QUES 05

At a metro station, a girl walks up **a stationary escalator in time t_1 If she remains stationary on the escalator, then the escalator takes her up in time t_2. The time taken by her to walk up on the moving escalator will be**

(a) $(t_1+t_2)/2$ (b) t

(b) $t_1t_2/(t_2-t_1)$

(c) $t_1t_2/(t_2+t_1)$

(d) t_1-t_2

Sol: (c)

Key concept: Net velocity when object is moving on the moving frame in One Dimension:

We will define this concept by taking an example.

River-Man problem in one dimension:

Velocity of river water current is u and velocity of man in still water is v, i.e. man can swim in water with velocity v.

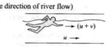
Case-1

Man swimming downstream (along the direction of river flow)

In this case velocity of river $\vec{v}_R = +u$

velocity of man w.r.t. river $\vec{v}_{mR} = +v$.

Now $\vec{v}_m = \vec{v}_{mR} + \vec{v}_R = u + v$



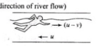
Case-2

Man swimming upstream (opposite to the direction of river flow)

In this case velocity of river $\vec{v}_R = -u$

velocity of man w.r.t. river $\vec{v}_{mR} = +v$

Now $\vec{v}_m = \vec{v}_{mR} + \vec{v}_R = (v - u)$



In this problem, we have to observe the motion from different frames. We have to find net velocity with respect to the Earth that will be equal to velocity of the girl plus velocity of escalator. Let displacement is L, then

Velocity of girl $v_g = \frac{L}{t_1}$

Velocity of escalator $v_e = \frac{L}{t_2}$

Net velocity of the girl seen from ground when walk up on the moving escalator $= v_g + v_e = \frac{L}{t_1} + \frac{L}{t_2}$

If t is total time taken in covering distance L, then

$$\frac{L}{t} = \frac{L}{t_1} + \frac{L}{t_2} \Rightarrow t = \frac{t_1 t_2}{t_1 + t_2}$$