

1.) Rangkuman Perhitungan dua gerak harmonik sederhana berfrekuensi sama jika keduanya :

a. searah



• Tinjau persamaan getaran selaras, x_1 dan x_2

$$x_1 = A_1 \cos(\omega t + \phi_1)$$

$$x_2 = A_2 \cos(\omega t + \phi_2)$$

• Persamaan getaran selaras gabungan

$$x = x_1 + x_2 = A \cos(\omega t + \phi)$$

• Persamaan menggunakan identitas trigonometri

$$x_1 = A_1 (\cos \omega t \cos \phi_1 - \sin \omega t \sin \phi_1)$$

$$x_2 = A_2 (\cos \omega t \cos \phi_2 - \sin \omega t \sin \phi_2)$$

$$\text{Sehingga, } x = x_1 + x_2 = A_1 (\cos \omega t \cos \phi_1 - \sin \omega t \sin \phi_1) + A_2 (\cos \omega t \cos \phi_2 - \sin \omega t \sin \phi_2)$$

$$\text{dan } x = A (\cos(\omega t + \phi) = A (\cos \omega t \cos \phi - \sin \omega t \sin \phi)$$

• Bandingkan $\sin \omega t$, didapatkan :

$$A \sin \omega t \sin \phi = (A_1 \sin \phi_1 + A_2 \sin \phi_2) \sin \omega t$$

$$A \sin \phi = A_1 \sin \phi_1 + A_2 \sin \phi_2$$

• Bandingkan $\cos \omega t$, didapatkan :

$$A \cos \omega t \cos \phi = (A_1 \cos \phi_1 + A_2 \cos \phi_2) \cos \omega t$$

$$A \cos \phi = A_1 \cos \phi_1 + A_2 \cos \phi_2$$

• Bandingkan $A \sin \phi$ dan $A \cos \phi$, didapatkan :

$$\tan \phi = \frac{A \sin \phi}{A \cos \phi} = \frac{A_1 \sin \phi_1 + A_2 \sin \phi_2}{A_1 \cos \phi_1 + A_2 \cos \phi_2}$$

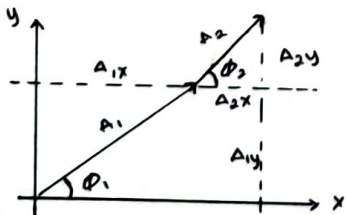
$$\phi = \arctan \left[\frac{A_1 \sin \phi_1 + A_2 \sin \phi_2}{A_1 \cos \phi_1 + A_2 \cos \phi_2} \right]$$

• Amplitudo getaran gabungan

$$A^2 = (A \sin \phi)^2 + (A \cos \phi)^2$$

$$A^2 = (A_1)^2 + (A_2)^2 + 2A_1 A_2 \cos(\phi_2 - \phi_1)$$

Deskripsi vektor untuk penggabungan dua osilasi harmonik yang searah dan frekuensi yang sama :



• Dari gambar, resultan R amplitudo dapat ditulis

$$R = \sqrt{R_x^2 + R_y^2} ; \tan \phi = \frac{R_y}{R_x}$$

dengan

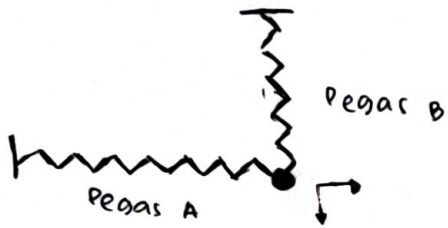
$$R_x = A_1 \cos \phi_1 + A_2 \cos \phi_2$$

$$R_y = A_1 \sin \phi_1 + A_2 \sin \phi_2$$

• Resultan penjumlahan dua gelombang

$$x = R \sin(\omega t + \phi)$$

b. tegak lurus



∴ Tinjauan getaran

$$x = A_x \cos(\omega_1 t + \phi_x)$$

$$y = A_y \cos(\omega_2 t + \phi_y)$$

1) Apabila $\omega = \omega_1 = \omega_2$ dan $\phi_x = \phi_y = \phi$, maka

$$\cos(\omega t + \phi) = \frac{x}{A_x} \quad \text{dan} \quad y = \frac{A_y}{A_x} x$$

2) Apabila $|\phi_x - \phi_y| = \phi$ dan frekuensi sama, maka

$$\cos \omega t = \frac{x}{A_x} \quad \text{dan} \quad \cos(\omega t + \phi) = \frac{y}{A_y}$$

$$\cos(\omega t + \phi) = \cos \phi \cos \omega t - \sin \phi \sin \omega t = \cos \phi \frac{x}{A_x} - \sin \phi \sqrt{1 - \cos^2 \omega t}$$

$$\frac{y}{A_y} = \cos \phi \frac{x}{A_x} - \sin \phi \sqrt{1 - \cos^2 \omega t} = \cos \phi \frac{x}{A_x} - \sin \phi \sqrt{1 - \frac{x^2}{A_x^2}}$$

$$\left(\frac{y}{A_y} - \cos \phi \frac{x}{A_x} \right)^2 = \left(-\sin \phi \sqrt{\frac{A_x^2 - x^2}{A_x^2}} \right)^2$$

$$\sin^2 \phi = \frac{y^2}{A_y^2} - \frac{2xy}{A_x A_y} \cos \phi + \frac{x^2}{A_x^2}$$

atau, dapat ditulis juga sebagai berikut.

