General Principles

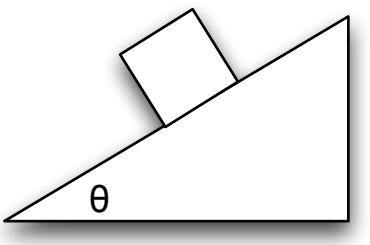
Free Body Diagrams Newton's 2nd Law

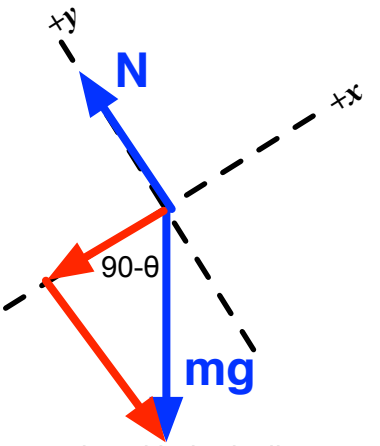
In multi-body problems, make sure that + directions match up.

$$\sum F = ma$$

$$\sum F = 0 \text{ (const v or no v only)}$$

Inclines





On an incline, rotate your axes to be with the incline. (Unless it's a banked turn - then stick to what it says in Uniform Circular Motion.)

Break the weight up into x and y components. The angle with the x-axis is the complementary angle. Normal only balances the y-component of the weight.

Static & Kinetic Friction

Kinetic (sliding) Friction opposes motion and is always equal to:

$$f_k = \mu_k N$$

Static (non-moving) Friction - imagine there's no friction - which way would the object slide? Static Friction must be the other way.

Static Friction balances opposing forces up to a maximum, then the object starts sliding.

$$f_s = \mu_s N \text{ (max only)}$$

Uniform Circular Motion

$$\sum F_{center} = \frac{mv^2}{r} \qquad v = r\omega$$

$$\sum F_{tangent} = 0 \qquad \omega = \frac{2\pi}{T}$$

Always define + toward the center of the circle, and - away from center.

Kinematics (const a)

$$\Delta x = \tfrac{1}{2}(v_0 + v)t$$

$$\Delta x = v_0 t + \tfrac{1}{2}at^2$$

$$v = v_0 + at$$

$$v^2 = v_0^2 + 2a\Delta x$$

Writing Differential Equations

Step 1: Start with ΣF=ma
Step 2: Put in force(s) acting
Step 3: Replace a with $\frac{dv}{dt}$

Kinematics (nonconst a)

$$v = \frac{dx}{dt}$$

$$a = \frac{dv}{dt}$$