5.4 Question

"Dragging" implies, to me...

Friction

\[ T \rightarrow \text{rope pulling A} \]

\[ \downarrow \text{Weight - Gravity tugging A downward} \]

\[ \downarrow \text{Friction Force exerted on A by table top} \]

\[ N = \text{Force of table pushing up on the block} \]

\[ F = \text{Friction Force} \]

\[ \vec{N} + \vec{W} = 0 \] since there is no motion in the vertical direction.

If Block A is speeding up \[ \frac{\vec{T}}{m} > \frac{\vec{F}}{m} \]

If Block A moves at constant speed \[ \frac{\vec{T}}{m} + \frac{\vec{F}}{m} = 0 \]
while in the tube, the sides of the tube exert a force on the ball causing it to move in a circular path. That force points toward the center of the circle.

The ball leaves the tube moving straight up. Once out of the tube, there are no more forces acting to cause the ball to change its flight path!
17a. A car driving at steady speed on a straight and level road. (No acceleration) The car is an inertial reference frame.

b. A car driving up a 10° incline at a steady speed. (No acceleration) This car is also an inertial frame.

c. A car speeding up ... (Acceleration ≠ 0!) This car is NOT an inertial frame.

d. A car driving at steady speed around a curve. (Acceleration = \( \frac{U^2}{r} \neq 0 \)) This car is NOT an inertial frame.
This is a tricky little problem. The key is the direction of \( \vec{F}_k \).

Remember \( \vec{F}_k \) is the sliding friction force and it always points opposite to the direction of motion.

But the net force, \( \vec{F}_{\text{net}} \),

So the forces describe an object sliding to the right being slowed down by kinetic friction.

A car skidding on locked wheels for example:

\[ \frac{1}{\text{ft}} \quad \frac{\text{ft}}{\text{sec}} \]

\[ \text{Screach!} \]
\[ a_x (\text{m/s}^2) \]

\[ F_x = \max, \quad m = 500 \text{g} = \frac{1}{2} \text{kg} \]

\[ F_x = \frac{1}{2} a_x \text{ Newtons} \]

Exactly same shape since \( F_x \) is proportional to \( a_x \).
A constant force causes an object to accelerate at 18.0 m/s^2.

a) Doubling the force, doubles the acceleration
   \[ a = 16.0 \text{ m/s}^2 \]

b) Doubling the mass, reduces the acceleration by a factor of 2.
   \[ a = 4.0 \text{ m/s}^2 \]

c) Since Force and Acceleration are proportional, \( F = ma \),
   doubling \( F \) and \( m \), \( 2F = (2m)a \), does not change \( a \), \( a = 8.0 \text{ m/s}^2 \)

d) Doubling \( F \) and halving \( m \),
   \[ 2F = \frac{m}{2}a_{\text{new}} \Rightarrow a_{\text{new}} = \frac{4F}{m} = 4a \]
   \[ a = 32.0 \text{ m/s}^2 \]
\[ \vec{F}_{\text{net}} = 0 \]

Since \( \vec{F}_{\text{net}} = 0 \), \( \vec{a} = 0 \)

\[ \vec{D} = \text{drag force and it points opposite to the direction of motion.} \]

\[ \vec{U} \text{ is to the right.} \]

Jet powered car where the thrust of the jet engine is balanced by the air resistance (drag).
5.43

- Elevator speeding up on the way down.

* I am assuming constant acceleration while the elevator speeds up. Velocity a

\[ \vec{T} \]

\[ \vec{F}_G \]

\( \vec{T} \) is the upward force due to the cable.

\( \vec{F}_G \) is the downward force of gravity.

\[ |\vec{F}_G| > |\vec{T}| \] for the elevator to accelerate downward.
Her velocity is decreasing in the downward direction. The upward acceleration increases as she stretches the trampoline. When she comes to a stop, the trampoline is maximally stretched and ready to launch her back up in the air! The forces acting are gravity and the normal force of the trampoline. The normal force increases as the trampoline stretches.
"A heavy box" implies to me that the box stays in the truck and does not slide off the back!

Assume $\mathbf{u}_{\text{box}} = 0$ to begin with.

\[ \mathbf{a} = \mathbf{F}_{\text{net}} = \mathbf{F}_{\text{gravity}} + \mathbf{F}_{\text{friction}} \] (Constant acceleration)

The forces acting on the box are:
- The normal force pushing up
- The horizontal force which causes the box to stay in the truck and accelerate!