

Example 2.4

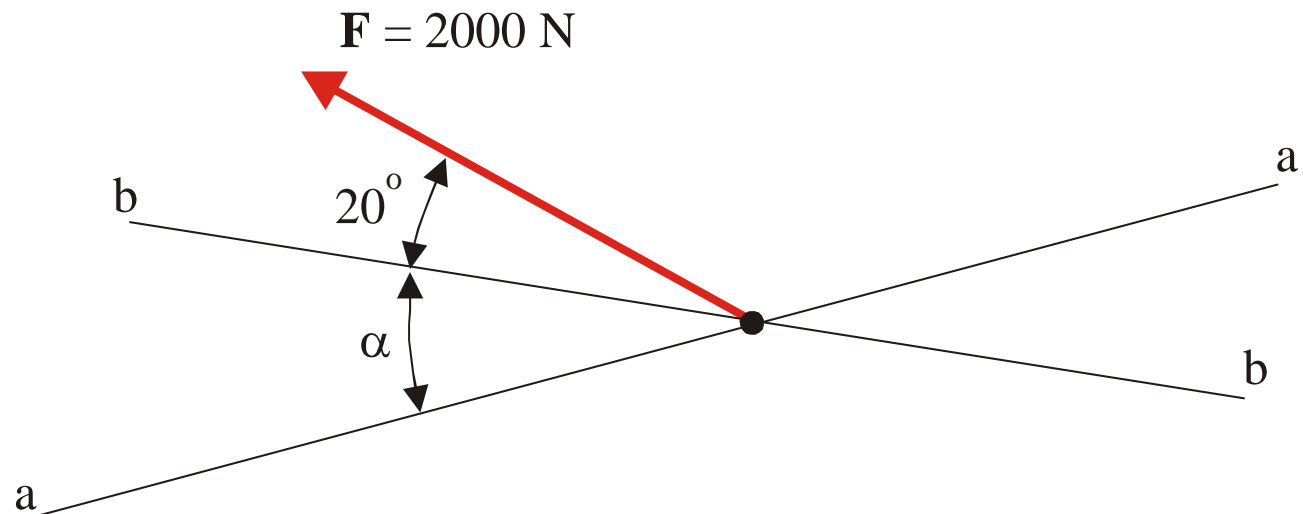
J. Frye

Example 2.4:

The force \mathbf{F} of magnitude 2000 N in the Figure below is to be resolved into two components along line $a-a$ and $b-b$. Knowing that the component of \mathbf{F} along line $b-b$ is to be 3407 N determine the angle α and the magnitude of the component along line $a-a$.

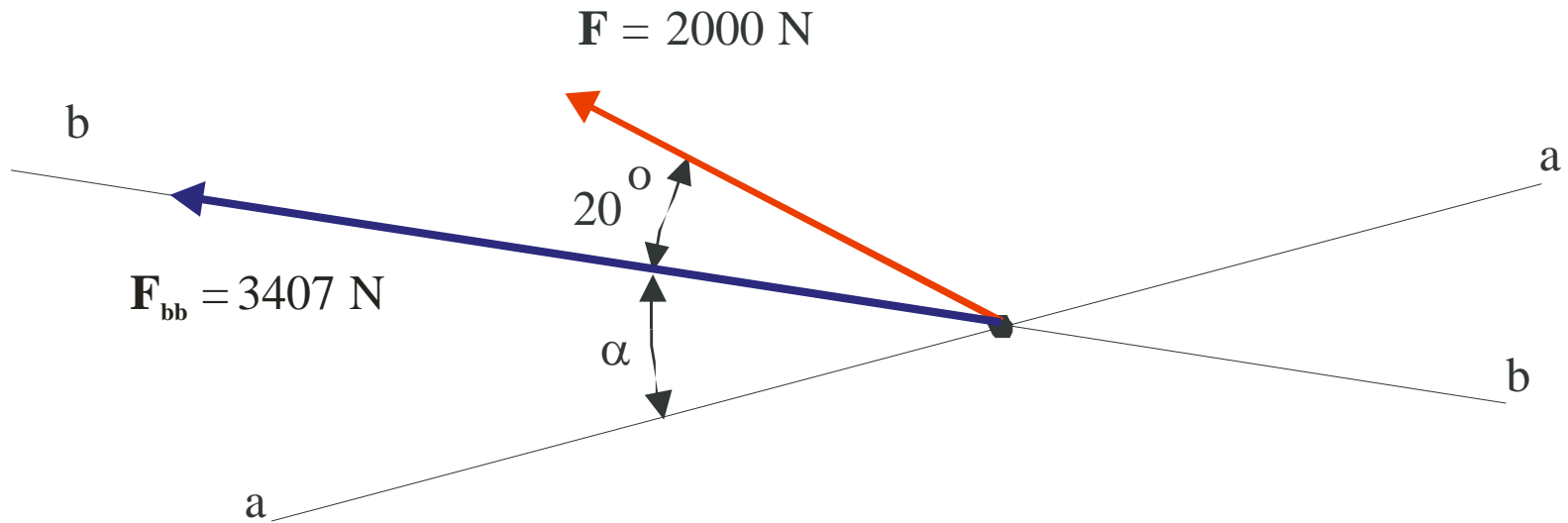
Use:

- A graphical method (parallelogram law or triangle rule), and
- Trigonometry (sine and/or cosine laws).



