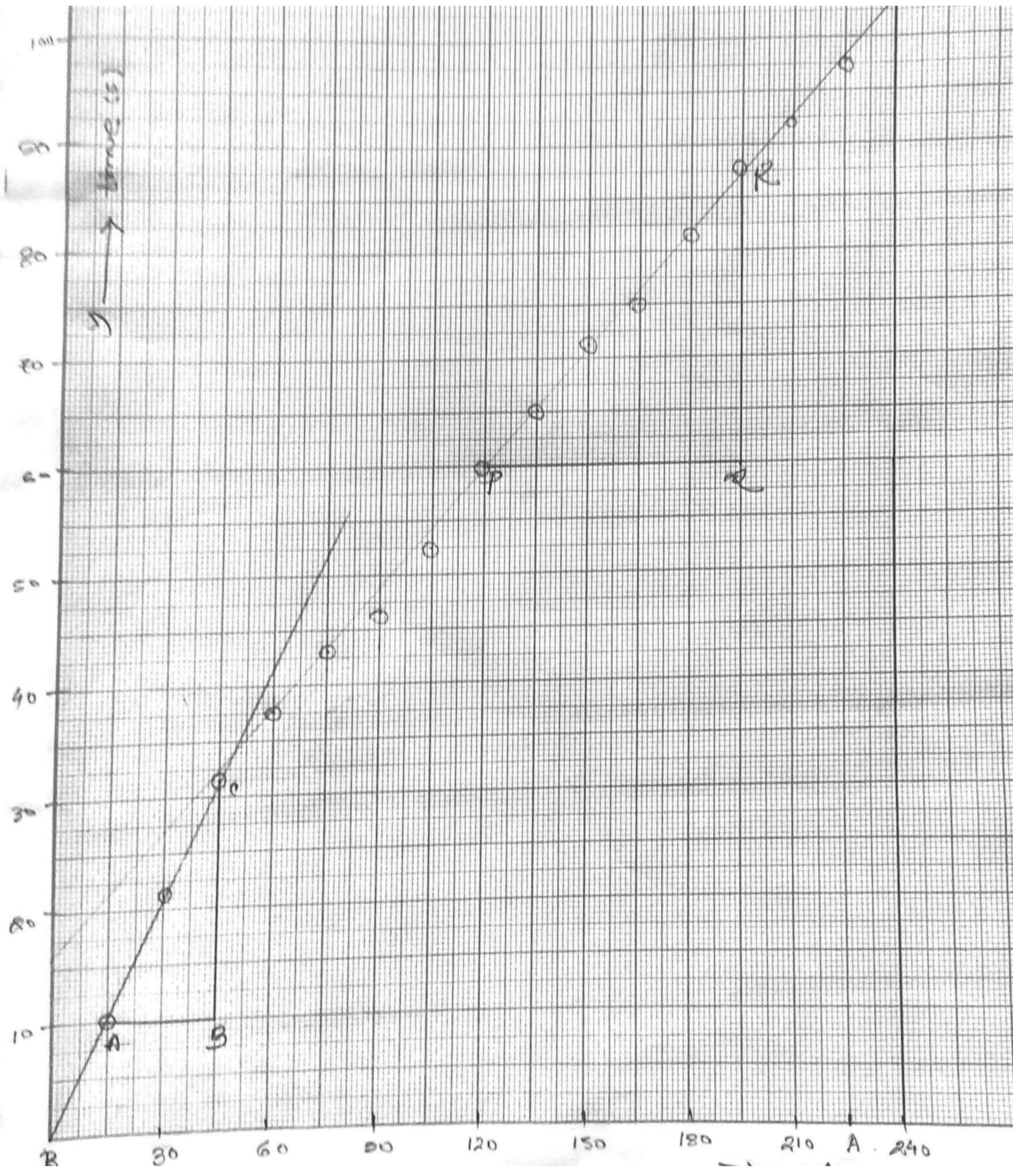
$$\therefore \xi = \frac{6.21^\circ}{2} = 3.11^\circ$$

