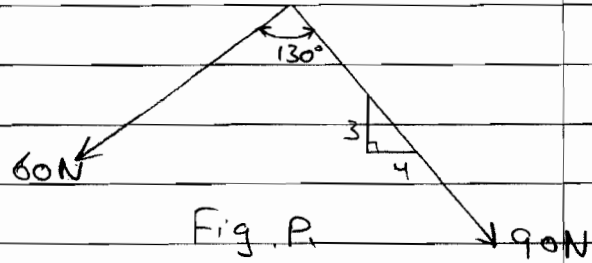


Problem 1:



Given:

forces and angles shown on fig P1

Req:

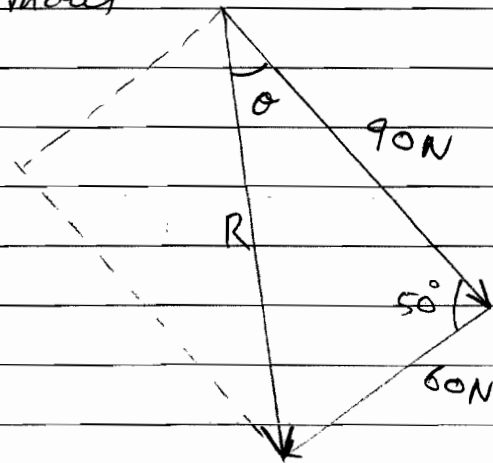
value & direction of Resultant without using Cartesian vectors.

Solution:

Using cosine law:-

$$R = \sqrt{(90)^2 + (60)^2 - 2(90)(60)\cos 50}$$

$$R = 68.97749 \text{ N}$$



Using sine law:-

$$\frac{60.0}{\sin \theta} = \frac{68.97749}{\sin 50}$$

$$\theta = 41.7854^\circ$$

Problem 2

Given :

Forces and angles on Fig P2

Req.:

Resolve force into components acting on lines aa and bb

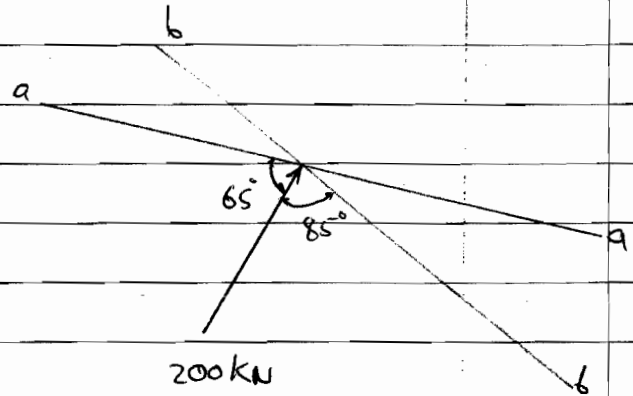
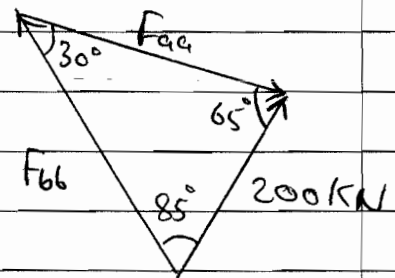


Fig P2

Solution:

Using sine law:-

$$\frac{F_{aa}}{\sin 85} = \frac{200}{\sin 30}$$



$$\therefore F_{aa} = 398.4779 \text{ kN}$$

$$\frac{F_{bb}}{\sin 65} = \frac{200}{\sin 30}$$

$$\therefore F_{bb} = 362.5231 \text{ kN}$$

Problem 3

Given:

Forces and angles as shown on fig P₃

Req:

Resultant R (Magnitude & Direction)