$$\sin^2(\phi_1 - \phi_2) = \frac{x^2}{A_x^2} + \frac{y^2}{A_y^2} - \frac{2xy}{A_x A_y} \cos(\phi_1 - \phi_2)$$

∴ untuk $\phi = 0$; $A_x = A_y = A$

$$\frac{y^2}{A^2} - \frac{2xy}{A^2} + \frac{x^2}{A^2} = 0 \rightarrow (y - x)^2 = 0 \Rightarrow x = y$$

∴ untuk $\phi = \frac{\pi}{2}$; $A_x = A_y = A$

$$\sin^2 \phi = 1$$

$$\frac{x^2}{A^2} + \frac{y^2}{A^2} = 1 \rightarrow x^2 + y^2 = A^2$$

∴ untuk $\phi = \frac{\pi}{4}$; $A_x = A_y = A$

$$\frac{y^2}{A^2} - \frac{2xy}{A^2} \left(\frac{1}{2} \sqrt{2} \right) + \frac{x^2}{A^2} = \frac{1}{2}$$

∴ untuk $\phi = \pi$

$$\frac{y^2}{A^2} + \frac{2xy}{A^2} + \frac{x^2}{A^2} = 0 \rightarrow (y + x)^2 = 0 \quad \text{atau} \quad x = -y$$

Azzura Ferliani Ramadhani

5025201190

Tugas 7

2.) Menghitung gabungan dari dua persamaan simpangan gerak harmonik sederhana yang saling tegak lurus dan berfrekuensi sama

$$x = 2 \sin \left(2t + \frac{2\pi}{6} \right)$$

$$y = 2 \sin \left(2t + \frac{4\pi}{6} \right)$$

maka,

$$\phi = \phi_y - \phi_x$$

$$= \frac{4\pi}{6} - \frac{2\pi}{6}$$

$$= \frac{2\pi}{6} = \frac{\pi}{3} = 60^\circ$$

Persamaan Gabungan :

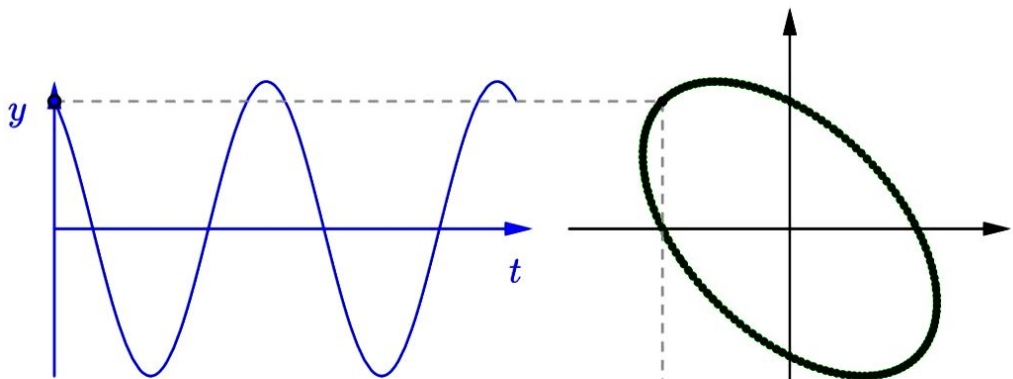
$$\sin^2 \phi = \frac{y^2}{A_y^2} - \frac{2xy}{A_x A_y} \cos \phi + \frac{x^2}{A_x^2}$$

$$\sin^2 60^\circ = \frac{y^2}{A_y^2} - \frac{2xy}{A_x A_y} \cdot \frac{1}{2} + \frac{x^2}{A_x^2}$$

$$\frac{1}{2} \sqrt{3} = \frac{y^2}{2^2} - \frac{xy}{2 \cdot 2} + \frac{x^2}{2^2}$$

$$\frac{1}{2} \sqrt{3} = \frac{y^2}{4} - \frac{xy}{4} + \frac{x^2}{4}$$

$$\frac{1}{2} \sqrt{3} = \frac{y^2 - xy + x^2}{4}$$

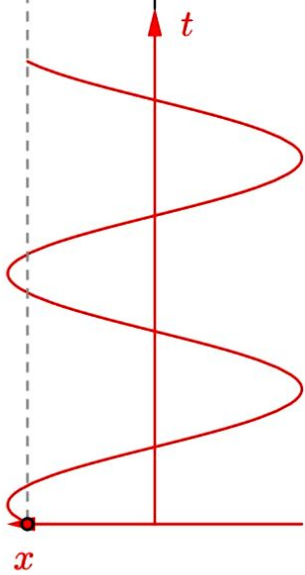


$c = 2$ $d = 4$
 $y = 2\sin(2t + \frac{4\pi}{6})$

$Ay = 2$

$t = 0$

Mulai/Berhenti Hapus jejak



$a = 2$ $b = 2$
 $x = 2\sin(2t + \frac{2\pi}{6})$

$Ax = 2$