Classical Mechanics 1, Autumn 2025 CMI

Assignment 4

Due by 6pm, Mon 8 Sep, 2025

inertial frames, degrees of freedom, Newton's laws

1. $\langle \mathbf{3+3} \rangle$ **Events and simultaneity.** (a) Suppose events A and B occur at the same location $\boldsymbol{r}_0$ but at distinct times $t_A < t_B$, as observed in an inertial frame K. Do they occur at the same location in all other inertial frames? Explain why/why not. (b) Suppose events A and B occur simultaneously a distance d apart as observed in an inertial frame K. Do A and B occur simultaneously a distance d apart in all other inertial frames of reference? Explain why/why not.

2. $\langle \mathbf{5} \rangle$ **Degrees of freedom.** Consider an idealized straight rigid wire of zero thickness and fixed length ℓ (essentially a line segment) that is free to move in a room. How many degrees of freedom does this system possess? Explain by enumerating the degrees of freedom.

3. $\langle \mathbf{3} \rangle$ **Acceleration without a force.** A particle is not subject to any force but observer A finds that it executes accelerated motion with respect to A's frame of reference. On the basis of Newton's 1^{st} law, explain whether A's frame is inertial or not.

4. $\langle \mathbf{2+2} \rangle$ **Force without acceleration.** Suppose a particle is known to be subject to a net force but an observer finds that it does not move. (a) Based on Newton's 1^{st} law, what can be deduced about whether the observer's frame is inertial or noninertial? (b) What can be said using Newton's 2^{nd} law?