REAL AND FICTICIOUS FORCES?

- A flow in a jet engine inlet is axial in the engine fixed coordinate system. The inlet area increases in the downstream direction.

- What are the forces and accelerations of a fluid particle as seen in the **engine fixed system**?
  - How does the velocity change at the duct wall

- What are the forces and accelerations of a fluid particle as seen in the **rotor (relative, or rotating) coordinate system**?
  - How does the velocity change at the duct wall?

A CORIOLIS SCAM?

Someone who had been to Equatorial Africa told me that tourists at the Equator were shown the following set of demonstations:

1) A vessel was filled with water at a location 100 feet north of the Equator. When a plug on the bottom was pulled out, a counter-clockwise swirl was set up.
2) The vessel was filled with water at a location 100 feet south of the Equator. When a plug on the bottom was pulled out, a clockwise swirl was set up.

Is this a valid illustration of the effect of Coriolis forces? Why or why not?

If not, how would you define what would be a valid demonstration?

FLOW IN ROTATING DUCTS (1)

- A horizontal square duct that is rotating around a vertical axis perpendicular to the duct has a velocity in the lower half of the duct that is twice the velocity in the upper half. The fluid is incompressible and constant density. At a station (0) all the motion is aligned with the duct.

- What happens downstream of station (0) as explained by:
  - An observer in the absolute system?
  - An observer in the relative system?

- How would you sum up the point of this concept question in one sentence?

FLOW IN ROTATING DUCTS (2)

- A horizontal square duct that is rotating around a vertical axis perpendicular to the duct has an incompressible fluid with non-uniform density. At a station (0) the density in the lower half of the duct is twice the density in the upper half, the relative velocity is uniform, and all the motion is aligned with the duct.

- What happens downstream of station (0) as explained by:
  - An observer in the absolute system?
  - An observer in the relative system?

- How would you sum up the point of this concept question in one sentence?

IS 16.540 APPLICABLE FOR PERSONAL TRAINERS?

You are tasked with training a goldfish for an Olympic swimming event. Would it be useful to have the goldfish swim in a tank that is mounted on a rotating table? Why or why not?

If this is deemed to be a good idea, how fast might the table have to spin? (How would you determine this?)

FLOW ON THE ROTATING EARTH

This concept question is based on an experiment performed by Professor A. H. Shapiro. A large (3 meter diameter) circular tank is filled with water (in the clockwise direction). After a day for the initial motion to die out, the plug is removed from the small drain hole in the center of the tank.

a) Sketch the streamlines in an inertial coordinate system and a coordinate system attached to the Earth.

b) What determines the direction of the swirl in the tank?

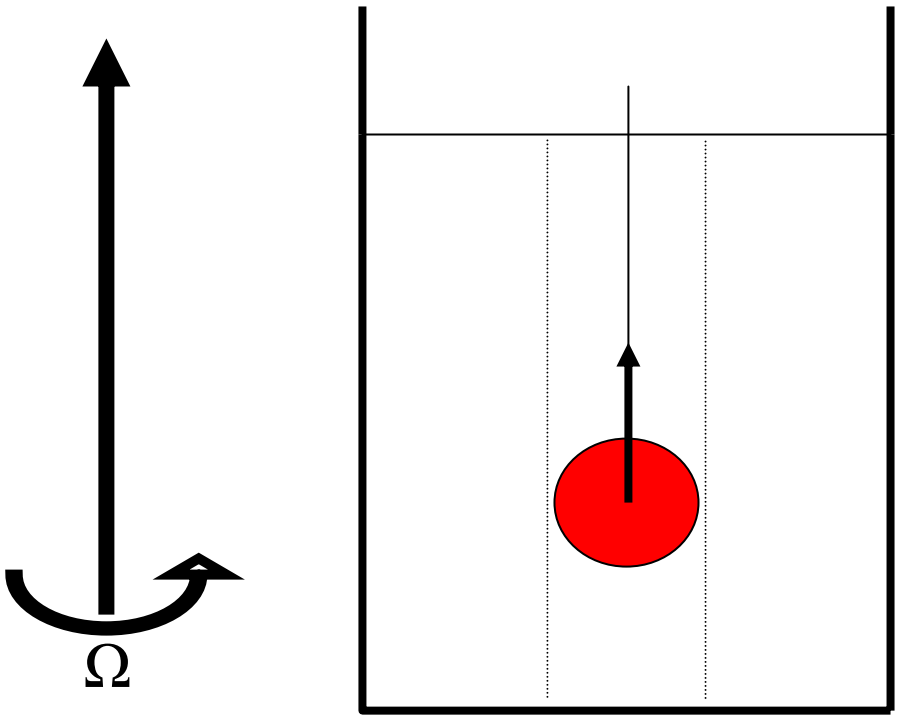
c) Consider a small bucket of water. Do you think the conclusions will be the same? Why or why not?

