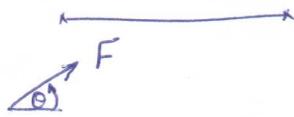


Force vectors

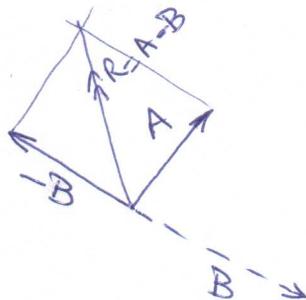
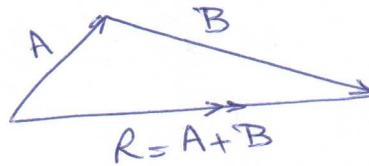
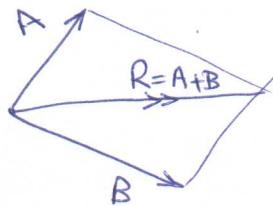
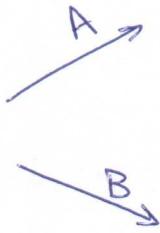
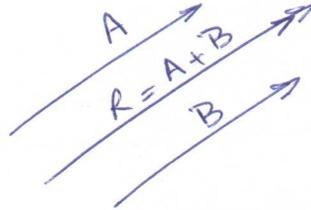
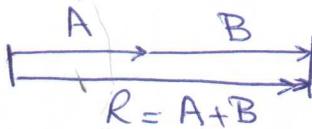
- * scalar
- * vectors



كيفية قياها تعرف بمقدارها فقط
كيفية اتجاهها تعرف بمقدارها واتجاهها

(الاتجاه من الافق وفي عكس اتجاه عقارب الساعة)

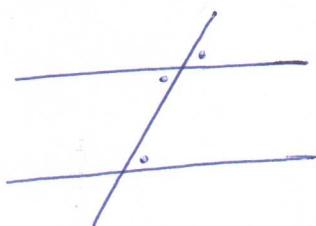
Vector operations



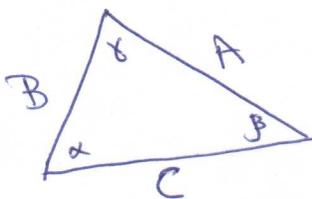
magnitude
direction
resultant force
Components
Resolve
vertical
horizontal
vertical
directed
clockwise
CCW
orientation

طرح المتجهات عن بعضها جمع باتجاه سالب

$$R = A - B = A + (-B)$$



F rule تبادل
Z rule تبادل
X rule تبادل



$$\alpha + \beta + \gamma = 180$$

$$F_x = R \cos \theta$$

$$F_y = R \sin \theta$$

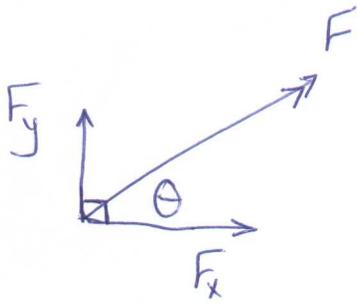
sine rule

CCW

$$\frac{A}{\sin \alpha} = \frac{B}{\sin \beta} = \frac{C}{\sin \gamma}$$

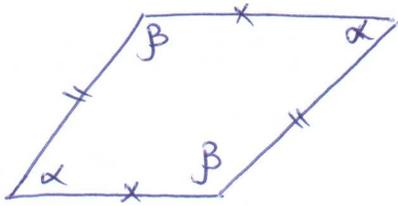
cosine rule

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



$$F_x = F \cos \theta$$

$$F_y = F \sin \theta$$



parallelogram للمعبر

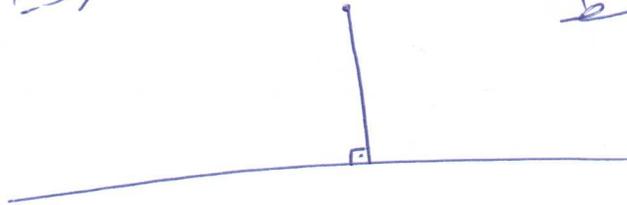
كل ضلعين متقابلين متساويين
كل زاويتين متقابلتين متساويتين

