15/4/21

$$x = K(x' + Vt') \quad \text{— (3)}$$

Since the relative motion of A and B is combined to only $x$.

$$y' = y$$
$$z' = z$$
$$t' = t$$

The value of $x'$ from equation (2) can be substituted in equation (3)

$$x = K\left[K(x - Vt) + Vt'\right]$$

$$x = K^2 (x - Vt + KVt'$$

$$KVt' = x - K^2(x - Vt)$$

$$t' = \frac{x - K^2 x + K^2 Vt}{KV}$$

$$t' = \frac{x - K^2 x}{KV} + \frac{K^2 Vt}{KV}$$

$$= \frac{x(1 - K^2)}{KV} + \frac{K^2 Vt}{KV}$$

$$t' = Kt + \frac{x(1 - K^2)}{KV} \quad \text{— (4)}$$

To find the value K, consider two reference A and B. The spaceship in reference frame A measures the time $t$ and the space-ship in reference frame B measure the time $t'$

$$x = ct \qquad \text{—— (5)}$$

$$x' = ct' \qquad \text{—— (6)}$$

Substituting the value of $x'$ and $t'$ from equation (2) and (4) in equation (6).

$$k(x - vt) = c\left[kt + \frac{x(1-k^2)}{kv}\right]$$

$$kx - kvt = ckt + cx\frac{(1-k^2)}{kv}$$

$$kx - cx\frac{(1-k^2)}{kv} = ckt + kvt$$

$$x\left[k - c\frac{(1-k^2)}{kv}\right] = ckt\left[1 + \frac{v}{c}\right]$$

$$x = \frac{ckt\left[1 + \frac{v}{c}\right]}{\left[k - c\frac{(1-k^2)}{kv}\right]}$$

$$= \frac{ckt\left(1 + \frac{v}{c}\right)}{k\left[1 - \frac{c}{v}\left(\frac{1}{k^2} - 1\right)\right]}$$

$$x = ct\frac{\left[1 + \frac{v}{c}\right]}{\left[1 - \frac{c}{v}\left(\frac{1}{k^2} - 1\right)\right]} \qquad \text{—— (7)}$$

Then substituting the value of $x$ from equation (5) into (7) we get