

# Example 2.4

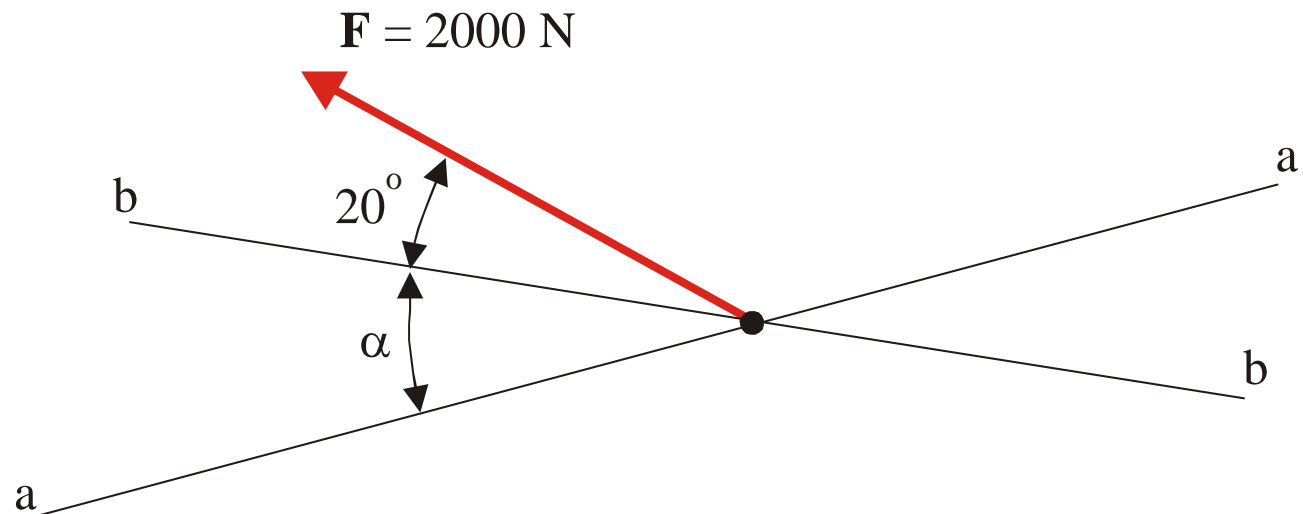
J. Frye

### Example 2.4:

The force  $\mathbf{F}$  of magnitude  $2000\text{ N}$  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  $3407\text{ N}$  determine the angle  $\alpha$  and the magnitude of the component along line  $a-a$ .

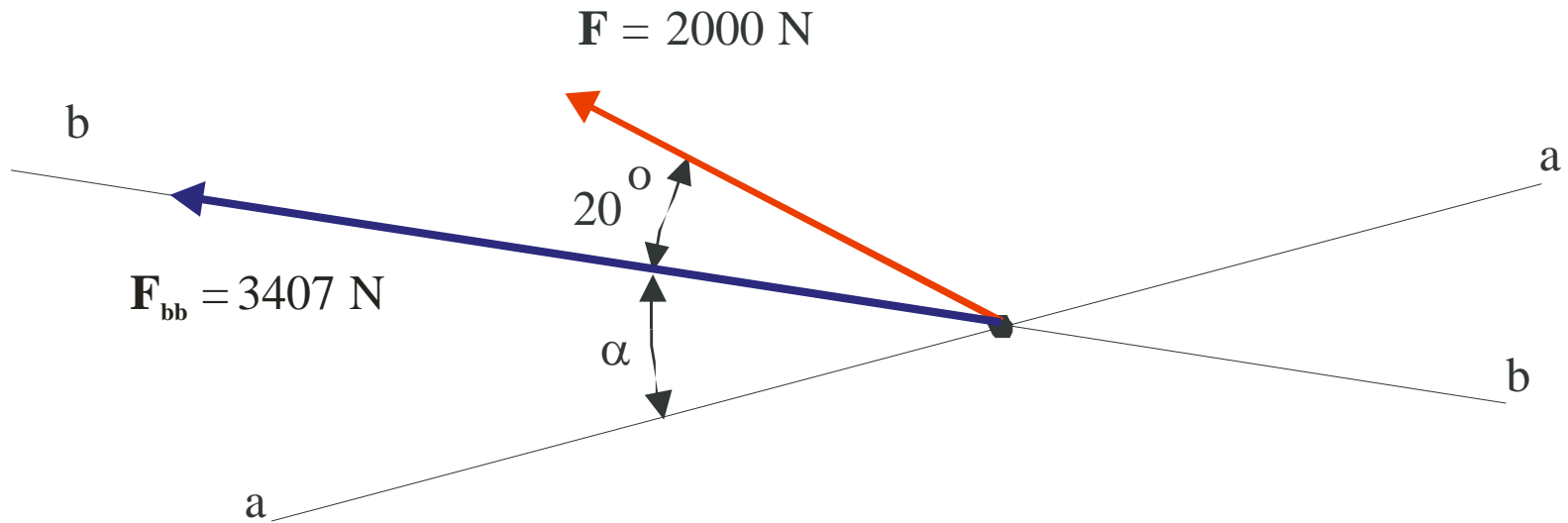
Use:

