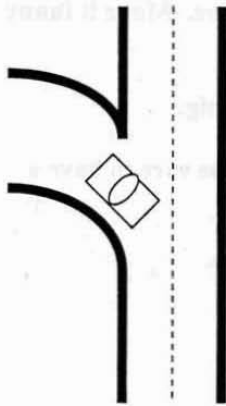


PHYSICS PROJECT: CENTRIFUGAL FORCE IS FICTITIOUS

20 POINTS - SUMMATIVE

In order to better understand the motion of a rotating system, consider a car approaching a curved exit ramp at high speed, as in the figure below. As the car takes the sharp left turn onto the ramp, a person sitting in the passenger seat slides to the right across the seat and hits the door. At that point, the force of the door keeps him from being ejected from the car. What causes the passenger to move toward the door? A popular but *erroneous* explanation is that some mysterious force pushes him outward. (This is sometimes called the “centrifugal” force, but we shall not use that term since it always creates confusion.)



The phenomenon is correctly explained as follows. Before the car enters the ramp and travels a curved path, the passenger, because of inertia, tends to move along the original straight-line path. This is in accordance with Newton's first law: the natural tendency of a body is to continue moving in a straight line. However, if a sufficiently large centripetal force (toward the center of curvature) acts on the passenger, he moves in a curved path along with the car. The origin of this centripetal force is the force of friction between the passenger and the car seat. If this frictional force is not great enough, the passenger slides across the seat as the car turns under him. Because of the passenger's inertia, he continues to move in a straight-line path. Eventually the passenger encounters the door not

because of some mysterious outward force but because *there is no centripetal force great enough to enable him to travel along the circular path followed by the car.*

As a second example, consider what happens when you run clothes through the rinse cycle of a washing machine. In the last phase of this cycle, the drum spins rapidly to remove water from the clothes. Why is the water thrown off? An *erroneous* explanation is that the rotating system creates some mysterious outward force on each drop of water, and this force causes the water to be hurled to the outer drum of the machine. The correct explanation goes as follows. When the clothes are at rest in the machine, water is held to them by molecular forces between the water and the fabric. During the spin cycle, the clothes rotate and the molecular forces are not great enough to provide the necessary *centripetal* force to keep the water molecules moving in a circular path along with the clothes. Hence, the drops of water, because of their inertia, move in straight-line paths until they encounter the sides of the spinning drum.

In summary, in describing motion in an accelerating frame, one must be very careful to distinguish real forces from fictitious ones. An observer in a car rounding a curve is in an accelerating frame and invents a fictitious outward force to explain why he or she is thrown outward. A stationary observer outside the car, however, considers only real forces on the passenger. To the observer, the mysterious outward force *does not exist!* The only real external force on the passenger is the centripetal (inward) force due to friction or the contact force of the door.

ASSIGNMENT ON THE BACK →

PHYSICS PROJECT: CENTRIFUGAL FORCE IS FICTITIOUS

20 POINTS - SUMMATIVE

PROJECT OPTIONS & DESCRIPTION:

Choose ONE of the following options for this project:

A **one page** typed (12 point font – double spaced) **short story** illustrating the concept that centrifugal force is fictitious and that the only real external force is the inward centripetal force. Use examples from your own life to make your paper come alive! Make it funny if you can. Do not plagiarize from this handout. Half of a page equals 10/20 points (50%).

OR

A **big comic strip** (include at least 6 scenes or frames) illustrating the concept that centrifugal force is fictitious and that the only real external force is the inward centripetal force. If you only show half the number of scenes or frames you will receive half credit, 10/20 points (50%).

**ALL PROJECTS MUST BE SUBMITTED BY THE ASSIGNED DEADLINE.*