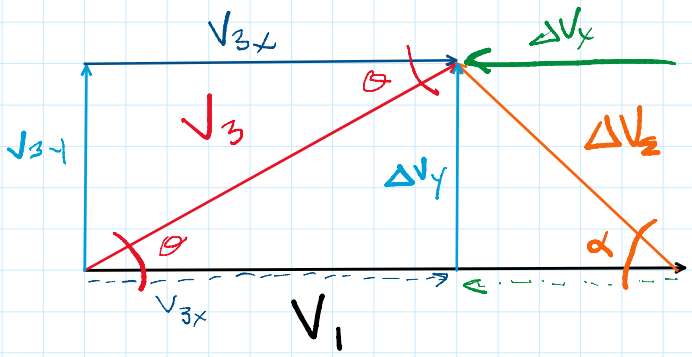
Velocity Vector Triangle Solutions

Tuesday, October 22, 2024 6:53 AM



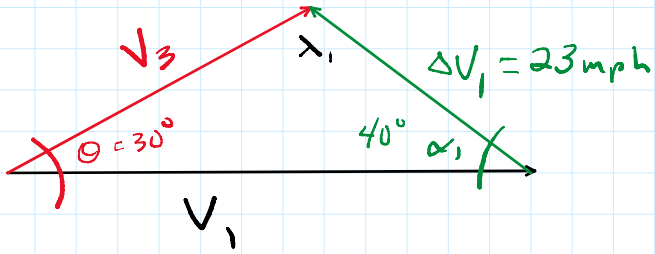
$$V_{3x} = V_3[\cos\theta] \qquad V_1 = V_3[\cos\theta] - \Delta V_x$$

$$\Delta V_x = V_3[\cos\theta] - V_1$$

$$\cos\alpha = \frac{\Delta V_x}{\Delta V_\ell}$$

$$\Delta V_x = \Delta V_\ell[\cos\alpha]$$

$$\Delta V_\ell = \frac{\Delta V_x}{\cos\alpha}$$



$A_{pp} = 0°$

$\theta = 30°$

$\beta_1 = A_{pp} - D_{rp} = 30°$

$\lambda_1 = 180 - 30 - 40$

$\lambda = 110°$

$$\frac{V_3}{\sin\alpha_1} = \frac{\Delta V_1}{\sin\theta}$$

$$\frac{V_3}{\sin(40)} = \frac{23}{\sin(30)}$$

$$V_3 = [\sin(40)]\left[\frac{23}{\sin(30)}\right]$$

$$V_3 = (0.6428)(46)$$

$$V_3 = 29.56 \text{ mph}$$

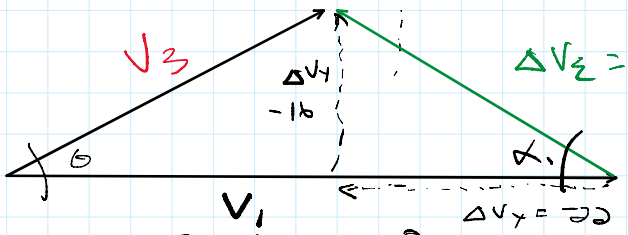
$$\frac{V_1}{\sin\lambda_1} = \frac{\Delta V_1}{\sin\theta}$$