Graphical Solution: Step 1

Draw a line b-b on your grid paper. Select a suitable scale and scale off $F = 2000 \text{ N}$ at 20° to line b – b and $F_{bb} = 3407 \text{ N}$ along the line b-b.

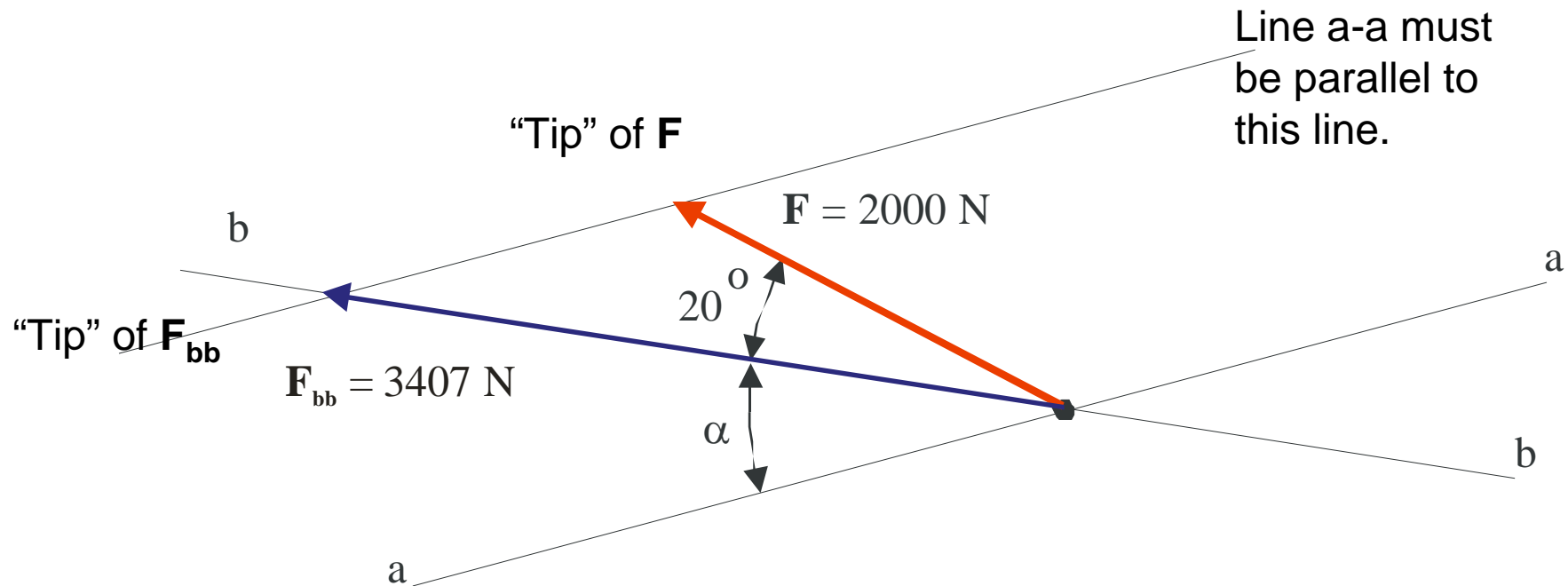


Note: At this point we only know Line a-a is at an angle, α , to Line b-b.

