Lecture 23 Checkpoints

1. Which speed, airspeed or groundspeed, depends on the wind speed?

   **Groundspeed** (airspeed is wrt air molecules, ref. frame)

2. Explain why we couldn’t go straight across the river if the river speed \( u \) is greater than our water speed \( v \).

   We must cancel \( u \): need \( \vec{v}_{\text{w}} = -\vec{u} \) \( \Rightarrow \left| \vec{v}_{\text{w}} \right| > \left| \vec{u} \right| \)

3. If \( u < v \), we can go straight across the river. Do we aim our boat upstream at a particular target on the opposite shore or aim upstream at a constant angle with the line straight across or downstream at a particular target or aim downstream at a particular angle, or just always aim straight across at zero angle?

   For a straight line trajectory, we need to keep cancelling \( u \)

   \( (\vec{v}_{\text{r}} = v \sin \theta = -u \text{ for fixed } v, u \Rightarrow \theta \text{ fixed}) \)

4. If we were running to the right \( \rightarrow \) , and the rain is falling straight down \( \downarrow \downarrow \) relative to someone standing still, circle the rain pattern we see:

   ![Rain Pattern Diagram]

   2 ways to understand
   i) \( \downarrow \downarrow \) closer as well as lower
   ii) \( \downarrow \downarrow \) closer as well as lower

5. What is Bart’s acceleration relative to the inside of the elevator? So what is his “second law” relative to that accelerated reference frame?

   \( \vec{a}_{\text{rel}} = 0 \Rightarrow \vec{F}_{\text{net}} = 0 \)

   \( F_{\text{net}} = m \vec{a}_{\text{rel}} \Rightarrow \vec{F}_{\text{net}} = m \vec{a} \)

6. Draw a picture of the direction of the effective gravity inside the accelerated airplane and at what angle would a plant grow inside if the acceleration could continue during its growth (wow!)?

   \( \vec{g}_{\text{eff}} = \vec{g} - \vec{a} \)

   ![Plant Growth Example]

   plant

7. Take the second law in an inertial frame: \( \vec{F}_{\text{net}} = m\vec{a} \). If we are in the reference frame moving at the acceleration \( \vec{a} \), what is the fictitious force we must add (and we feel), to use the “second law” relative to our accelerated reference frame? Check your answer against linearly and circularly accelerated examples.

   At rest in accel. frame \( \Rightarrow \vec{a} = 0 \Rightarrow \vec{F}_{\text{net}} = 0 \Rightarrow \vec{F}_{\text{net}} = m\vec{a} \)

   F_{\text{fictitious}} = -ma

8. What is the component of the Earth’s angular velocity vector perpendicular to the Earth’s surface at the equator? What Foucault pendulum period does this suggest we would find there?

   \( \omega = \omega \cos \lambda \)

   \( \omega \sin \lambda = 0 \Rightarrow \lambda = 0 \)

   \( T = \infty \)