$$\frac{V_1}{\sin(110)} = \frac{23}{\sin(30)}$$

$$V_1 = [\sin(110)]\left[\frac{23}{\sin(30)}\right]$$

$$V_1 = (0.9397)(46)$$

$$V_1 = 43.23 \text{ mph}$$



$\Delta V_x = -22 mph$

$\Delta V_y = 16 mph$

$V_3 = 27 mph$

① $\Delta V_2 = \sqrt{(22)^2 + (16)^2}$

$\Delta V_2 = \sqrt{484 + 256}$

$\Delta V_2 = \sqrt{740}$

$\Delta V_2 = 27.20 mph$

② $\alpha_1 = \tan^{-1}\left[\frac{\Delta V_y}{\Delta V_x}\right]$

$\alpha_1 = \tan^{-1}\left[\frac{-16}{-22}\right]$

$\alpha_1 = \tan^{-1}(0.7272)$

$\alpha_1 = 36^\circ$

③ $\frac{\sin\theta}{\Delta V_2} = \frac{\sin\alpha_1}{V_3}$

$\frac{\sin\theta}{27.2} = \frac{\sin(36)}{27}$

$\theta = \sin^{-1}\left[(27.2)\left(\frac{\sin(36)}{27}\right)\right]$

$\theta = \sin^{-1}[27.2\,(0.2177)]$

$\theta = \sin^{-1}(0.5921)$

$\theta = 36.31^\circ$

④ $\lambda_1 = 180 - 36 - 36.3$

$\lambda_1 = 107.7^\circ$

⑤ $\frac{V_1}{\sin\lambda_1} = \frac{V_2}{\sin\alpha_1}$

$\frac{V_1}{\sin(107.7)} = \frac{27}{\sin(36.3)}$

$\frac{V_1}{0.9527} = \frac{27}{0.5920}$

$\frac{V_1}{0.9527} = 45.61$

$V_1 = 43.45$

Combining The Triangles

$W_1 = 5000 lbs$

$V_1 =$

$V_3 = 25 mph$

$\Delta V_x = -14.72 mph$

$\Delta V_y = -8.5 mph$

$\Delta V_2 =$

$W_2 = 4000 lbs$

$V_2 =$

$V_4 =$

$\Delta V_{2\Sigma} =$

ΔV_2

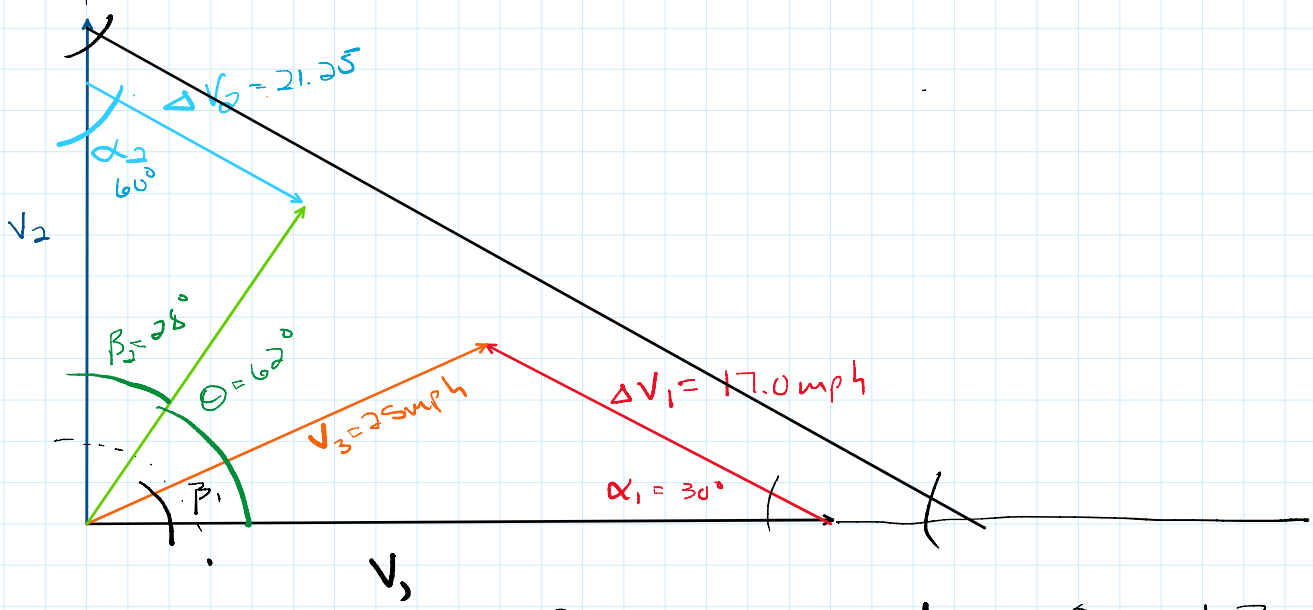
$\alpha_1 =$

$\theta =$

$R_A = 90°$

$\alpha_2 =$

$\phi = 62°$



① Calculate α_1

$\alpha_1 = \tan^{-1}\left(\frac{\Delta V_y}{\Delta V_x}\right)$

$\alpha_1 = \tan^{-1}\left(\frac{-8.5}{-14.72}\right)$

$\alpha_1 = \tan^{-1}(0.5774)$

$\alpha_1 = 30°$

② Calculate ΔV_{Σ}

$\Delta V_{\Sigma_1} = \sqrt{\Delta V_x^2 + \Delta V_y^2}$

$\Delta V_{\Sigma_1} = \sqrt{(14.72)^2 + (8.5)^2}$

