A simple pendulum is suspended at the ceiling of a box car. The car is accelerating with an acceleration $a$. To an observer inside of the box, the mass $m$ is not moving with respect to him.

So in this accelerating frame; i.e., the non-inertial frame, the acceleration $a_{\text{non-inertial}} = 0$.

Identify the equation below which states “$F = ma$” in this non-inertial frame.

A) $T - ma = 0$.
B) $T + ma = 0$.
C) $T = ma$.

Explanation: To someone on the ground, which is an inertial frame (not the non-inertial frame), “$F = ma$” says $T \sin \theta = ma$.

However, in the non-inertial frame, where $a_{\text{non-inertial}} = 0$, the corresponding net force must be $F_{\text{non-inertial}} = T - ma = ma_{\text{non-inertial}} = 0$.

Here “$-ma$” is the inertial force, which is the “fictitious force”.

This fictitious force is present only in an accelerating frame, which the present case this is the box car frame.

Answer A.

06.03-03 A Pendulum in A Box Car 2004-3-24