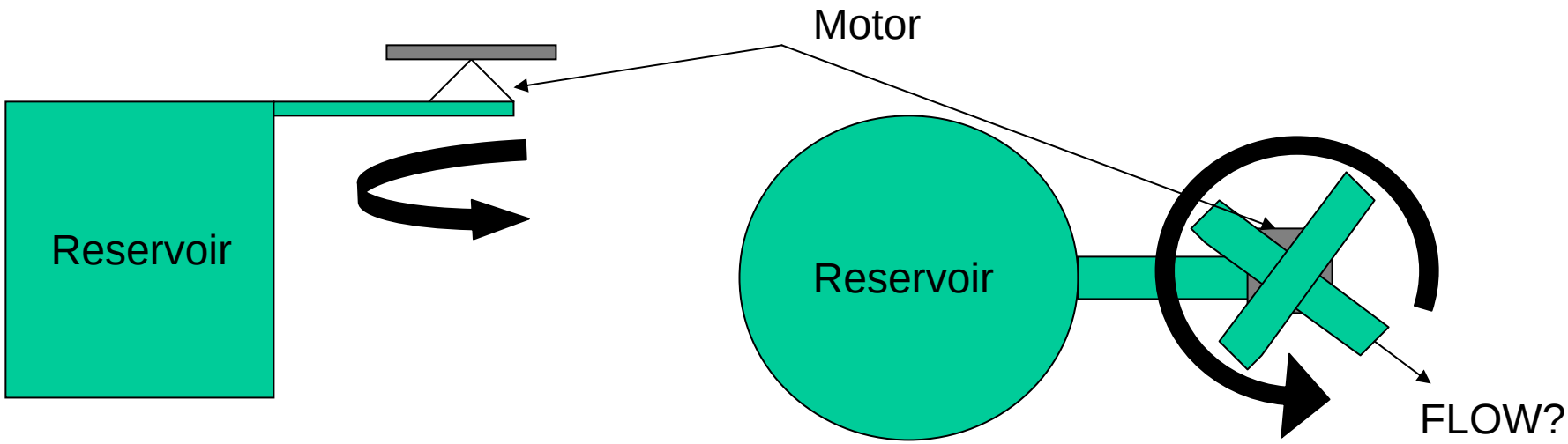
AXIAL MOTION IN A ROTATING FLOW

A sphere is immersed in a container of fluid rotating at high speed. The sphere is moved slowly upwards from the bottom of the container as shown below.

a) What is the direction of the relative vorticity above and below the sphere?

b) What can you say about the vertical speed of a *buoyant ball* released in a rotating container compared to the speed of the same ball released in a stationary container?





A lawn sprinkler is connected to a reservoir through a hose (neglect viscous and gravitational effects). Initially, the water inside the reservoir, hose and sprinkler is still. Gravity can be neglected. An electric motor is then started generating a rotation in the sprinkler as shown in the figure.

Will water flow out of the sprinkler? Why or why not?

One argument is that a pressure gradient will be established between the center of rotation (inlet to the sprinkler) and the exit to the atmosphere. This will counteract the effects of centrifugal forces so there will be no motion.

Is this correct? Is it relevant? Is it the whole story?