$\Delta V_{\Sigma_1} = \sqrt{216.6784 + 72.25}$

$\Delta V_{\Sigma_1} = \sqrt{288.93}$

$\Delta V_{\Sigma_1} = 17.00$ mph

③ Find β_1

$\frac{\sin\beta_1}{\Delta V_1} = \frac{\sin\alpha_1}{V_3}$

$\frac{\sin\beta_1}{17} = \frac{\sin(30°)}{25}$

$\sin\beta_1 = [17]\left[\frac{0.5}{25}\right]$

$\sin\beta_1 = 0.34$

$\beta_1 = 19.88°$

④ Find λ_1

$\lambda_1 = 180 - \alpha_1 - \beta_1$

$\lambda_1 = 180 - 30 - 19.88$

$\lambda_1 = 130.12°$

⑤ Find V_1

$\frac{V_1}{\sin\lambda_1} = \frac{V_3}{\sin\alpha_1}$

$\frac{V_1}{\sin(130.12)} = \frac{25}{\sin(30)}$

$\frac{V_1}{0.7647} = 50$

$V_1 = 38.23$ mph

⑥ Find ΔV_2

⑦ Find α_2

⑧ Find β_2

$$\Delta V_2 = \Delta V_1 \left[\frac{W_1}{W_2}\right]$$

$$\Delta V_2 = (17)\left[\frac{5000}{4000}\right]$$

$$\Delta V_2 = (17)(1.25)$$

$$\Delta V_2 = 21.25 \text{ mph}$$

$$\alpha_2 = 180 - R_A - \alpha_1$$

$$\alpha_2 = 180 - 90 - 30$$

$$\alpha_2 = 180 - 120$$

$$\alpha_2 = 60^\circ$$

$$\beta_2 = R_A - \phi$$

$$\beta_2 = 90 - 62$$

$$\beta_2 = 28^\circ$$

⑨ Find λ_2

$$\lambda_2 = 180 - 60 - 28$$

$$\lambda = 180 - 88$$

$$\lambda_2 = 92^\circ$$

⑩ Find V_4

$$\frac{V_4}{\sin\alpha_2} = \frac{\Delta V_2}{\sin\beta_2}$$

$$\frac{V_4}{\sin(60)} = \frac{21.25}{\sin(28)}$$

$$\frac{V_4}{0.8660} = \frac{21.25}{0.4695}$$

$$\frac{V_4}{0.8660} = 45.26$$

$$V_4 = 39.2 \text{ mph}$$

⑪ Find V_2

$$\frac{V_2}{\sin\lambda_2} = \frac{\Delta V_2}{\sin\beta_2}$$

$$\frac{V_2}{\sin(92)} = \frac{21.25}{\sin(28)}$$

$$\frac{V_2}{0.9994} = \frac{21.25}{0.4695}$$

$$\frac{V_2}{0.9994} = 45.26$$

$$V_2 = 45.23 \text{ mph}$$

Not 90° App

$W_1 = 3900$ lbs

$\theta = 40^\circ$

$\alpha_1 = 60^\circ$

$V_1 =$

$V_3 =$