- 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  $20^\circ$  to line b – b and  $F_{bb} = 3407 \text{ N}$  along the line b-b.

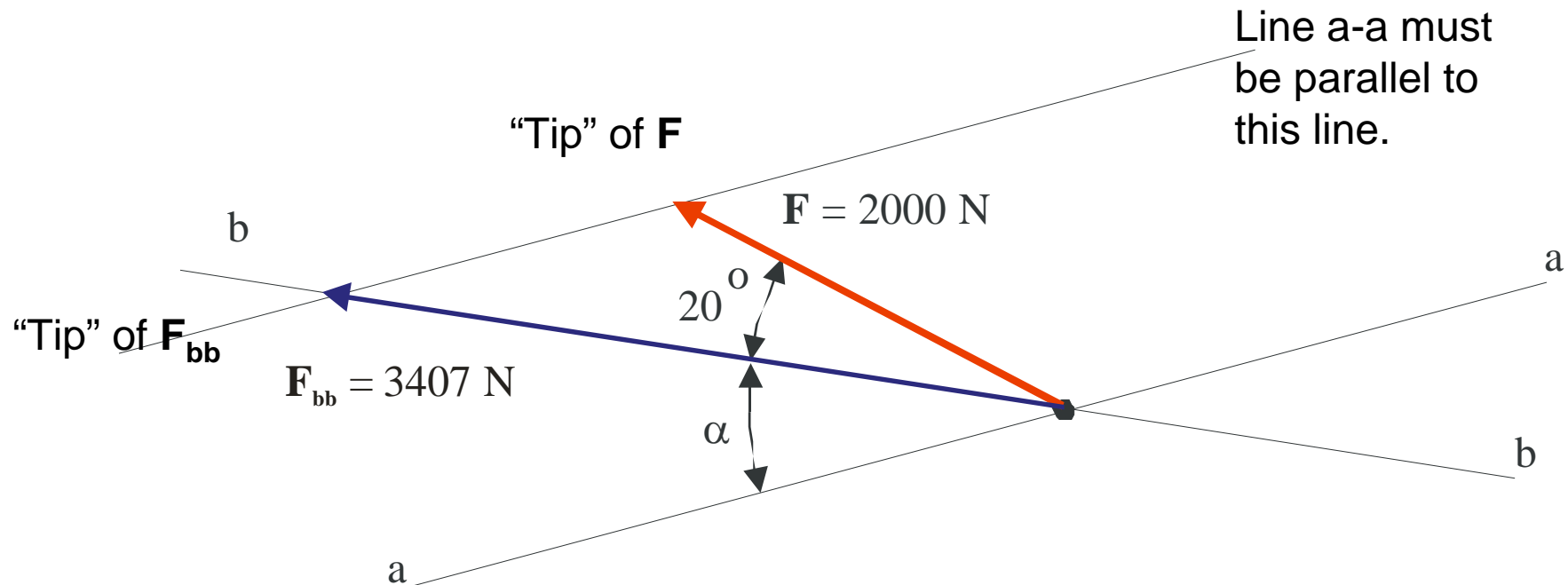


**Note:** At this point we only know Line a-a is at an angle,  $\alpha$ , to Line b-b.

## Graphical Solution – Step 2

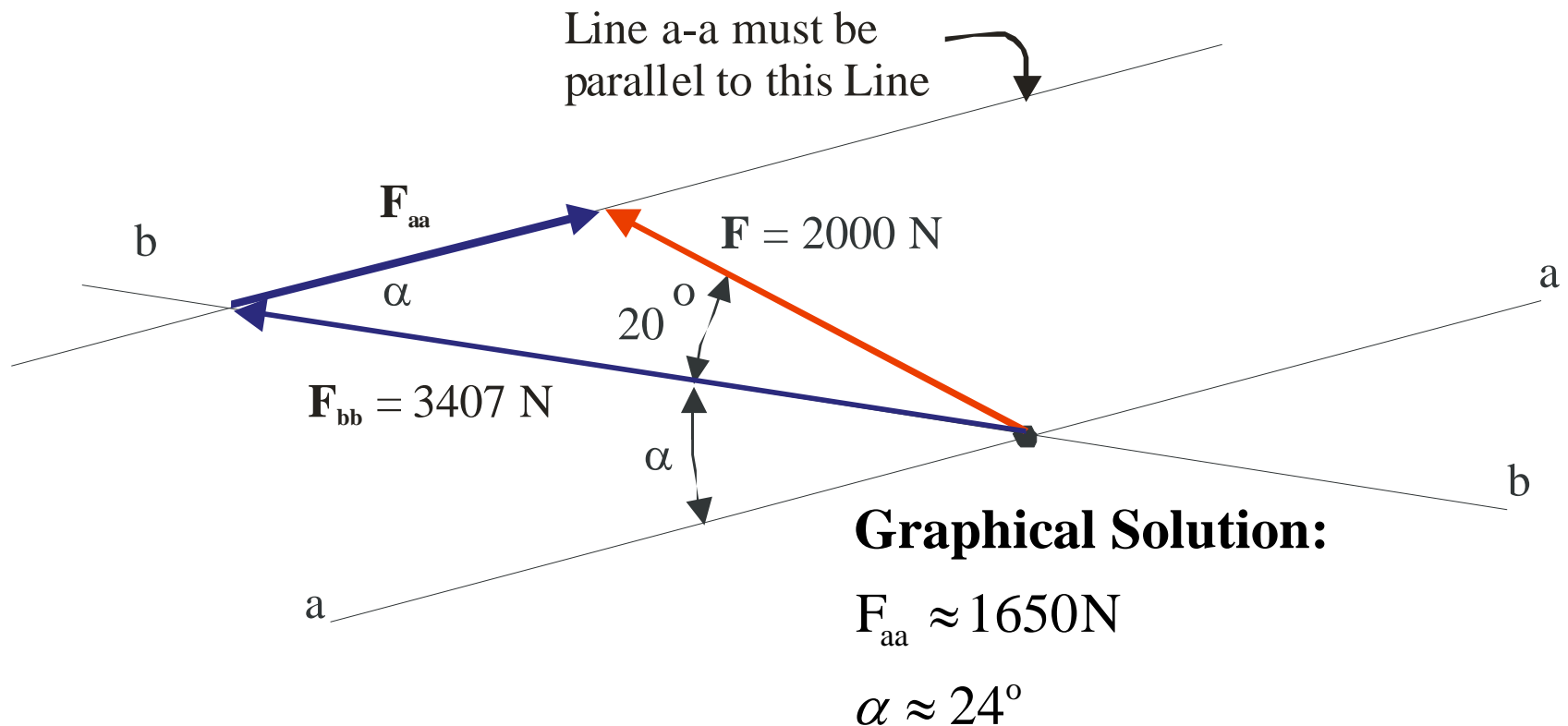
At the “Tip” of  $\mathbf{F}_{bb}$  draw a line to the “Tip” of  $\mathbf{F}$ .

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.

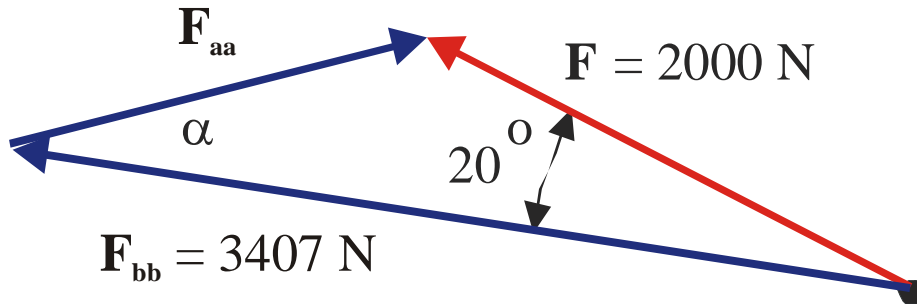


### Graphical Solution – Step 3

From our completed component drawing we can now scale off  $F_{aa}$  and measure angle  $\alpha$  (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:

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

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