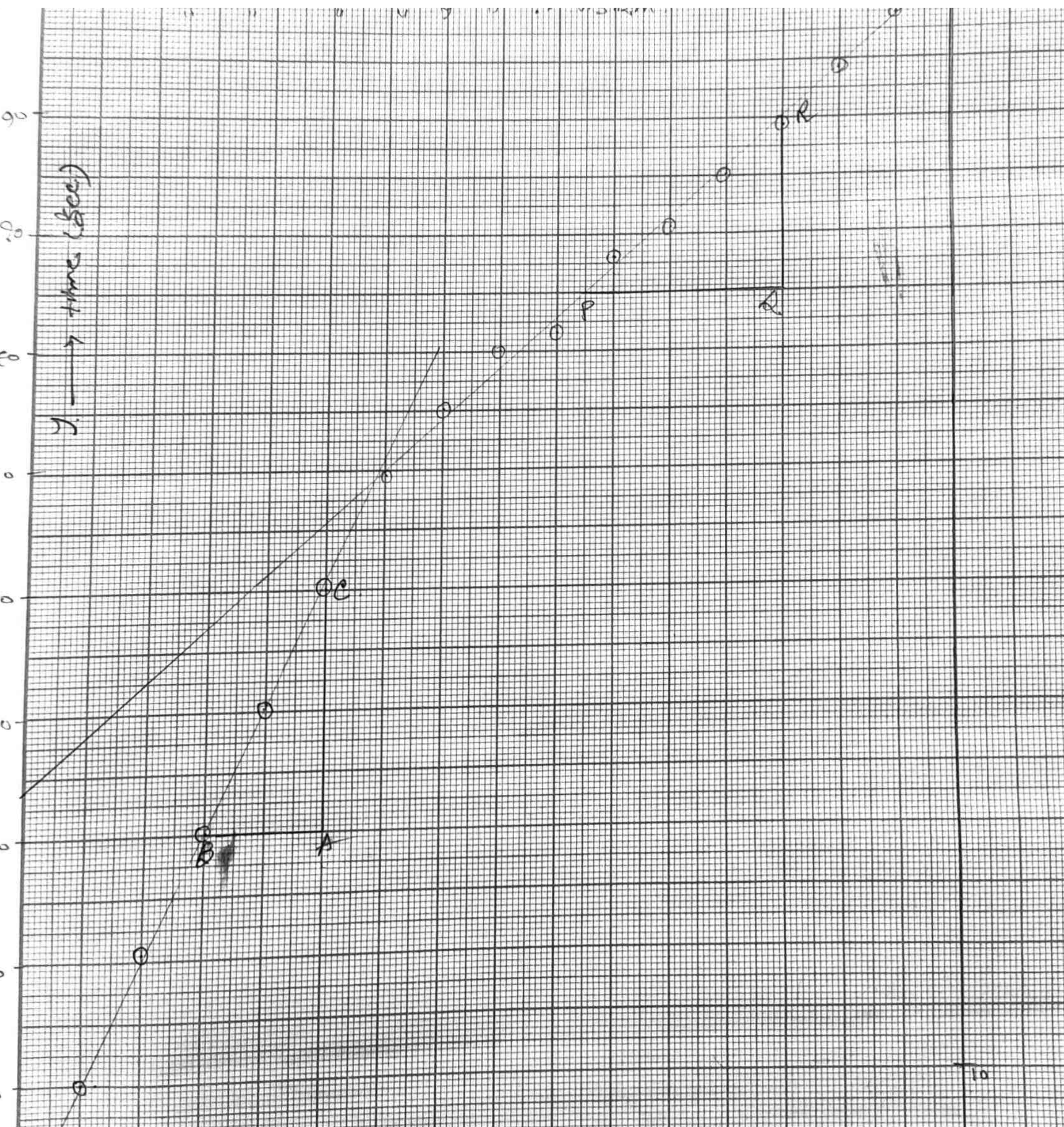
From graph, $t_{id} = 16.25$ m/s.

$t_{iu} = 33.75$ ms.

$$\theta_c = \frac{1}{2} \times \left[\sin^{-1}\left(\frac{1.43}{2.73}\right) + \sin^{-1}\left(\frac{1.5}{3.5}\right)\right]$$

$$\theta_c = 28.48^\circ$$


100
90
80
70
60
50
40
30
20
10
time (s)
R
30
60
90
120
150
180
210
A
240
A
B
C
P
Q
R



T. ⟶ time (Sec)
90
80
70
60
50
40
30
20
10
A
15
30
45
60
90
120
150
180
210
B
240
P
Q
R
A
B
C

$$Z_d = \frac{1}{2} \times V_1 \times \frac{t_{1d}}{\cos\theta_c}$$

$$\Rightarrow Z_d = \frac{1}{2} \times 16.25 \times \frac{1.5}{\cos(28.48^\circ)}$$

$$= 13.87\,km.$$

$$Z_u = \frac{1}{2} \times V_1 \frac{t_{1u}}{\cos\theta_c}$$

$$= \frac{1}{2} \times 1.43 \times \frac{33.75}{\cos(28.48^\circ)}$$

$$= 27.45\,km$$

(4) ~~For~~ From graph we observe,

$t_{1A} = 6.5\,ms$

$t_{2A} = 12.5\,ms.$

slope = velocity of direct wave = 5/5 ~~=~~

= 1 km/s.