$\beta_1 = 40^\circ$

$\Delta V_1 = 17$ mph

$W_2 = 4200$

$\psi = 100^\circ$

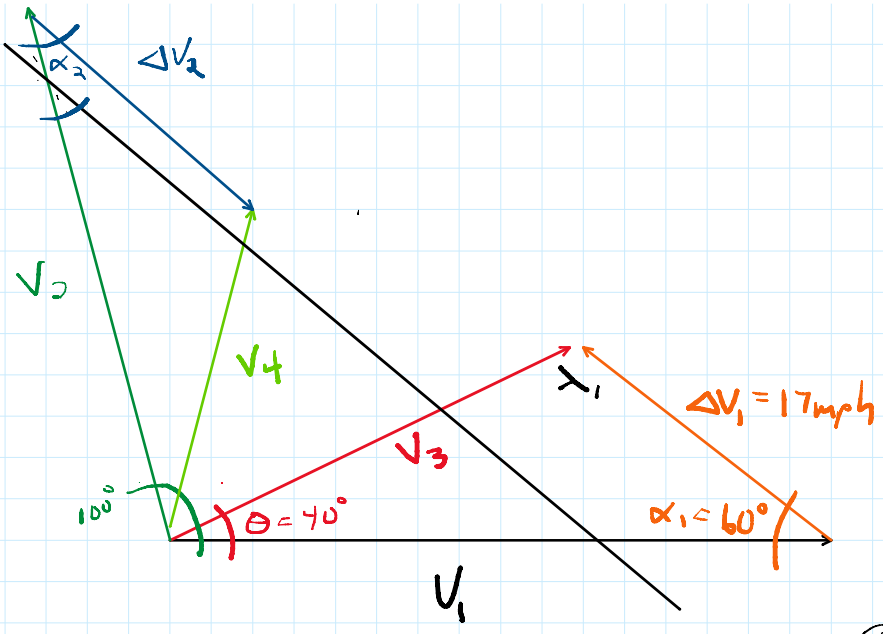
$\phi = 80^\circ$

$V_2 =$

$V_4 =$

$\beta_2 =$

$\Delta V_2 =$



① Find λ_1

$\lambda_1 = 180 - 60 - 40$

$\lambda_1 = 80°$

② Find V_3

$$\frac{V_3}{\sin\alpha_1} = \frac{\Delta V_1}{\sin\theta}$$

$$\frac{V_3}{\sin(60°)} = \frac{17}{\sin(40)}$$

$$\frac{V_3}{0.8660} = \frac{17}{0.6428}$$

$$\frac{V_3}{0.8660} = 26.44$$

$V_3 = 22.90$ mph

③ Find V_1

$$\frac{V_1}{\sin\lambda_1} = \frac{\Delta V_1}{\sin\theta}$$

$$\frac{V_1}{\sin(80)} = \frac{17}{\sin(40)}$$

$$\frac{V_1}{0.9848} = \frac{17}{0.6428}$$

$$\frac{V_1}{0.9848} = 26.44$$

$V_1 = 26.03$ mph

④ Find α_2

$\alpha_2 = 180° - RA - \alpha_1$

$\alpha_2 = 180 - 100 - 60$

$\alpha_2 = 20°$

$\beta_2 = \Psi - \phi$

$\beta_2 = 100 - 80$

$\beta_2 = 20$

⑤ Find ΔV_2

$$\Delta V_2 = \Delta V_1\left(\frac{W_1}{W_2}\right)$$

$$\Delta V_2 = (17)\left(\frac{3900}{4200}\right)$$

$\Delta V_2 = (17)(0.9286)$

$\Delta V_2 = 15.79$ mph

⑥ Find V_4

$$\frac{V_4}{\sin\alpha_2} = \frac{\Delta V_2}{\sin\beta_2}$$

$$\frac{V_4}{\sin 20} = \frac{15.79}{\sin 20}$$

$V_4 = 15.79$

⑦ Find λ_2

⑧ Find V_2

$\lambda_2 = 180 - \alpha_2 - \beta_2$

$\lambda_2 = 180 - 20 - 20$

$\lambda_2 = 140°$

$$\frac{V_2}{\sin \lambda_2} = \frac{\Delta V_2}{\sin \beta_2}$$

$$\frac{V_2}{\sin(140)} = \frac{15.79}{\sin(20)}$$

$$\frac{V_2}{0.6428} = \frac{15.79}{0.3420}$$

$$\frac{V_2}{0.6428} = 46.17$$

$V_2 = 29.68$ mph

App Veh 1 $= 0°$

Dep $\angle$ Veh 1 $= \theta$ theta

Diff App & Dep $V_1 = \beta_1 = (\theta - 0°)$

App $\angle$ Veh 2 $= \Psi$ Psi

Dep $\angle$ Veh 2 $= \phi$ Phi

$\beta_2 = (\Psi - \phi)$