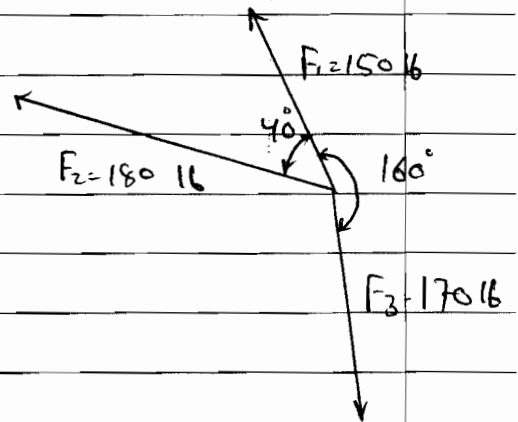
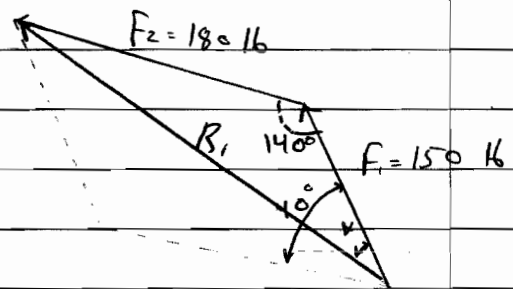


Fig P₃

Solution:

We must divide this problem into two parts. The first part solving F_1 and F_2 to find R_1 & the second part to solve R_1 and F_3 to get R .



Part 1:

$$R_1 = \sqrt{180^2 + 150^2 - 2(180)(150)\cos 140}$$

$$R_1 = 310.2683 \text{ lb}$$

using sine law:-

$$\frac{310.2683}{\sin 140} = \frac{180}{\sin \alpha}$$

$$\alpha = 21.8951^\circ$$

Part 2:

Solving R_1 with F_2

using cosine law

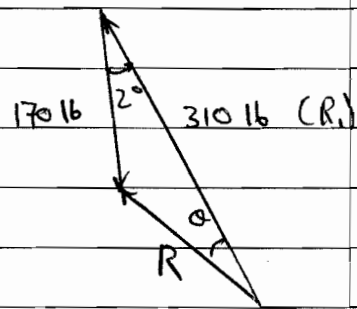
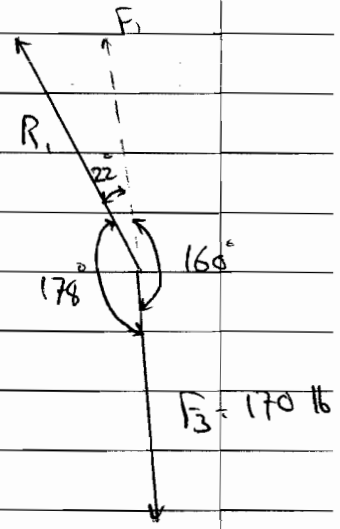
$$R = \sqrt{310.2863^2 + 170 - 2(170)(310.2863)\cos 2}$$

$$R = 139.9037 \text{ lb}$$

using sine law:

$$\frac{170}{\sin \theta} = \frac{140}{\sin 2}$$

$$\theta = 2.4388^\circ$$



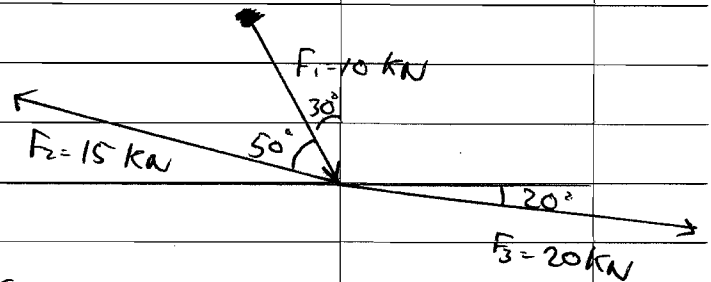
Problem 4:

Given:

Fig P4

Req.:

