$sin\theta = \frac{2}{55}\ and\ cos\varphi = -\frac{2}{5}$ and $\theta\ and\ \varphi$- lies in the second quadrant.

1. Determine $cos\theta$?

$$cos^2\theta + sin^2\theta = 1$$

$$cos\theta = \pm\sqrt{1 - sin^2\theta}$$

If θ lie in the second quadrant than $cos\theta < 0$

$$cos\theta = -\sqrt{1 - \left(\frac{2}{55}\right)^2} = -\sqrt{1 - \frac{4}{3025}} = -\frac{\sqrt{3021}}{55}$$

2. Find $sin\varphi$

$$cos^2\varphi + sin^2\varphi = 1$$

$$sin\varphi = \pm\sqrt{1 - cos^2\varphi}$$

If φ lie in the second quadrant than $sin\varphi > 0$

$$sin\varphi = \sqrt{1 - cos^2\varphi} = \sqrt{1 - \left(-\frac{2}{5}\right)^2} = \sqrt{\frac{21}{25}} = \frac{\sqrt{21}}{5}$$

3. What $\sin(\varphi + \theta)$?

$$\sin(\varphi + \theta) = sin\varphi cos\theta + cos\varphi sin\theta$$

$$\sin(\varphi + \theta) = \frac{\sqrt{21}}{5}\left(-\frac{\sqrt{3021}}{55}\right) + \left(-\frac{2}{5}\right)\frac{2}{55} = -\frac{3\sqrt{7049} + 4}{275}$$

4. Find $\cos(\varphi + \theta)$?

$$\cos(\varphi + \theta) = \left(-\frac{2}{5}\right)\left(-\frac{\sqrt{3021}}{55}\right) - \frac{\sqrt{21}}{5}\frac{2}{55} = \frac{2\sqrt{3021} - 2\sqrt{21}}{275}$$

5. Determine $\mathrm{tg}(\theta - \varphi)$

$$\mathrm{tg}(\theta - \varphi) = \frac{tg\theta + tg\varphi}{1 - tg\theta tg\varphi}$$

$$tg\theta = \frac{sin\theta}{cos\theta} = \frac{\frac{2}{55}}{-\frac{\sqrt{3021}}{55}} = -\frac{2}{\sqrt{3021}}$$

$$tg\varphi = \frac{sin\varphi}{cos\varphi} = \frac{\frac{\sqrt{21}}{5}}{-\frac{2}{5}} = -\frac{\sqrt{21}}{2}$$

$$\mathrm{tg}(\theta - \varphi) = \frac{-\frac{2}{\sqrt{3021}} + -\frac{\sqrt{21}}{2}}{1 - \frac{2}{\sqrt{3021}} * \frac{\sqrt{21}}{2}} = \frac{-4 - \sqrt{63441}}{2\sqrt{3021} - 2\sqrt{21}}$$

6. Equivalent to $\sin(\theta - \varphi)$?

$$\sin(\theta - \varphi) = sin\theta cos\varphi - cos\theta sin\varphi$$

$$\sin(\theta - \varphi) = \frac{2}{55}\left(-\frac{2}{5}\right) + \frac{\sqrt{3021}}{55}\frac{\sqrt{21}}{5} = \frac{-4 + 3\sqrt{7049}}{275}$$