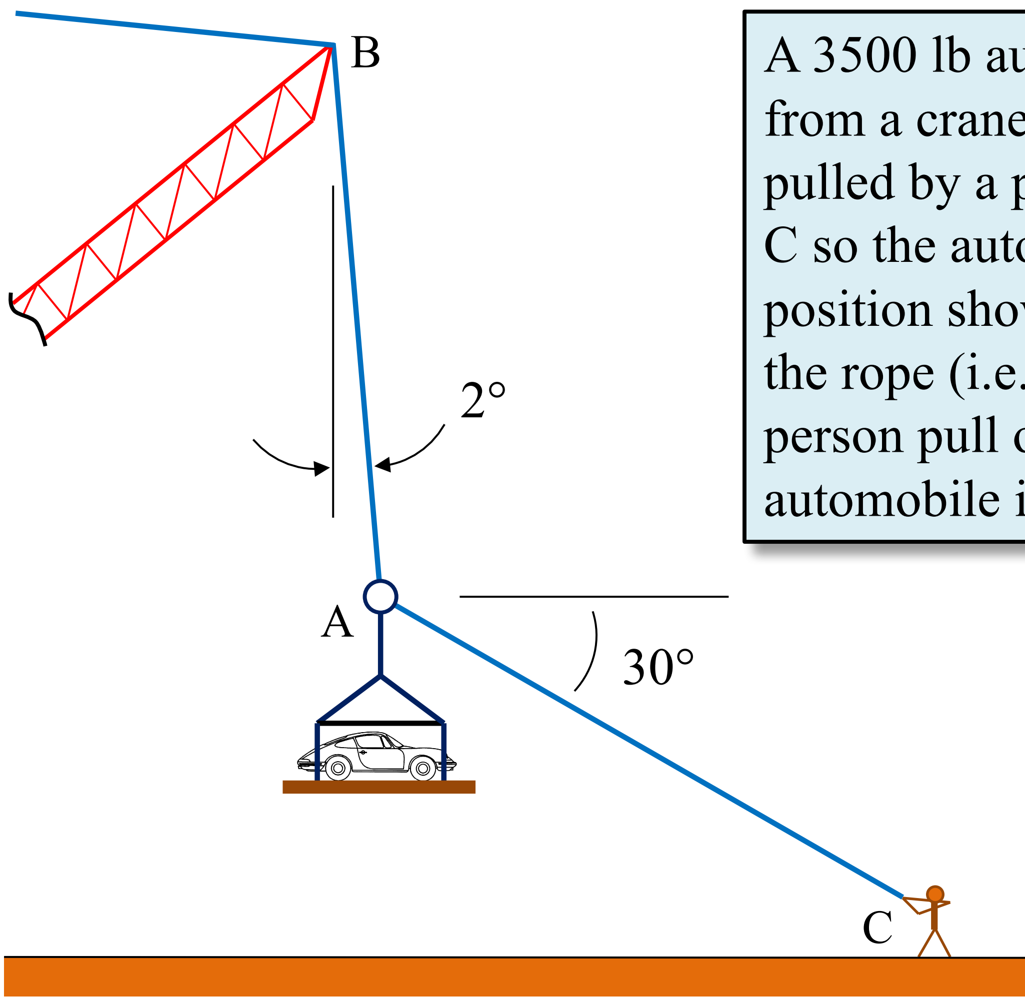
Two-Dimensional Equilibrium of a Point Example Problem

