CE 201 (4 & 5)
[071]

H.W. # 1
Key solution

Problem 1:

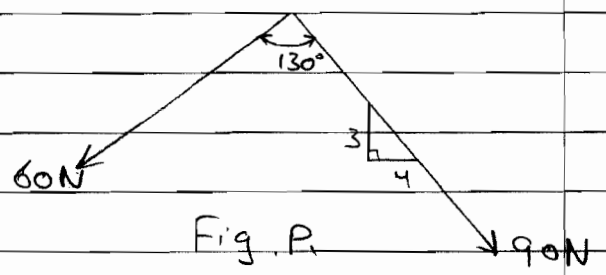
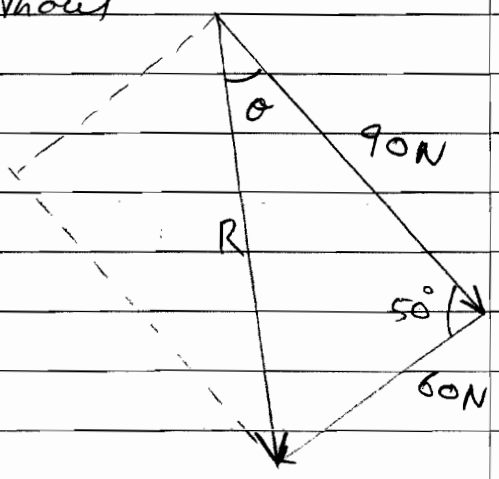


Fig. P1

Given:
forces and angles shown on fig P1

Req:
value & direction of Resultant without using cartesian vectors.



Solution:

using Cosine law:

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

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

Using sine law:

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

$$\boxed{\theta = 41.7854^\circ}$$

Problem 2

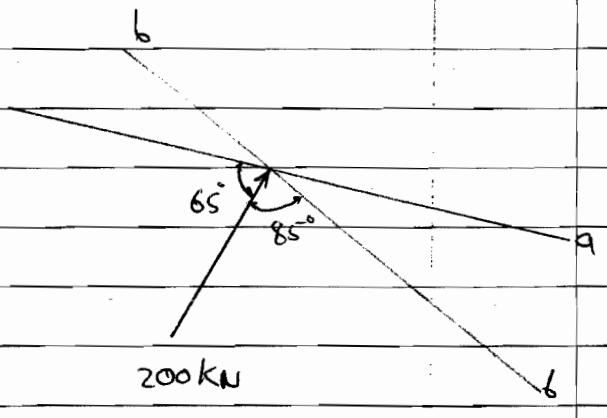


Fig P2

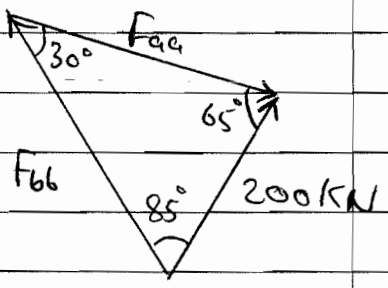
Given:

Forces and angles on Fig P2

Req:

Resolve force into components acting on lines aa and bb

Solution:



Using sine law:-

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

$$\therefore \boxed{F_{aa} = 398.4779 \text{ KN}}$$

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

$$\therefore \boxed{F_{bb} = 362.5231 \text{ KN}}$$

Problem 3

Given:
Forces and angles as shown on fig P3

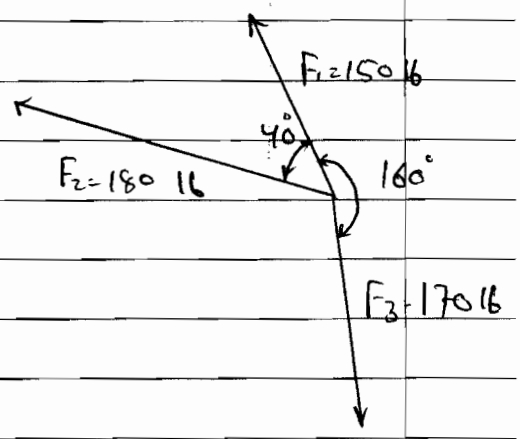
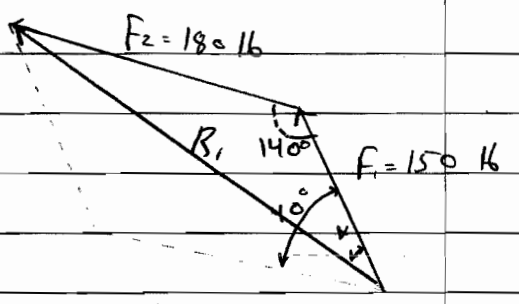


Fig P3

Req:
Resultant R (Magnitude & Direction)

Solution:
We must divide this problem into two parts. The first part solving F1 and F2 to find R1 & the second part to solve R1 and F3 to get R.