Magnitude and direction of forces

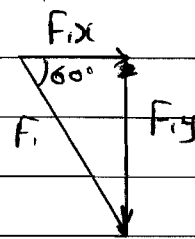


Solution:

$$R = \sqrt{R_x^2 + R_y^2}$$

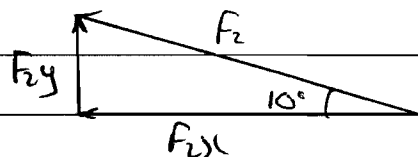
$$R_x = \sum F_x$$

$$R_y = \sum F_y$$



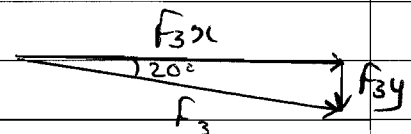
$$F_{1x} = 10 \cos 60 = 5 \text{ kN}$$

$$F_{1y} = -10 \sin 60 = -8.66 \text{ kN}$$



$$F_{2x} = -15 \cos 10 = -14.8 \text{ kN}$$

$$F_{2y} = +5 \sin 10 = 2.60 \text{ kN}$$



$$F_{3x} = 20 \cos 20 = 18.8 \text{ kN}$$

$$F_{3y} = -20 \sin 20 = -6.8 \text{ kN}$$

$$R_x = 5 - 14.8 + 18.8 = 9.0 \text{ kN}$$

$$R_y = -8.66 + 2.60 - 6.8 = -12.86 \text{ kN}$$

$$R = \sqrt{9.0^2 + (-12.86)^2} = 15.6965 \text{ kN}$$

$$\theta = \tan^{-1}(R_y/R_x) = -55.91^\circ$$

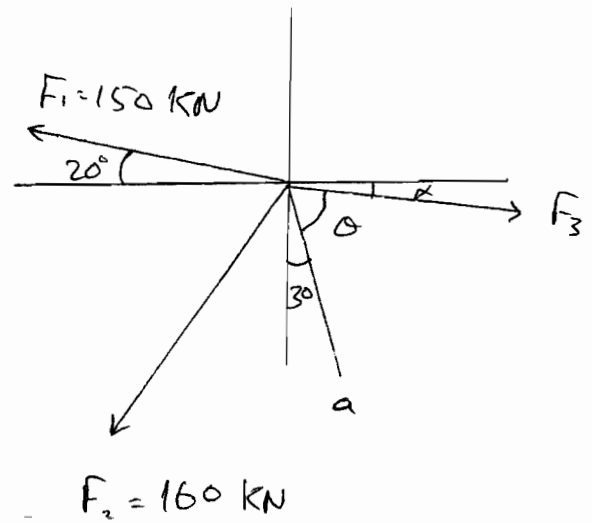
Problem 5

Given:-

Fig P5

Req:-

Magnitude & Direction of F_3 .



Solution :-

$$R = \sqrt{R_x^2 + R_y^2}$$

$$R_x = \sum F_x$$

$$R_y = \sum F_y$$

$$R_x = F_{x1} + F_{x2} + F_{x3}$$

$$100 \sin 30 = -150 \cos 20 - 160 \sin 25 + F_3 \cos \alpha$$

$$F_3 \cos \alpha = 258.6 \text{ kN} = F_{3x}$$

$$R_y = F_{y1} + F_{y2} + F_{y3}$$

$$-100 \cos 30 = 150 \sin 20 - 160 \cos 25 - F_3 \sin \alpha$$

$$F_3 \sin \alpha = -7.1 \text{ kN} = F_{3y}$$

$$F_3 = \sqrt{F_{3x}^2 + F_{3y}^2} = \sqrt{258.6^2 + 7.1^2} = 258.7 \text{ kN}$$

$$\alpha = \tan^{-1} \left(\frac{F_{3y}}{F_{3x}} \right) = \tan^{-1} \left(\frac{-7.1}{258.6} \right) = -1.57^\circ$$

$$\theta = 90 - 30 - 1.57 = 58.43^\circ$$