Steven Vukazich
San Jose State University

General procedure for the Analysis of Planar Bodies in Static Equilibrium

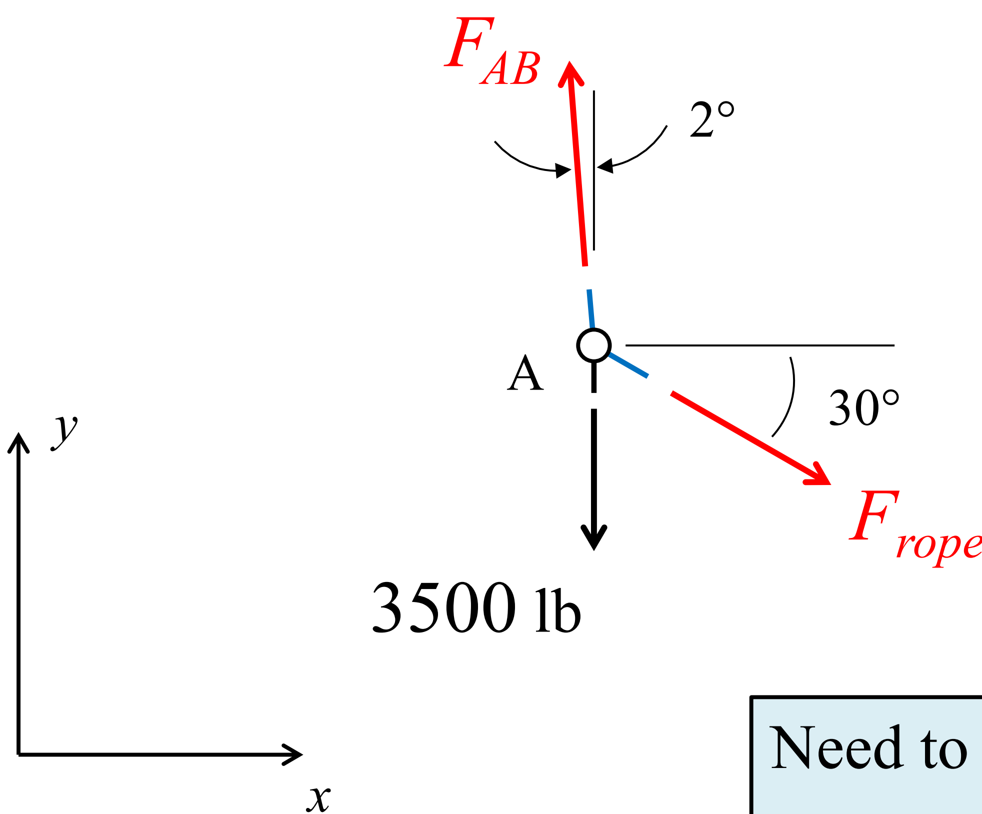
- Choose the free body to isolate;
- Draw a **Free Body Diagram (FBD)** of the body;
  - Isolate the body from all of its surroundings,
  - Magnitudes and directions of all known and unknown forces acting on the body should be included and clearly indicated,
  - Indicate dimensions on the FBD,
- Write the **equations of equilibrium** and solve the equations for the unknown quantities.

Example Problem



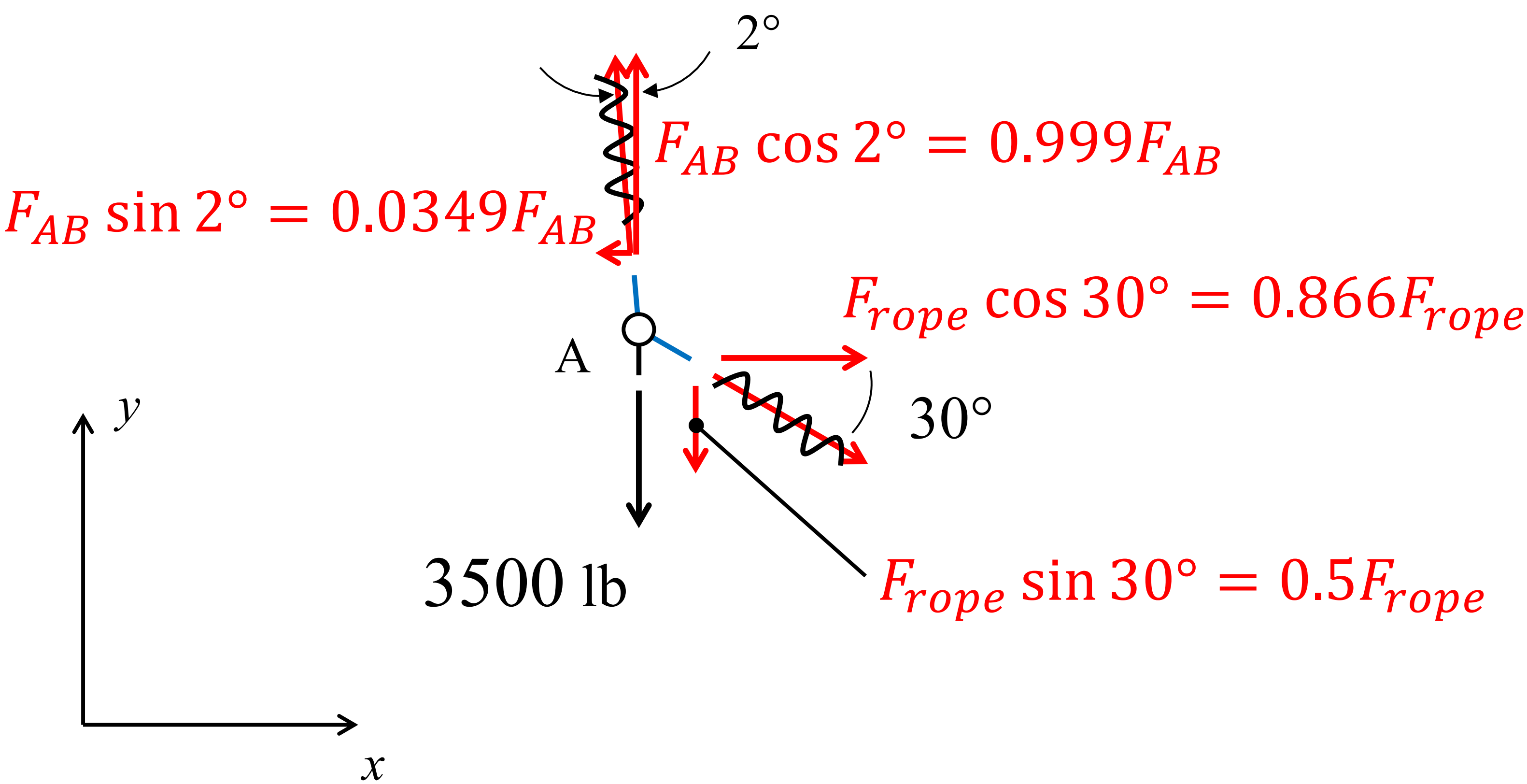
A 3500 lb automobile is suspended from a crane. The support at A is pulled by a person with a rope at point C so the automobile is held in the position shown. What is the tension in the rope (i.e. how hard must the person pull on the rope to hold the automobile in the position shown)?