Part 1:

$$R_1 = \sqrt{180^2 + 150^2 - 2(180)(150)\cos 40}$$

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

Using sine law:-

$$\frac{310.2683}{\sin 140} = \frac{180}{\sin \alpha} \Longrightarrow \boxed{\alpha = 21.8951^\circ}$$

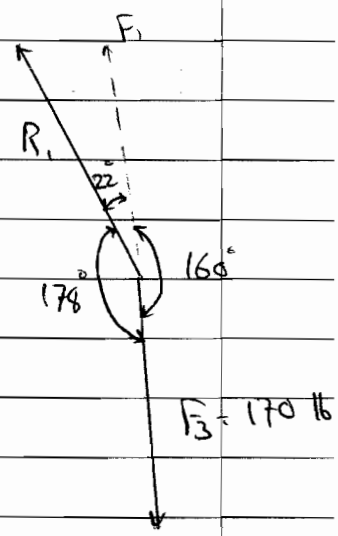
Part 2 :

Solving R_1 with F_3

using cosine law

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

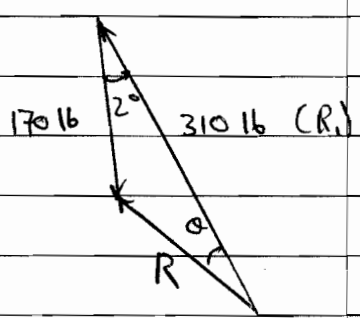
$$R = 139.9037 \text{ lb}$$



using sine law :

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

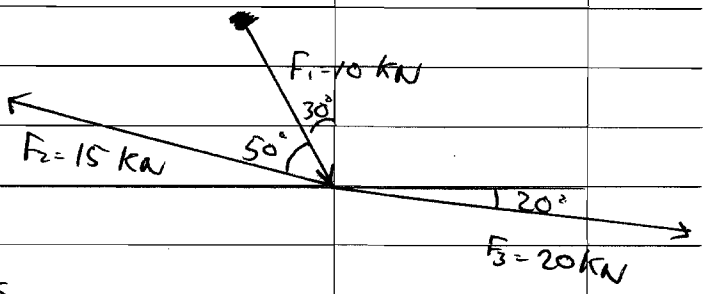
$$\theta = 2.4388°$$



Problem 4:

Given:

Fig P4

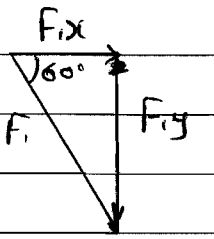


Req:

Magnitude and direction of forces

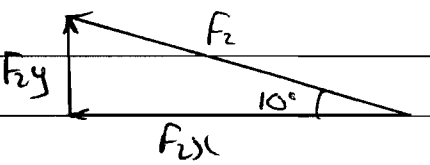
Solution:

$$R = \sqrt{Rx^2 + Ry^2}$$

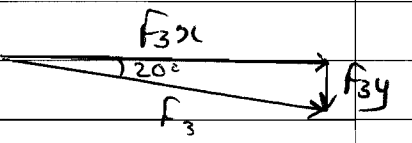


$$Rx = \Sigma Fx$$
$$Ry = \Sigma Fy$$

$$F_{1x} = 10 \cos 60 = 5 \text{ KN}$$
$$F_{1y} = -10 \sin 60 = -8.66 \text{ KN}$$



$$F_{2x} = -15 \cos 10 = -14.8 \text{ KN}$$
$$F_{2y} = +5 \sin 10 = 2.60 \text{ KN}$$



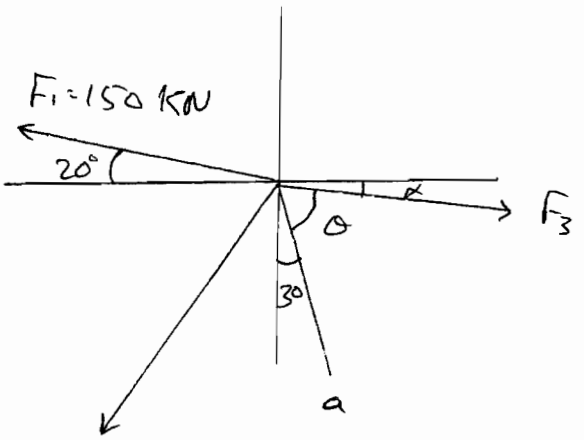
$$F_{3x} = 20 \cos 20 = 18.8 \text{ KN}$$
$$F_{3y} = -20 \sin 20 = -6.8 \text{ KN}$$

$$Rx = 5 - 14.8 + 18.8 = 9.0 \text{ KN}$$
$$Ry = -8.66 + 2.60 - 6.8 = -12.86 \text{ KN}$$

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

$$\theta = \tan^{-1}(Ry/Rx) = -55.01°$$

Problem 5



F2 = 160 KN

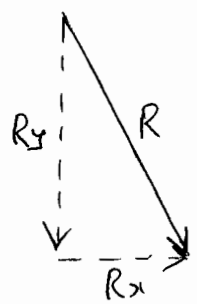
Given:
Fig P5-

Req'd:

Magnitude & Direction of F_3.

Solution:

$$R = \sqrt{Rx^2 + Ry^2}$$
$$Rx = \Sigma Fx$$
$$Ry = \Sigma Fy$$



(assume Direction)

$$Rx = Fx_1 + Fx_2 + Fx_3$$
$$100 \sin 30 = -150 \cos 20 - 160 \sin 25 + F_3 \cos \alpha$$

$$F_3 \cos \alpha = 258.6 \text{ KN} = F_3x$$

$$Ry = Fy_1 + F_2y + F_3y$$

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

$$F_3 \sin \alpha = -7.1 \text{ KN} - F_3y$$

$$\boxed{F_3 = \sqrt{F_3x^2 + F_3y^2} = \sqrt{258.6^2 + 7.1^2} = 258.7 \text{ KN}}$$

$$\alpha = \tan^{-1}\left(F_3y / F_3x\right) = \tan^{-1}\left(\frac{-7.1}{258.6}\right) = -1.57^\circ$$

$$\boxed{\theta = 90 - 30 - 1.57 = 58.43^\circ}$$