V_{2A} = velocity in 2nd surface

$$= \frac{40-15}{18-11}\,km/s = 3.57\,km/s.$$

V_{3A} = velocity in 3rd ~~wave~~ surface

$$= \frac{155-120}{44.5-37}\,km/s = 4.66\,km/s.$$

For reverse data

V_{1c} = Velocity of direct wave

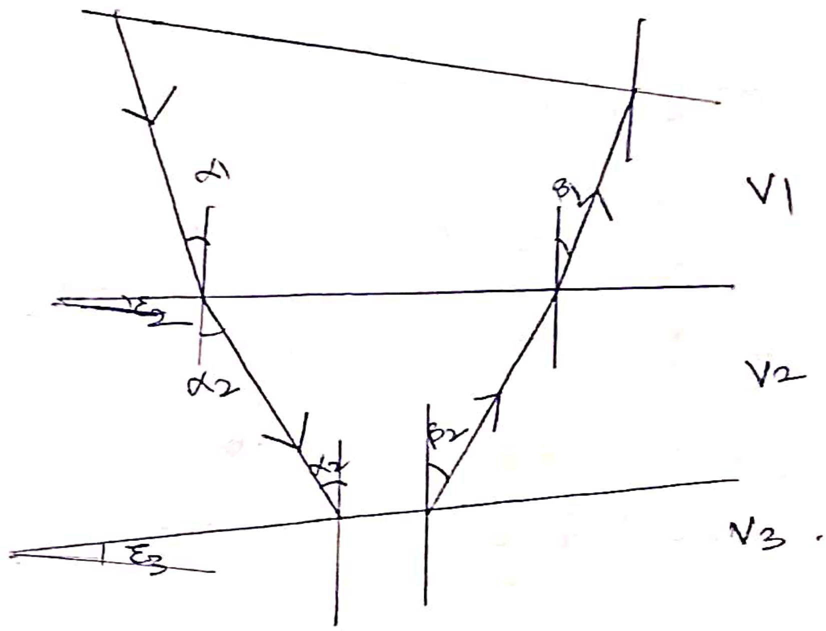
$= \frac{7}{5}$ km/s $= 1.4$ km/s

$V_{3c} = \frac{(70-45)}{4}$ km/s $= 8.75$ km/s.

$V_{2c} = \frac{125-105}{31-25}$ km/s $= 3.33$ km/s

From graph, $t_{1c} = 9$ ms.

$t_{2c} = 23$ ms.



$$t_x = x/V_x + \sum_{i=1}^{n-1} \frac{2z_i}{V_i} \cos\theta_i$$

$$\theta_i = \sin^{-1}\left(\frac{V_i}{V_x}\right)$$

$$\alpha_1 = \sin^{-1}\left(\frac{V_{1e}}{V_{2e}}\right) = \sin^{-1}\left(\frac{1.4}{3.33}\right) = 24.86^\circ$$

$$\beta_1 = \sin^{-1}\left(\frac{V_{1A}}{V_{2A}}\right) - \sin^{-1}\left(\frac{1}{3.57}\right) = 16.27^\circ$$

$$\xi_2 = \frac{\alpha_1 - \beta_1}{2} = 4.23°$$

For second

$$\alpha_2 = \sin^{-1}\left(\frac{V_1}{V_{3c}}\right) = \sin^{-1}\left(\frac{1.4}{8.75}\right) = 9.21°$$

$$\beta_1 = \sin^{-1}\left(\frac{V_1}{V_{3n}}\right) = \sin^{-1}\left(\frac{1}{4.66}\right) = 12.40°$$

$$\alpha_2 = a_1' + \xi_2$$

$$\beta_2 = b_1' - \xi_2$$

$$a_1 = \alpha_1 - \xi_2 = 24.86 - 4.23° = 20.63°.$$

$$b_1 = \beta_1 - \xi_2 = 16.27° - 2.69° = 13.58°.$$

$$\xi = \frac{\alpha_2 - \beta_2}{2} = 4.21°.$$

$$a_1' = \sin^{-1}\left(\frac{V_2}{V_1} \sin a_1\right) = 56.93°$$

$$b_1' = \sin^{-1}(3.\cancel{57} \sin 13.58°) = 56.96°.$$

$$\alpha_2 = 56.93° + 4.23° = 61.16°.$$

$$\beta_2 = 56.96° - 4.23° = 52.73°.$$

ⓐ $V_1 = 1 km/s. = V_{2c}.$

$V_d = 3.33 km/s$

$V_u = 3.57 km/s = 22A.$

$\therefore$ dip of 1st interface

$$= \frac{\sin^{-1}\left(\frac{V_1}{V_u}\right) - \sin^{-1}\left(\frac{V_1}{V_d}\right)}{2} =$$

$= 0.604°$

(b) Overburden depth

$$t_u = \frac{2 J_u \cos\theta_{ic}}{V_1} + \frac{x}{V_2}\sin(\theta_c - \beta)$$

$$t_u = \frac{2 J_u \cos\theta_{ic}}{V_1}$$

$V_1 = 1\text{km}$

$$\theta_c = \sin^{-1}\left(\frac{V_1}{V_u}\right) + \sin^{-1}\left(\frac{V_1}{V_d}\right) = 16.87^\circ$$

$$J_u = \frac{t_u V_1}{2\cos\theta_{ic}}$$

For $t_u = 6.5\text{ms}$.

$$J_u = \frac{6.5 \times 1}{2 \times \cos(16.87^\circ)} = 3.40\text{km}.$$

$$h_u = \frac{J_u}{\cos\beta} \approx 3.40\text{km}.$$

For $t_u = 9\text{ ms}$

$$J_d = \frac{9 \times 1}{2\cos(16.87^\circ)} = 4.71\text{km}.$$