$$2\alpha + 2\beta = 360^\circ$$

has a minimum magnitude

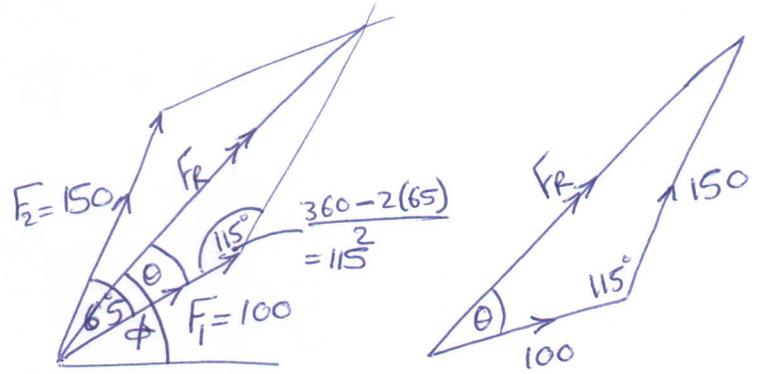
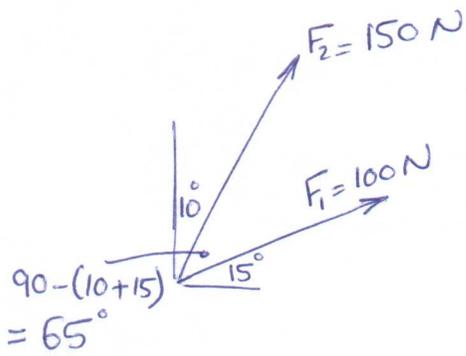
زاوية قائمة =

اقل مسافة من نقطة الى خط
هو الخط العمودي من
النقطة على الخط



ex. 2-1

$F_R = ??$ $\phi = ??$



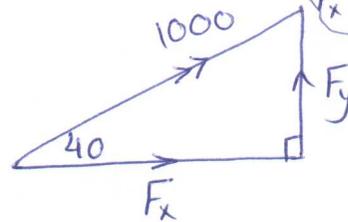
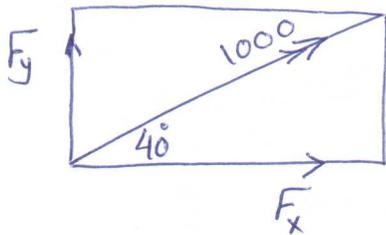
$$F_R = \sqrt{(100)^2 + (150)^2 - 2 * 100 * 150 * \cos 115} = 212.6 \text{ Newton}$$

$$\frac{F_R}{\sin 115} = \frac{150}{\sin \theta} \quad \sin \theta = \frac{150 \sin 115}{F_R} \quad \theta = 39.8^\circ$$

$$\phi = \theta + 15 = 39.8 + 15 = 54.8^\circ$$

ex. 2-2 $F_x = ??$, $F_y = ??$

(a)



$$\frac{1000}{\sin 90} = \frac{F_y}{\sin 40} = \frac{F_x}{\sin 50}$$

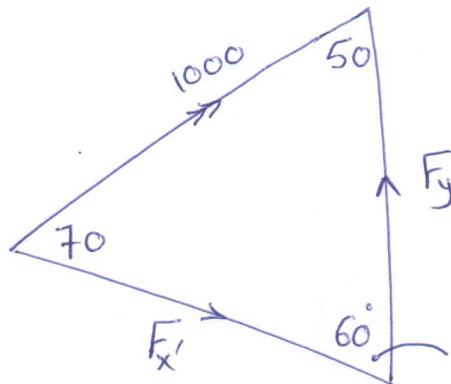
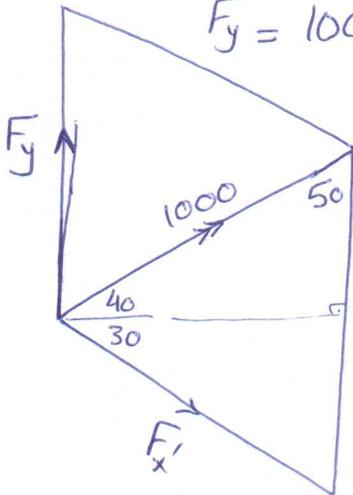
$$F_y = \frac{1000 \sin 40}{\sin 90} = 1000 \sin 40$$

$$F_x = \frac{1000 \sin 50}{\sin 90} = 1000 \cos 40$$

$$F_x = 1000 \cos 40 = 766 \text{ Newton}$$

$$F_y = 1000 \sin 40 = 643 \text{ Newton}$$

(b)



$$180 - (70 + 50) = 180 - 120 = 60$$

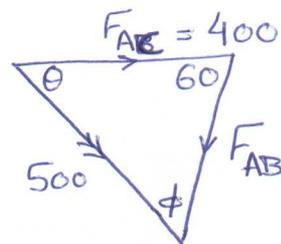
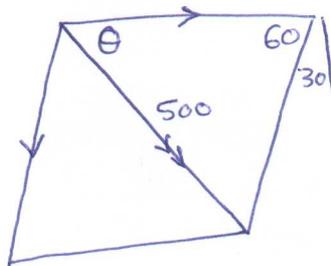
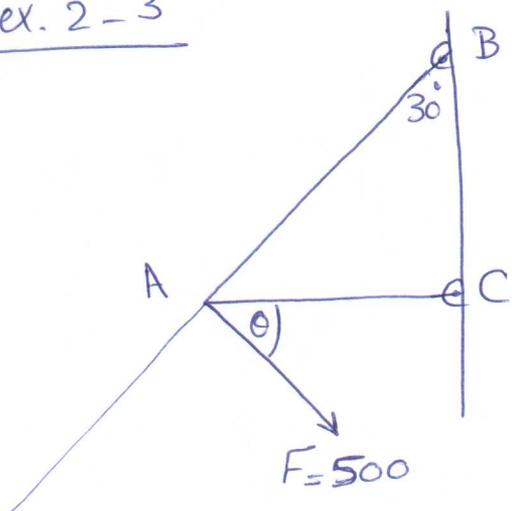
$$\frac{1000}{\sin 60} = \frac{F_x'}{\sin 50} = \frac{F_y}{\sin 70}$$