Graphical Solution – Step 2

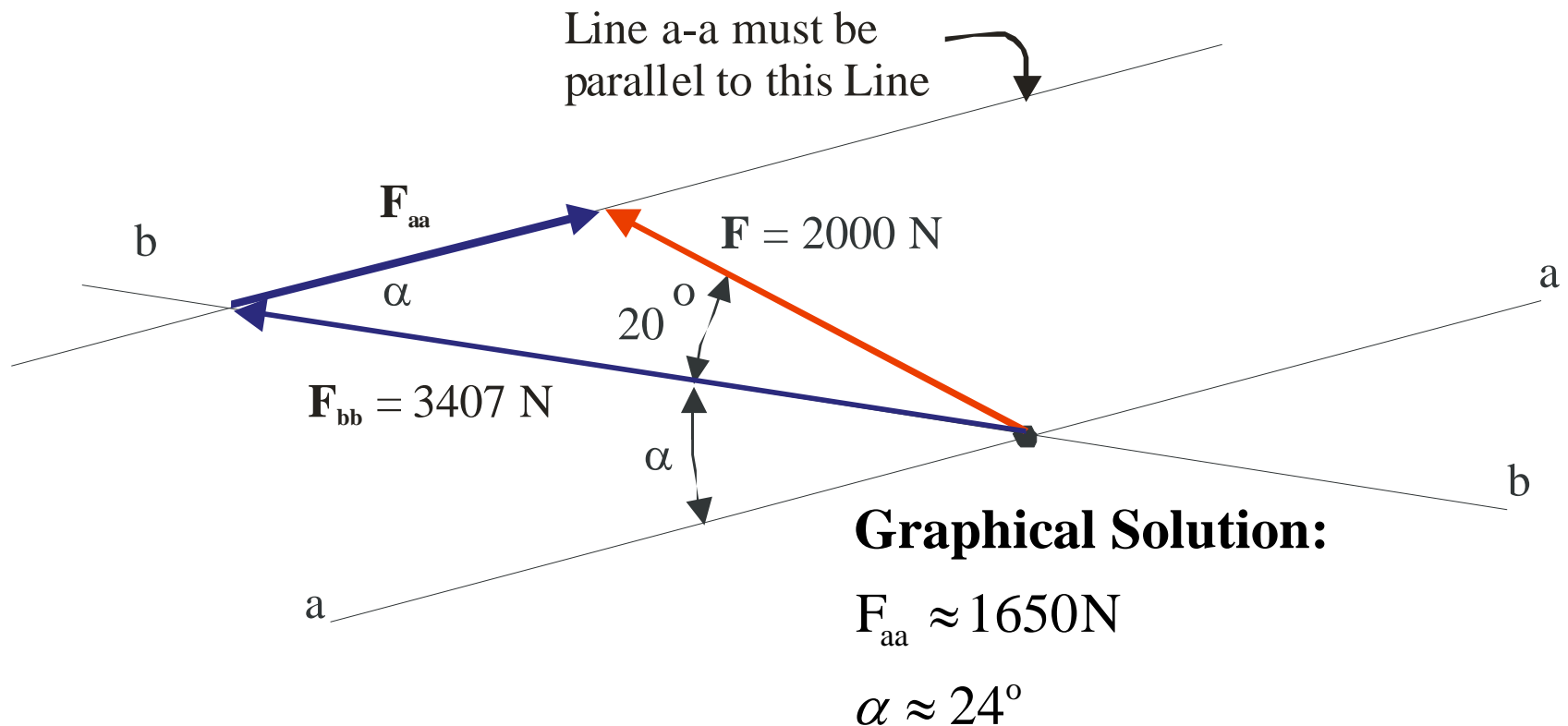
At the “Tip” of \mathbf{F}_{bb} draw a line to the “Tip” of \mathbf{F} .

Since $\mathbf{F}_{aa} + \mathbf{F}_{bb} = \mathbf{F}$, where \mathbf{F}_{aa} and \mathbf{F}_{bb} are the components of \mathbf{F} , the Line a-a must be parallel to this line. The segment of this line from the “Tip” of \mathbf{F}_{bb} to the “Tip” of \mathbf{F} is component \mathbf{F}_{aa} and can use our scale to determine its magnitude.

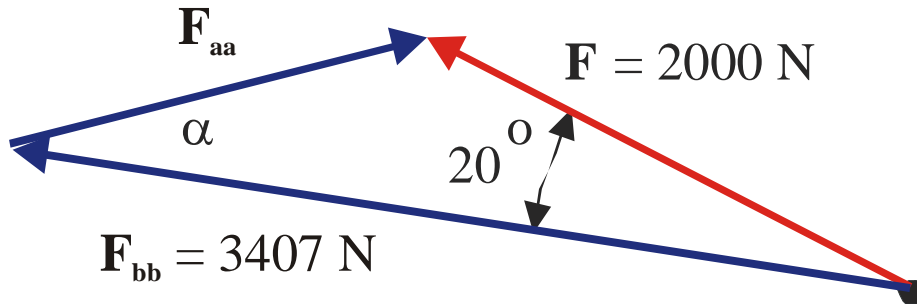


Graphical Solution – Step 3

From our completed component drawing we can now scale off F_{aa} and measure angle α (the internal angle of the component triangle) with a protractor.



Trig Solution:



Cosine Rule:

$$F_{aa}^2 = 3407^2 + 2000^2 - 2(3407)(2000)\cos 20^\circ$$

$$F_{aa}^2 = 2801517.96$$

$$F_{aa} = 1673.77 \text{ N}$$

Sine Rule:

$$\frac{1673.77}{\sin 20^\circ} = \frac{2000}{\sin \alpha}$$

$$\sin \alpha = 0.40868$$

$$\alpha = 24.12^\circ$$

Graphical Solution:

$$F_{aa} \approx 1650 \text{ N}$$

$$\alpha \approx 24^\circ$$