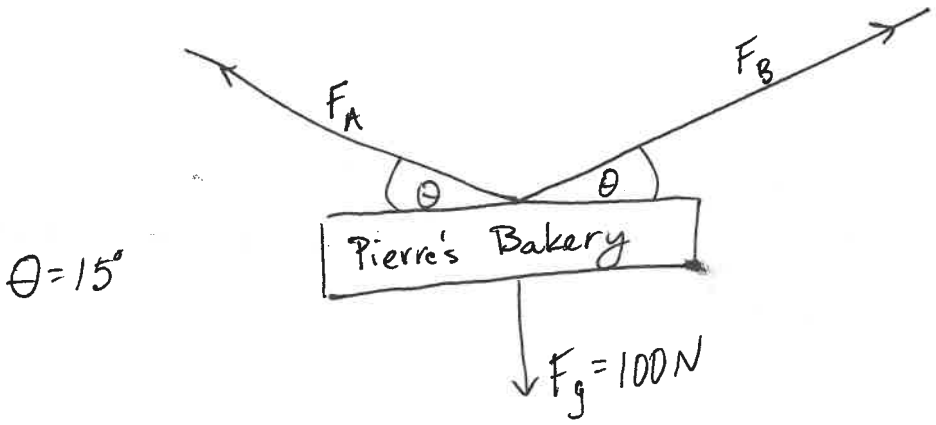
Forces in Equilibrium + Motion Along an Incline

Equilibrium
↳
↳
↳

Ex. 1

A 100 N sign is hung by two wires as seen below. What is the tension in the wires?



Performing Calculations for Equilibrium Problems:

- Draw a Free-Body Diagram
- List your givens
- List your unknowns
- Isolate your X (horizontal) and Y (vertical) components
- Since the object is in equilibrium, $F_{net} = ma = 0$ in both the X and Y directions

Motion on an Incline:

— when objects are not on a flat, level surface:

•

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— Hint:

Ex. 2

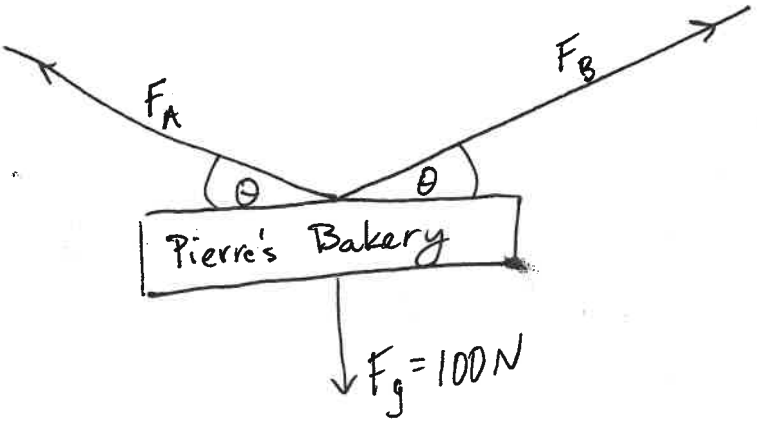
Determine the rate of acceleration of a 25 kg wooden crate as it slides down a wooden ramp with a coefficient of friction, $\mu = 0.2$. The angle the ramp makes with the horizontal is 30°.

Forces in Equilibrium + Motion Along an Incline

Equilibrium
- ↳ Forces on an object are balanced
- ↳ Not accelerating
- ↳ Stationary or moving at a constant speed in a straight line

Ex. 1

A 100 N sign is hung by two wires as seen below. What is the tension in the wires?



$\theta = 15°$

Given: $F_g = 100\,N$, $\theta = 15°$ Unknown: F_A, F_B

X-direction: $-F_{AX} + F_{BX} = 0$

$-F_A\cos\theta + F_B\cos\theta = 0$

$F_A\cos\theta = F_B\cos\theta$

Y-direction: $F_{AY} + F_{BY} - F_g = 0$

$F_A\sin\theta + F_B\sin\theta - F_g = 0$

$2F_A\sin\theta = F_g$

$F_A = \frac{F_g}{2\sin\theta} = \frac{100N}{2\sin(15)} = \frac{100\,N}{0.518}$

$F_A = 193\,N$

$F_B = 193\,N$

Performing Calculations for Equilibrium Problems:

- Draw a Free-Body Diagram
- List your givens
- List your unknowns
- Isolate your X (horizontal) and Y (vertical) components
- Since the object is in equilibrium, $F_{net} = ma = 0$ in both the X and Y directions

Motion on an Incline:

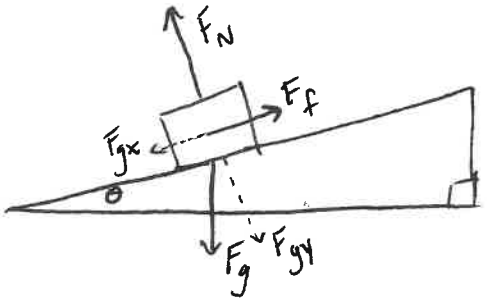
- When objects are not on a flat, level surface:
  - Some of the gravitational force is directed along the surface
  - The Normal Force is not equal to the object's weight
- Hint: Change your coordinate system so the x-axis is parallel to the slope

Ex. 2

Determine the rate of acceleration of a 25kg wooden crate as it slides down a wooden ramp with a coefficient of friction, $\mu = 0.2$. The angle the ramp makes with the horizontal is 30°.

Given: $m = 25\,kg$
$\mu = 0.2$
$\theta = 30°$
$v_i = 0\,m/s$

Unknown: $a = ?$



X-direction:

$F_{Net} = F_{gx} - F_f$
$ma = m(9.8\,m/s^2)\sin\theta - \mu F_N$
$ma = m(9.8\,m/s^2)\sin\theta - \mu m(9.8\,m/s^2)\cos\theta$
$a = (9.8\,m/s^2)\sin\theta - \mu(9.8\,m/s^2)\cos\theta$
$a = (9.8\,m/s^2)\sin(30°) - (0.2)(9.8\,m/s^2)\cos(30°)$
$a = 3.2\,m/s^2$

Y-directions:

$F_{Net} = F_N - F_{gy}$
$0 = F_N - F_{gy}$
$F_N = F_{gy}$
$F_N = m(9.8\,m/s^2)\cos\theta$