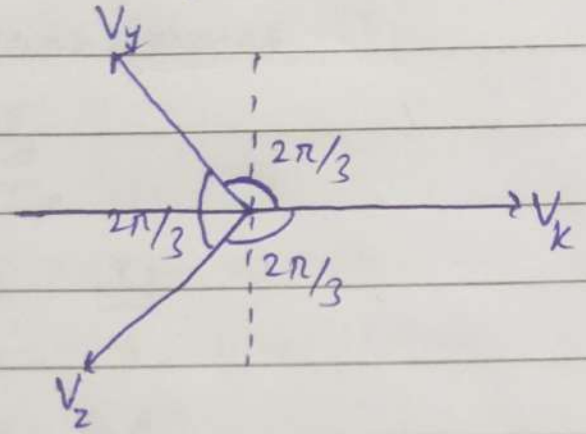
Q. The instantaneous voltages at three terminals marked X, Y and Z are given by $\mathrm{V_x = V_0 \sin \omega t V_Y = V_0 \sin\left(\omega t + \frac{2\pi}{3}\right)}$ and $\mathrm{V_Z = V_0 \sin\left(\omega t + \frac{4\pi}{3}\right)}$ An ideal voltmeter is configured to read rms value of the potential difference between its terminals. It is connected between points X and Y and then between Y and Z. The reading(s) of the voltmeter will be:- (A) $\mathrm{V_{XY}^{rms} = V_0}$ (B) $\mathrm{V_{YZ}^{rms} = V_0\sqrt{\frac{1}{2}}}$ (C) Independent of the choice of the two terminals (D) $V_{XY}^{rms} = \mathrm{V_0}\sqrt{\frac{3}{2}}$ (JEE ADVANCED 2017)

5. Given voltages at terminals X, Y and Z are

$V_x = V_0 \sin(\omega t)$; $V_y = V_0 \sin\left(\omega t + \frac{2\pi}{3}\right)$; $V_z = V_0 \sin\left(\omega t + \frac{4\pi}{3}\right)$

The phasor diagram is as follows:



Amplitude of $V_x = V_y = V_z = V_0$ (Given)

$\therefore$ ~~For~~ $V_{XY} = \sqrt{V_0^2 + V_0^2 - 2(V_0)(V_0)\cos\phi} = (V_x - V_y)$

(where ϕ is angle between X and Y)

$\phi = \frac{2\pi}{3}$

$\Rightarrow V_{XY} = \sqrt{2V_0^2 - 2V_0^2\left(-\frac{1}{2}\right)} = (V_x - V_y)$

$\Rightarrow V_{XY} = \sqrt{3}V_0$

$$\therefore \boxed{V_{XY}(rms) = \frac{V_{XY}}{\sqrt{2}} = \frac{\sqrt{3}V_0}{\sqrt{2}}}$$

Similarly,

$V_{YZ}(rms) = V_{XZ}(rms) = \frac{\sqrt{3}V_0}{\sqrt{2}}$

$\Rightarrow \Delta V$ is independent of choice of terminals

Hence, option (C) and (D) are correct