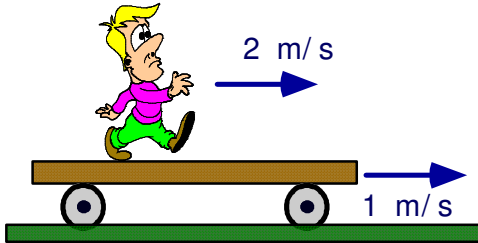


Unit 3: Kinematics in 2D

1 - Relative Velocity

In order to properly describe an object's motion we need to know... *its frame of reference, point of view*

Example: A man walks to the right with a velocity of 2 m/s on a platform that moves with a velocity of 1 m/s to the right.



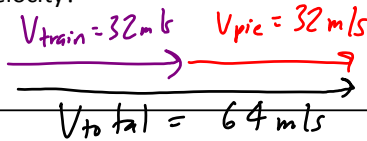
a) What is the person's velocity relative to the platform?

Reference frame: platform
 $v_{\text{person-platform}} = \underline{2}$ m/s

b) What is the person's velocity relative to the ground?

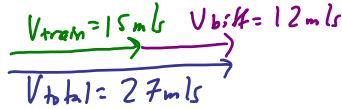
Reference frame: ground
 $v_{\text{person-ground}} = v_{\text{platform}} + v_{\text{person-platform}}$
 $v_{\text{person-ground}} = \underline{1}$ m/s + $\underline{2}$ m/s
 $v_{\text{person-ground}} = \underline{3}$ m/s

Example: You can throw a pie at 32 m/s. If you are standing on a train traveling 32 m/s east and throw a pie forward what is its resultant (total) velocity?



Example: A bowling team on a train heads east at 15 m/s. A stationary observer watches them play as they pass. At what velocity would the following throws appear to be moving at?

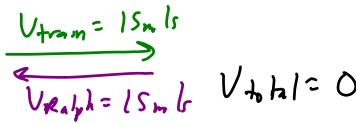
Biff: Throws @ 12 m/s East



Hank: Throws @ 18 m/s East



Ralph: Throws @ 15 m/s West



Train A leaves Vancouver station traveling east at 90. km/h at 9:00 am. At the same time train B leaves Montreal traveling west at 110 km/h. If the two stations are 4800 km.

a. At what time do they meet?

$$v_{\text{rel}} = 90 \text{ km/h} + 110 \text{ km/h} = 200 \text{ km/h}$$

$$v = \frac{d}{t} \quad t = \frac{d}{v} = \frac{4800 \text{ km}}{200 \text{ km/h}} = \boxed{24 \text{ h}}$$

b. Where are they when they meet?

$$v_A = \frac{d_A}{t} \quad d_A = v_A t = (90 \text{ km/h})(24 \text{ h}) = 2160 \text{ km E of Vancouver}$$

If the conductor of train A notices that it takes exactly 3.2 s for train B to pass it, what is the length of train B?

$$v_{\text{rel}} = 200 \text{ km/h} \div 3.6 = 55.56 \text{ m/s}$$

$$d = v \cdot t = (55.56 \text{ m/s})(3.2 \text{ s}) = \boxed{180 \text{ m}}$$