Universitas
Pembangunan Jaya

STATIKA (CVL104)
3 SKS

Universitas Pembangunan Jaya

ATURAN PERKULIAHAN :

- Dispensasi keterlambatan 30 menit dari jam belajar.
- Absen dilakukan 15 menit setelah dosen masuk, kemudian jika ada mahasiswa yang terlambat harap lapor ke ketua kelas untuk dicatat kemudian dilaporkan ke dosen ybs.
- Absen diverivikasi 30 menit setelah mahasiswa hadir.
- **BAGI MAHASISWA YANG TERLAMBAT MASUK PERKULIAHAN > 30 MENIT,** diperkenankan masuk namun **TIDAK DAPAT ABSEN** karena sudah diverivikasi.
- Selama sesi perkuliahan, dilarang menyalakan nada dering **Smartphone / Handphone**, jika ada telepon masuk harap keluar kelas minta ijin dosen ybs. Jika ada yang mengangkat telepon di kelas akan ada **PUNISHMENT**.

Universitas
Pembangunan Jaya

TEXT BOOK

- Hibbeler, R.C. (2004). Statics and Mechanics of Materials SI Edition.
- Hibbeler, R.C. (2010). Structural Analysis. 8th edition. Prentice Hall. ISBN : 978-0-13-257053-4
- Meriam, J.L., Kraige,L.G., (2006), Engineering Mechanics - Statics. 6th edition. John Wiley & Sons, Inc. ISBN : 978-0471739326
- Materi perkuliahan Prof Binsar, ITB
- Analisa Struktur, Agus Setiawan

Universitas
Pembangunan Jaya

SCORE

- Task : 30%
- UTS / Mid Semester : 30%
- UAS / Final Semester : 40%

Universitas
Pembangunan Jaya

HUKUM NEWTON, VEKTOR

Universitas
Pembangunan Jaya

- TIU :
  - Mahasiswa dapat menjelaskan tentang prinsip keseimbangan, uraian, dan penjumlahan gaya.
- TIK :
  - Mahasiswa dapat menjelaskan konsep gaya

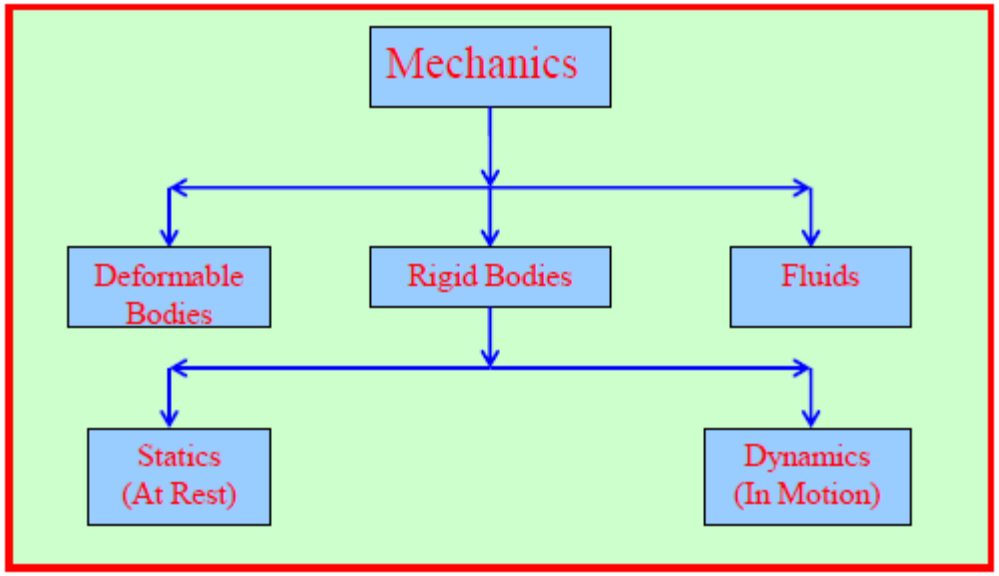
Universitas
Pembangunan Jaya

MECHANICS

- Mekanika adalah sebuah divisi dari Ilmu Pengetahuan yang mempelajari perilaku sebuah objek akibat beban yang bekerja tehadapnya.
- *Mechanics is the branch of the physical sciences which deals with the state of rest or motion of bodies that are subjected to the action of forces.*

