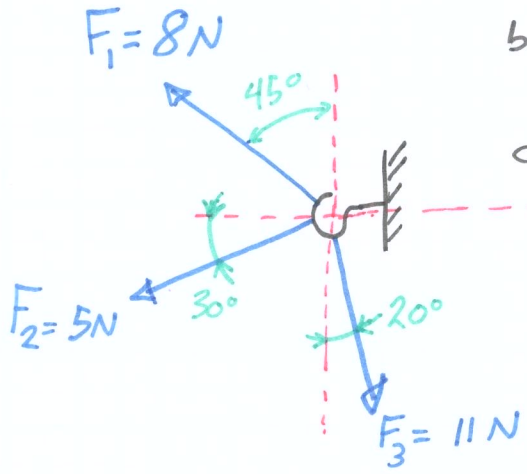
Problem: For the hook below:

a) Using vector addition, Find the resultant force vector

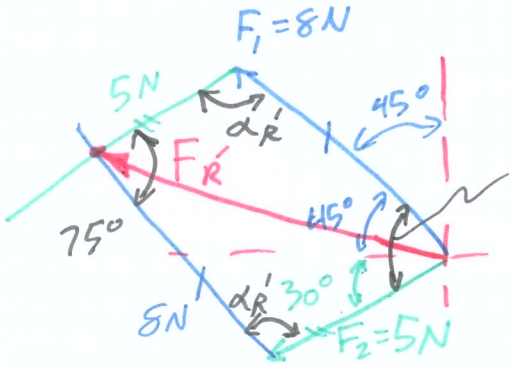
b) Using cartesian force components, find the resultant force vector

c) Find the reaction force vector using particle equilibrium and the resultant force.



a) Vector Addition

- 1st let's add $\vec{F_1} + \vec{F_2} = \vec{F_{R'}}$



Parallelogram

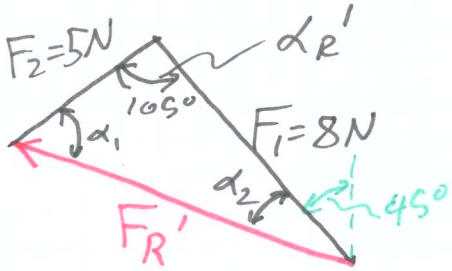
$30° + 45° = 75°$

α_R' ?

$360° = 2 \times 75° + 2\alpha_R'$

$\boxed{\alpha_R' = 105°}$

- Vector Triangle



Cosine Law

$$C = \sqrt{A^2 + B^2 - 2AB\cos c}$$

$$F_R' = \sqrt{F_1^2 + F_2^2 - 2F_1F_2\cos(\alpha_R')}$$

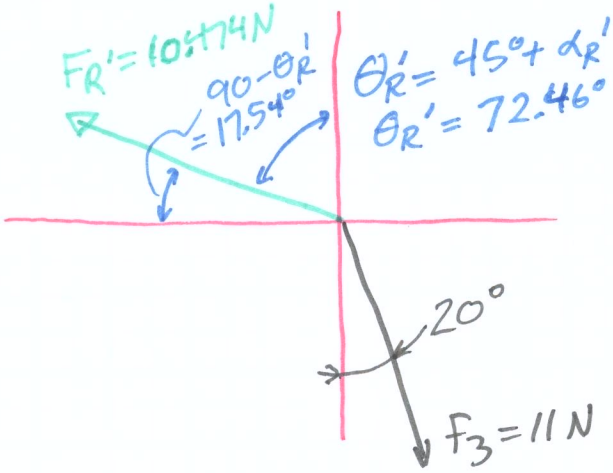
$$F_R' = \sqrt{8^2 + 5^2 - 2(8)(5)\cos(105^\circ)} = \boxed{F_R' = 10.474\,N}$$