Free-Body Diagram of Point A

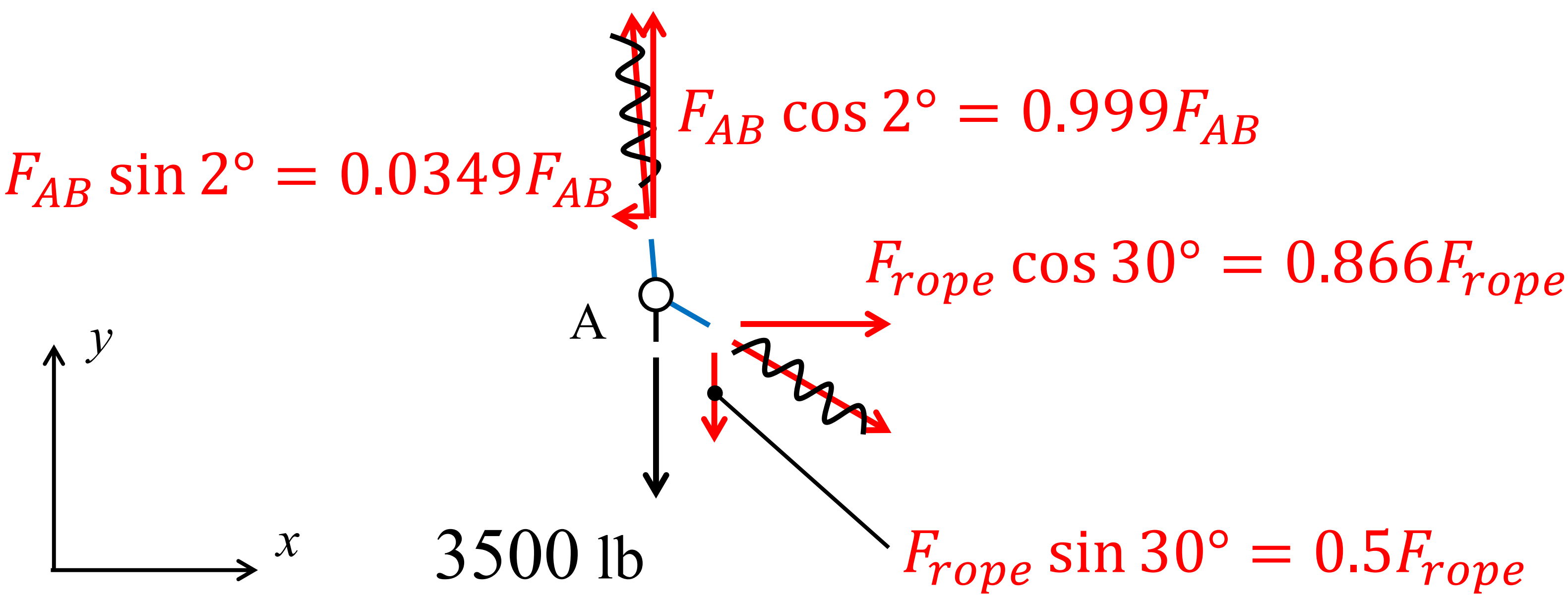


Need to express $\boldsymbol{F_{AB}}$ and $\boldsymbol{F_{rope}}$ in components

Free Body Diagram of Point A



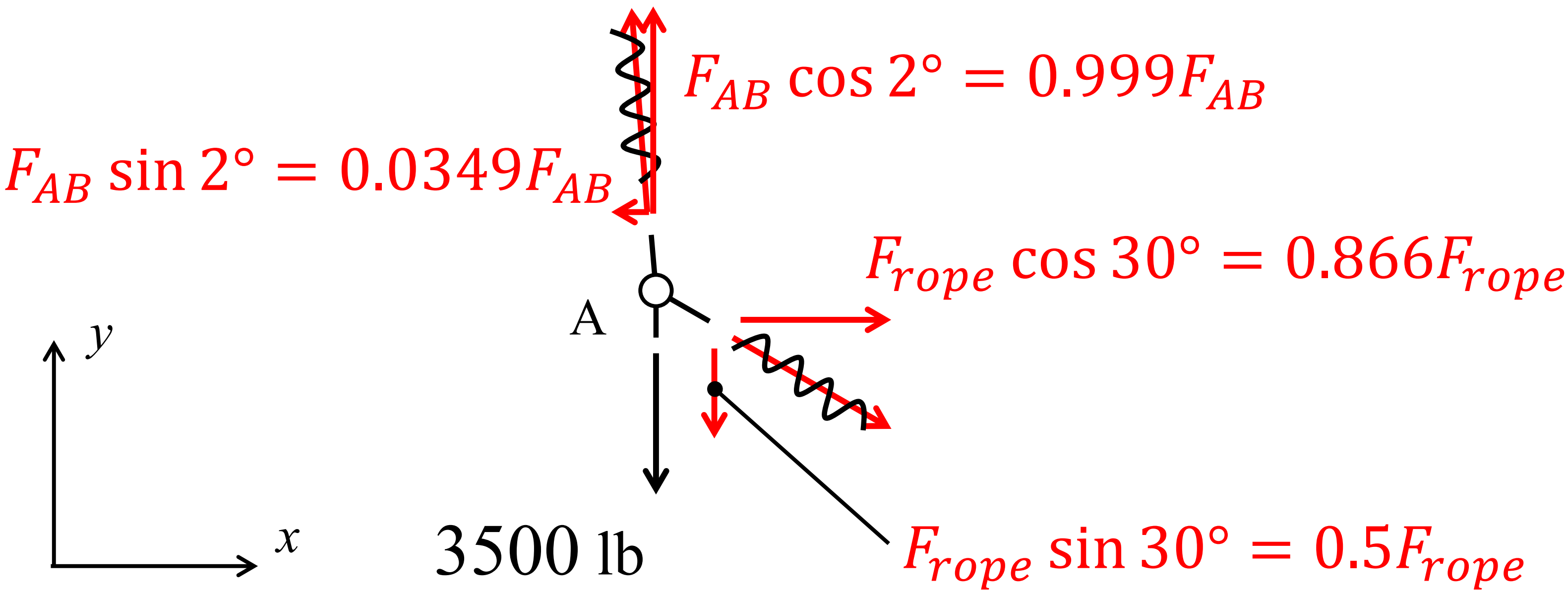
Equilibrium in the x Direction



$$\xrightarrow{+} \sum F_x = 0$$

$$\boxed{-0.0349 F_{AB} + 0.866 F_{rope} = 0}$$

Equilibrium in the y Direction



$$+\uparrow \sum F_y = 0$$

$$\boxed{0.999F_{AB} - 0.5F_{rope} - 3500 = 0}$$

Solve Equilibrium Equations

Equation 1

$$\boxed{-0.0349F_{AB} + 0.866F_{rope} = 0}$$

$$F_{AB} = \frac{0.866F_{rope}}{0.0349} = 24.814F_{rope}$$

$$\boxed{F_{AB} = 24.814F_{rope}}$$

Equation 2

$$\boxed{0.999F_{AB} - 0.5F_{rope} - 3500 = 0}$$

$$0.999(24.814F_{rope}) - 0.5F_{rope} - 3500 = 0$$

$$\boxed{F_{rope} = 144 \text{ lb}}$$

$$F_{AB} = 24.814(144)$$

$$\boxed{F_{AB} = 3576 \text{ lb}}$$

Free Body Diagram of Point A Showing Results