Universitas
Pembangunan Jaya

SUBDIVISION OF MECHANICS

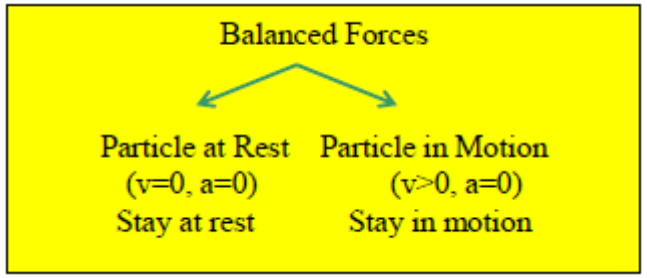


Universitas
Pembangunan Jaya

NEWTON'S THREE LAWS OF MOTION

- First Law

"A particle originally at rest, or moving in a straight line with constant velocity, will remain in this state provided the particle IS NOT subjected to an unbalanced external force"



Universitas
Pembangunan Jaya

SECOND LAW

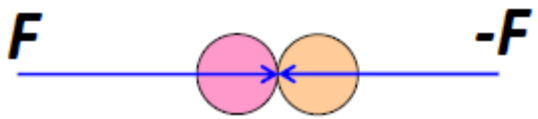
"A particle acted upon by an unbalanced force **(F)** experiences an acceleration **(a)** that has the same direction as the force and a magnitude that is directly proportional to the force". If **(F)** is applied to a particle of mass **(m)**, this law may be expressed mathematically as:

$$F = m\,a$$

Universitas
Pembangunan Jaya

THIRD LAW

"The mutual forces of action and reaction between two particles are equal in magnitude, opposite in direction and collinear in orientation".



Universitas
Pembangunan Jaya

NEWTON'S LAW OF GRAVITATIONAL ATTRACTION

A law governing the gravitational attraction between any two particles is mathematically stated as:

$$F = G\,[m_1 \times m_2 / r^2]$$

Where :

- F = force of gravitation between the two particles
- G = A universal constant of gravitation; (66.73x10-12 m3/kg s2)
- m1 and m2 = mass of each of the two particles
- r = the distance between the two particles

Universitas
Pembangunan Jaya

WEIGHT

Weight is the gravitational force between the earth and the particle. If we assume that:

- W = weight of the particle
- m = m1 = is the mass of the particle
- m2 = is the mass of the earth
- r = is the distance between the earth's center and the particle

Then,

$$W = G\,[m_1 \times m_2 / r^2]$$

Letting :

$$g = G \cdot m_2 / r^2$$

Therefore, from the second law of motion (F = m . a)

Where

g = acceleration due to gravity

Universitas
Pembangunan Jaya

UNIT OF MEASSURMENT

S1 UNITS

SI is known as the International System of Units where Length is in *meters (m)*, time is in *seconds (s),* and mass is in *kilograms (kg)* and force is *in Newton (N)*

(1 Newton is the force required to give 1 kilogram of mass an acceleration of 1 m/s^2).