$$F_x' = \frac{1000 \sin 50}{\sin 60} = 884.6 \text{ Newton}$$

$$F_y = \frac{1000 \sin 70}{\sin 60} = 1085 \text{ Newton}$$

ex. 2-3

$$\theta = ??, F_{AC} = 400$$



$$\frac{400}{\sin \phi} = \frac{500}{\sin 60} = \frac{F_{AB}}{\sin \theta}$$

$$\sin \phi = \frac{400 \times \sin 60}{500}$$

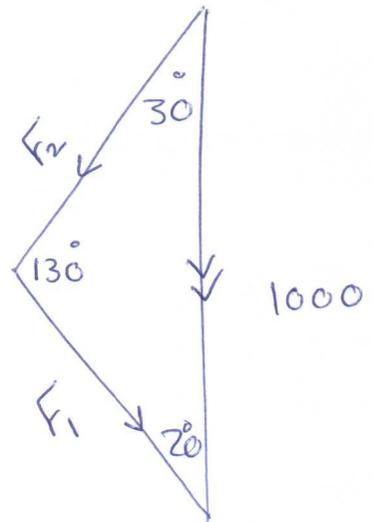
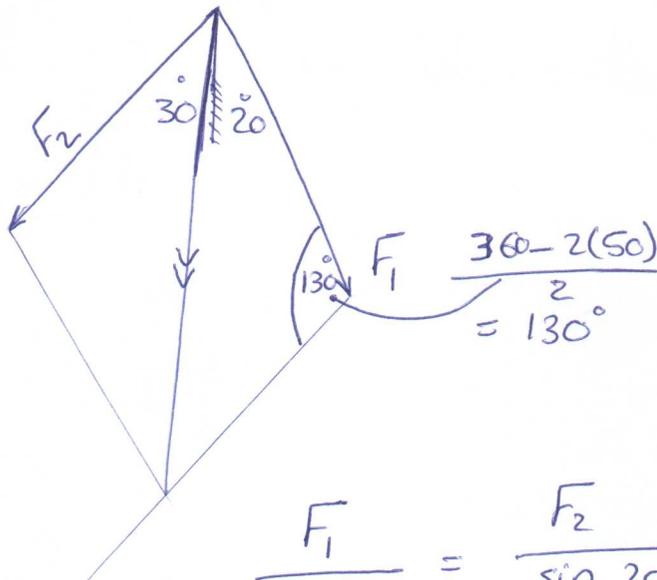
$$\phi = 43.9^\circ$$

$$\theta = 180 - (60 + \phi) = 76.1^\circ$$

ex. 2-4

$F_R = 1000$ Newton \downarrow

(a) $F_1 = ??$, $F_2 = ??$, $\theta = 30^\circ$

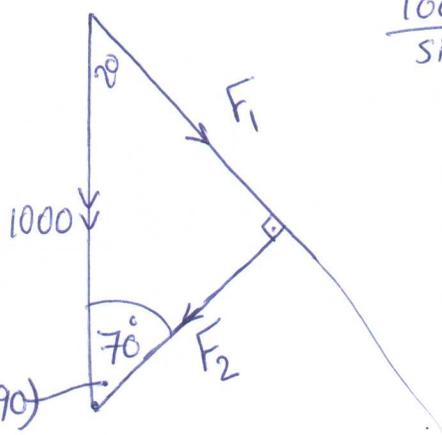


$$\frac{F_1}{\sin 30} = \frac{F_2}{\sin 20} = \frac{1000}{\sin 130}$$

$$F_1 = \frac{1000 \sin 30}{\sin 130} = 653 \text{ Newton}$$

$$F_2 = \frac{1000 \sin 20}{\sin 130} = 446 \text{ Newton}$$

(b) $F_1 = ??$, $F_2 = ??$, F_2 is min.



$$\frac{1000}{\sin 90} = \frac{F_1}{\sin 70} = \frac{F_2}{\sin 20}$$

$$F_1 = \frac{1000 \sin 70}{\sin 90} = \text{Newton}$$

$$F_2 = \frac{1000 \sin 20}{\sin 90} = \text{Newton}$$

$$\begin{aligned} 180 - (20 + 90) \\ = 180 - 110 \\ = 70^\circ \end{aligned}$$

$$F_1 = 1000 \cos 20 = 940 \text{ Newton}$$

$$F_2 = 1000 \sin 20 = 342 \text{ Newton}$$