Written #1

(1) First Law states that objects at rest or in motion tend to keep these states unless acted upon by external forces. This means that in a closed system with no outside forces you expect an object to experience no change in motion.

Second law states $F=ma$. The acceleration an object experiences is directly related to the amount of force applied to it. More massive objects are harder to accelerate.

Third law states that for each force an object applies to another, there is an equal and opposite force applied back on the first. This law only applies in inertial frames, or non-accelerating frames. Basically, any object that is attached to a referance frame that is accelerating will violate the law, such as an accelerating rocket.

Also, as speeds approach relativity, time is skewed and forces are not measured at the same time, violating the law.

(2) $F = ma$ $\quad \int a\,dt = \int \frac{F}{m}\,dt \quad \frac{F}{m} = a \Rightarrow$ solve for v

$a = \frac{F}{m} \qquad V = V_0 + \frac{F}{m}t \qquad V = V_0 + a\Delta t$

$$V = \frac{\Delta X}{\Delta t} = \frac{X - X_0}{\Delta t} = \frac{dx}{dt} \rightarrow dt \cdot V = dx$$

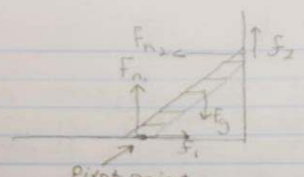
$$dt(V_0 + a\Delta t) = dx$$

$$\int_0^t V_0 + at\,dt = \int_{X_0}^{X} dx \rightarrow V_0 t + \frac{1}{2}at^2 = X - X_0$$

$$X = X_0 + V_0 t + \frac{1}{2}at^2$$

You can also do $\int v\,dt = \int (V_0 + \frac{F}{m}t)\,dt \rightarrow X = X_0 + V_0 t + \frac{F}{2m}t^2$

③



In equilibrium, $F_{n_1} + F_g + f_2 = 0$ and
$F_{n_2} + f_1 = 0$.

Also, $\tau_g + \tau_{f_2} + \tau_{F_{n_2}} = 0$

$\tau = I\alpha$.

When the ladder starts to slide, we know that τ_g must be larger than $\tau_{f_2} + \tau_{F_{n_2}}$. We can solve for the ladder's instantaneous angular acceleration using $\tau_g = I\alpha$.

The Ladder also has y and x components of linear motion. To find the x component of acceleration we take note of the forces acting horizontally on the ladder, f_1 and F_{n_2}. For the ladder to slide rather than just pivot, F_{n_2} must be larger than f_1 (at some point)

$F_{n_2} - f_1 = ma_x$, which lets us solve for instantaneous a_x.

For a_y, we see $F_{n_1} + f_2 - F_g = ma_y$ where $F_g > F_{n_1} + f_2$ and thus a_y is directed in the downward direction.

All these values change as the ladder slides.