Universitas
Pembangunan Jaya

CONVERSITON FACTORS

- Force; 1 lb = 4.4482 N
- Mass; slug = 14.5938 kg
- Length; ft = 0.304 m

Universitas
Pembangunan Jaya

PREFIXES

- giga = G = 10^9 = 1,000,000,000
- mega = M = 10^6 = 1,000,000
- kilo = k = 10^3 = 1,000
- milli = m = 10^{-3} = 0.001
- micro = μ = 10^{-6} = 0.000 001
- nano = η = 10^{-9} = 0.000 000 001

Universitas
Pembangunan Jaya

FORCE VECTORS

- Scalars and Vectors

Scalar

- A quantity identified by positive or negative number.
- It is characterized by its magnitude only
- Elementary algebra is used when mathematical operations are involved
- Examples include mass, length, and volume

Universitas
Pembangunan Jaya

FORCE VECTORS

Vectors

- A quantity by its magnitude and direction
- Examples include force, moment, and displacement

Universitas
Pembangunan Jaya

GRAPHICAL REPRESENTATION OF A VECTOR

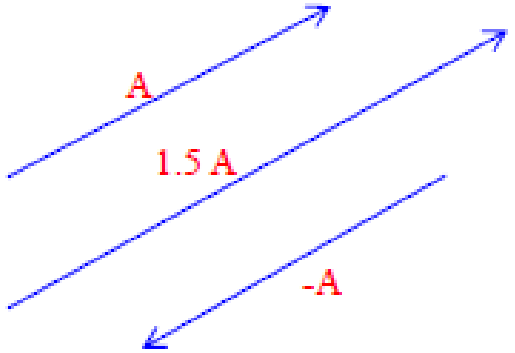
- Vectors are represented by ARROWS
- Magnitude is represented by the length of the arrow
- Direction is defined by
- Vector A is written as $\overrightarrow{A}$ ϕ

Universitas
Pembangunan Jaya

VECTOR OPERATIONS

Multiplication and Division of a Vector by a Scalar

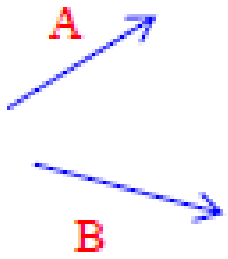
- Vector **A**
- Scalar *a*
- **A** *a* = *a***A**
- Magnitude of *a***A**
- Direction of **A** if *a* is positive (+)
- Direction of –**A** (opposite) if *a* is negative (-)

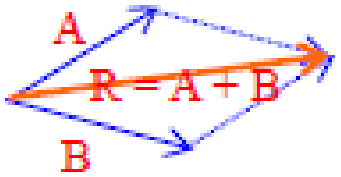


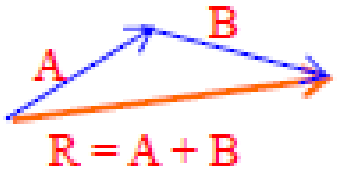
Universitas
Pembangunan Jaya

VECTOR ADDITION

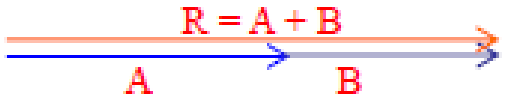
- Vectors are added according to the parallelogram law
- The resultant R is the diagonal of the parallelogram







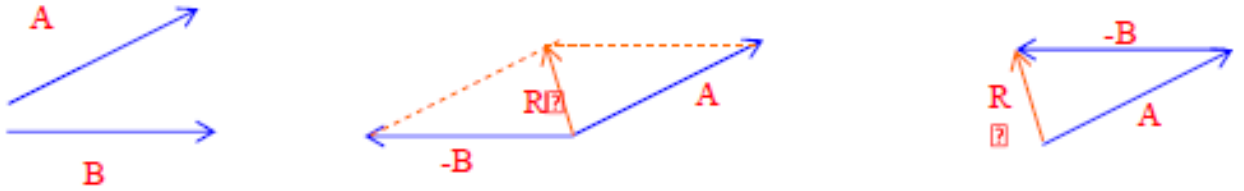
- If two vectors are co-linear (both have the same line of action), they are added algebraically