- Sine Law

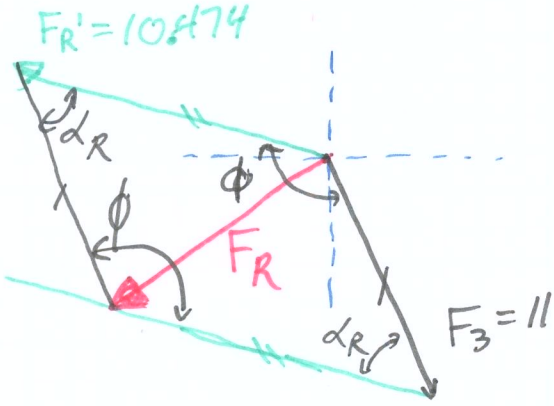
$$\frac{F_R'}{\sin\alpha_R'} = \frac{F_2}{\sin\alpha_2} \qquad \alpha_2 = \sin^{-1}\left(\frac{F_2}{F_R'}\sin(\alpha_R')\right)$$

$$\alpha_2 = \sin^{-1}\left(\frac{5}{10.474}\sin(105)\right) = \boxed{\alpha_2 = 27.46^\circ}$$

- Draw our system with $\vec{F_R}$ replacing $\vec{F_1}$ and $\vec{F_2}$



- Now we Find $\vec{F_R} = \vec{F_R'} + \vec{F_3}$

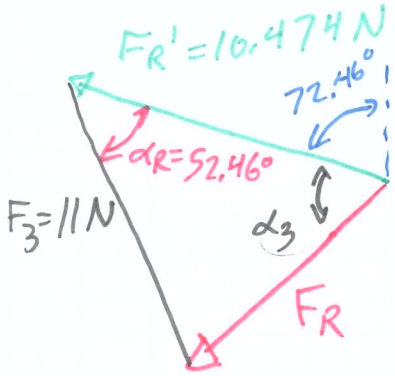


$$\phi = 90^\circ + 20^\circ + 17.54^\circ$$
$$\phi = 127.54^\circ$$

$$360^\circ = 2\alpha_R + 2\phi$$
$$\alpha_R = \frac{360 - 2(127.54)}{2}$$

$$\boxed{\alpha_R = 52.46^\circ}$$

• Now Draw our Vector Triangle $(\vec{F}_R, \vec{F}_3, \vec{F}_{R'})$



Cosine law

$$F_R = \sqrt{F_3^2 + F_{R'}^2 - 2(F_3)(F_{R'})\cos\alpha_R}$$

$$F_R = \sqrt{(11)^2 + (10.474)^2 - 2(11)(10.474)\cos(52.46)}$$

$$\boxed{F_R = 9.503\,N}$$

• Sine law

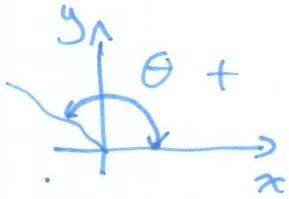
$$\frac{F_R}{\sin\alpha_R} = \frac{F_3}{\sin\alpha_3}$$

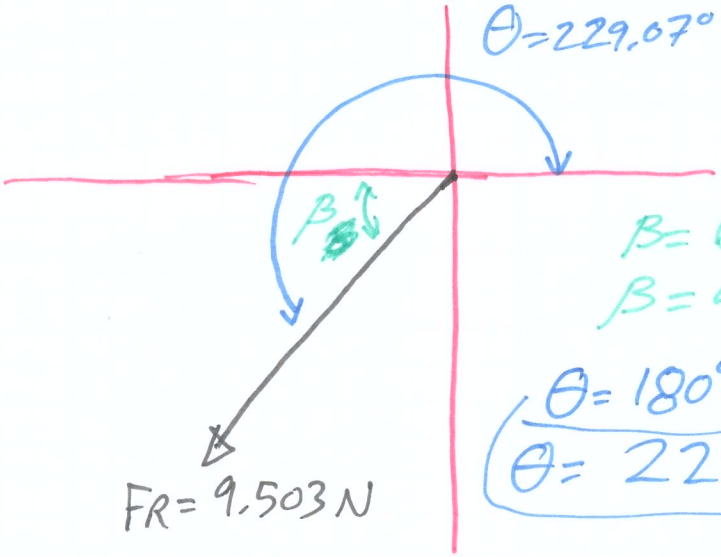
$$\alpha_3 = \sin^{-1}\left(\frac{F_3}{F_R}\sin\alpha_R\right)$$

$$\alpha_3 = \sin^{-1}\left(\frac{11}{9.503}\sin(52.46°)\right)$$

$$\boxed{\alpha_3 = 66.61°}$$

• Draw Resultant





$\beta = 66.61° - 17.54°$

$\beta = 49.07°$

$\theta = 180° + \beta$

$\boxed{\theta = 229.07°}$