VKSO 3.) Fictitious force / Pseudo force

A fictitious force (also called a Pseudo force, inertial force or d' Alembert force) is an apparent force that acts on all masses whose motion is described using a non-inertial frame of reference frame, such as rotating reference frame. The Pseudo-force becomes effective when the reference system has started to accelerate relative to a reference system without acceleration.

For example, Suppose two bodies A & B are sitting in a moving bus and C is looking at both of them from the ground, so when C draws a free body diagram of B, it has a net force that gives it acceleration.

But if A draws a free-body diagram for B, then B rests for him, needs a fictitious force in his body in order to counteract the force shown by A. This force is called the Pseudo force.

Examples of Pseudo force.

Following are the some examples of Pseudo force.

1.) Euler force,
2.) Coriolis force,
3.) Centrifugal force.

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In Mechanics, the Euler force is the fictitious tangential force that occurs when a non-uniform rotating reference system is used to analyze the movement and the angular velocity of the axes of the reference frame. Euler's acceleration (Named after Leonhard Euler), also called azimuthal acceleration or transverse acceleration, is the part of the absolute acceleration that results from the change in the angular velocity of the reference system or frame.

For example :- Euler's power is felt by a person driving a merry-go-round. At the beginning of the ride, Euler's force is the apparent force pushing the person backwards, and when the ride stops it is the apparent force pushing the person forward. A person on a horse near the perimeter of the arena perceives a greater apparent force than a person on a horse closer to the axis of rotation.

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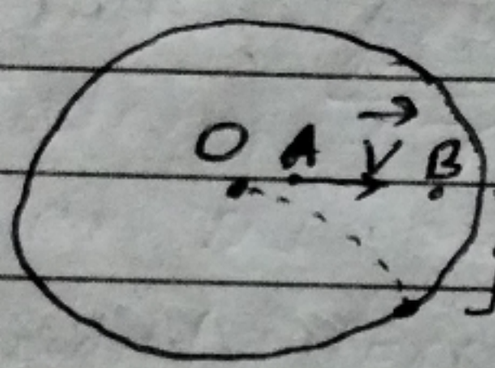
Coriolis Force

It is a fictitious force. It acts upon any moving body in an independently rotating system and arises in frames that rotate with a constant angular speed ω.

The fictitious force that acts on a particle when, it is in motion relative to a rotating frame of reference is known as the Coriolis force. It is given as:

$$F_C = -2m(\vec{\omega} \times \vec{v}')$$



where Fc is proportional to the angular velocity $\vec{\omega}$ of the rotating frame and also to the velocity $\vec{v}'$ of the particle relative to it. Following are the some cases where Coriolis force is zero.

1.) If $\vec{\omega}=0$, it means the reference frame is non-rotating.

2.) If $\vec{v}'=0$, it means the particle is at rest relative to the rotating frame.

Furthermore, the direction of this force is perpendicular to both the angular

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velocity of the rotating frame and the velocity of the particle w.r.t the rotating frame. and it is represented as the Cross product of $\vec{\omega}$ and $\vec{v}'$.

In equation $F_c = -2m(\vec{\omega} \times \vec{v}')$, the -ve sign shows that the direction of Coriolis force is opposite to that given by right handed screw rule. The force can be expressed as:

$$F_c = -2m(\vec{\omega} \times \vec{v}') = -2m\,\vec{\omega}\,\vec{v}' \sin\theta\,\hat{n}$$

Special Cases:

1.) The Coriolis force is zero, when $\theta = 0$. Similarly, if the angular velocity vector of the rotating frame is parallel to the particle velocity relative to the rotating frame then Coriolis force vanishes.

2.) If $\theta = \pi/2$, $\sin\theta = 1$ So the Coriolis force ($F_c = 2m\vec{\omega}\vec{v}'$) is maximum. when $\vec{\omega}$ and $\vec{v}'$ are at right angles to each other, the Coriolis force is maximum.