how to solve Newton's Second Law problems with one object

1. Make a **sketch** of the object and its surroundings. When possible, draw $\vec{v}$.
2. **Identify the question** with a "?" and a symbol.
3. Check that all given units are **SI units**.
4. For symbolic problems, write down **the "given" symbols**.
FREE-BODY DIAGRAM
5. Identify the **object** you will apply Newton's Second Law to. This is usually the object whose mass is mentioned in the problem. Identify the **instant or interval of time** for which you are applying Newton's Second Law to the object.
6. Start a **Free-Body Diagram** for the object by drawing a vector for the object's **weight**.
7. Complete the **Free-Body Diagram** by drawing a force vector exerted **by each thing that is *touching* the object**. The diagram should include only the forces exerted *on*, not *by*, the object that you are focusing on. A surface may exert *both* a normal force *and* a frictional force.
FORCE TABLE
8. Write down **axes** with **positive directions**—usually, you should choose an axis that points in the object's direction of movement.
9. Start a **Force Table**. For each force in your Free Body Diagram, write down a number, symbol, or expression for **the magnitude of the overall vector**. If you are given a value for the magnitude of a force, use that value. Otherwise, if a force has a "special formula", use that special formula to calculate or represent the magnitude. The forces with special formulas are weight, kinetic friction, and *maximum* static friction: $w = mg$, $f_k = \mu_k n$, $\max f_s = \mu_s n$ There are no special formulas for normal force or tension, or for static friction when the static friction is not assumed to be at its maximum. If a magnitude has no special formula and no given value, just represent the magnitude with a symbol.
10. Complete the **Force Table** by breaking each force into **components**. Always include a "+" or "-" sign on each nonzero component. Use the value, symbol, or expression for the overall magnitude from step 9 to calculate or represent the components.
NEWTON'S SECOND LAW EQUATIONS
11. Write the **Newton's Second Law equations** at the top of two adjacent columns: $\sum F_x = ma_x$ $\sum F_y = ma_y$ Keep your later versions of the *x*- and *y*-equations organized in these two columns.
12. On the left side of the Newton's Second Law equations, add all the individual **force components,** including any negative signs, using the components from the Force Table.
13. On the right side of the equations, where possible, substitute specific values or symbols for the object's **mass** and for $\boldsymbol{a_x}$ **and** $\boldsymbol{a_y}$. If an object is motionless in a component, or if an object moves with constant velocity in a component, then that component of its acceleration is 0.
14. When you have one equation with one unknown, or when you have two equations with two unknowns, you can **use algebra to solve** for the unknowns.
15. **Check** that you answered the right question, and answered all parts of the question, and that your answer makes sense. For numerical answers, **check** that you included units. For symbolic answers, **check** that your answer includes only the "given" symbols.