PHYS 615 – Activity 15.1: Galilean Transform

1. *Dropping a Ball in an Elevator*

   A glass elevator is moving up at constant velocity V – it's initial height at time 0 is H_0. A person inside of the elevator drops a ball from height h_0 above the elevator floor – they hold the ball in their hand and then let go of it at time 0. How long does it take for the ball to hit the floor of the elevator?

   Find the answer in two different frames of reference: (1) in the frame of reference of the person dropping the ball, that is, the frame of reference moving together with the elevator; (2) in the frame of reference fixed to the ground outside.

   Bonus question: What changes if the elevator, initially moves at V_0, but accelerates at a rate A? Explain.

2. *Newton's Laws Invariance under Galilean Transformation*

   Using arguments similar to those of the text's section 15.2, show that Newton's 1st and 3rd Laws are invariant under the Galilean transformation.

3. *Inelastic Collision*

   Consider a classical inelastic collision of the form $A + B \rightarrow C + D$. (For example, this could be a collision such as $Na + Cl \rightarrow Na^{+} + Cl^{-}$, in which two neutral atoms exchange an electron.)

   Show that the law of conservation of classical momentum is unchanged under the Galilean transformation if and only if total mass is conserved – as is certainly true in classical mechanics. (We shall find in relativity that the classical definition of momentum has to be modified and that total mass is *not* conserved.)