Solving Problems Involving Newton's Laws of Motion

1. Draw a Diagram

Write down the given quantities (adopt a notation)

Write down a symbol for what you are looking for

Translate English → Mathematics

Choose a convenient coordinate system to simplify the problem

Draw a picture of the problem, labeling it with symbols

2. Draw a Free-Body Diagram

Isolate the object(s) of interest

Replace all strings, springs, surfaces, etc. with vectors representing the forces they exert ON the object

The third law may help you identify some of the forces

3. Identify the Acceleration

Identify (and if necessary calculate) the acceleration of the object(s) of interest

4. Apply Newton's Laws of Motion

Apply the vector equations:

$$\mathbf{a = F_{net} / m}$$

5. Solve For The Unknown Quantities

6. Check the Results

There is often more than one way to solve the problem!

Solving Problems Involving Conservation Laws

1. **Draw a Diagram**
   Write down the given quantities (adopt a notation)
   Write down what you are looking for
   Choose a convenient coordinate system

2. **Choose a System/Draw a Free-Body Diagram**
   Isolate the system of particles of interest
   Replace all strings, springs, surfaces, etc. with vectors representing the forces they exert ON the object

3. **Identify the Appropriate Conservation Laws**
   $F_{net} = 0 \rightarrow$ Conservation of Linear Momentum
   Conservative Forces $\rightarrow \Delta E = 0$ ($E = K + PE$)
   Non-Conservative Forces $\rightarrow W_{nc} = \Delta E$

4. **Apply Conservation Law(s)**
   Vector Form: $P_i = P_f$
   Scalar Form: $E_i = E_f$

5. **Solve For The Unknown Quantities**

6. **Check the Results**
   Make sure the conservation law is obeyed!