Universitas
Pembangunan Jaya

VECTOR SUBTRACTION

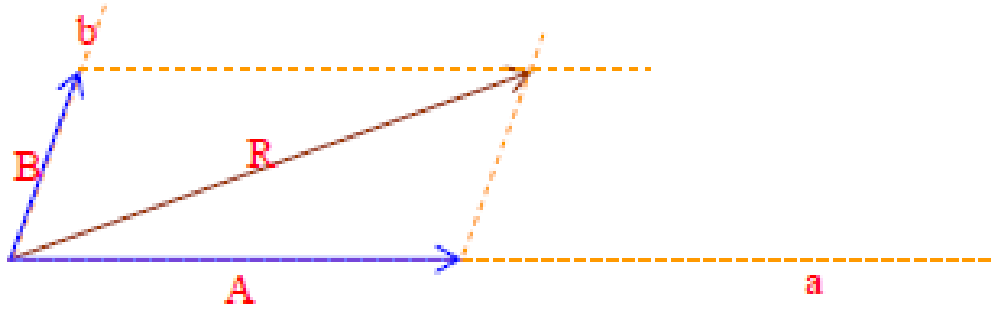
- The resultant is the difference between vectors A and B



Universitas
Pembangunan Jaya

RESOLUTION OF A VECTOR

- If lines of action are known, the resultant **R** can be resolved into two components acting along those lines (i.e. a and b).



Universitas
Pembangunan Jaya

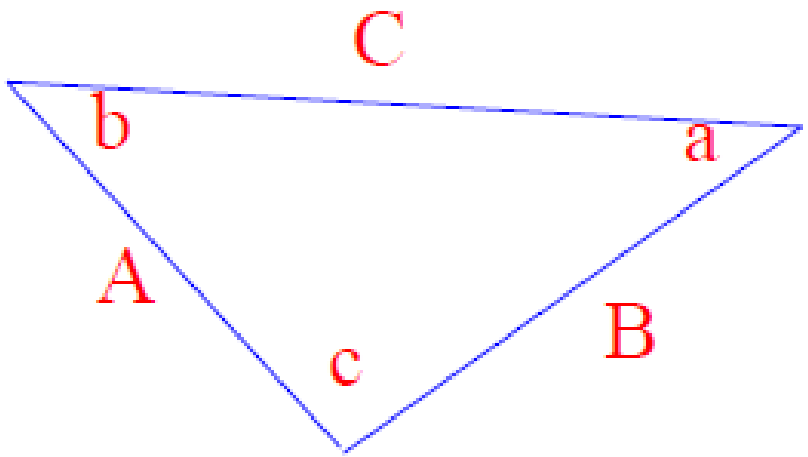
ANALYSIS OF PROBLEMS

- Two procedures to be followed:
- **Parallelogram law**
- **Trigonometry**
- sine and/or cosine laws may be used

Universitas
Pembangunan Jaya

Sine Law

$$\frac{A}{\sin a} = \frac{B}{\sin b} = \frac{C}{\sin c}$$



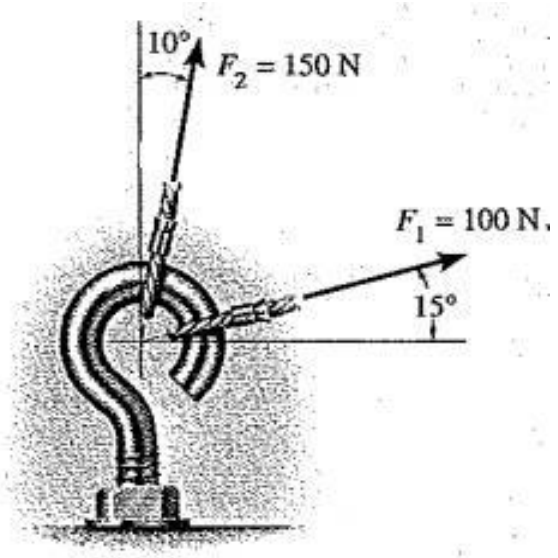
Cosine Law

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

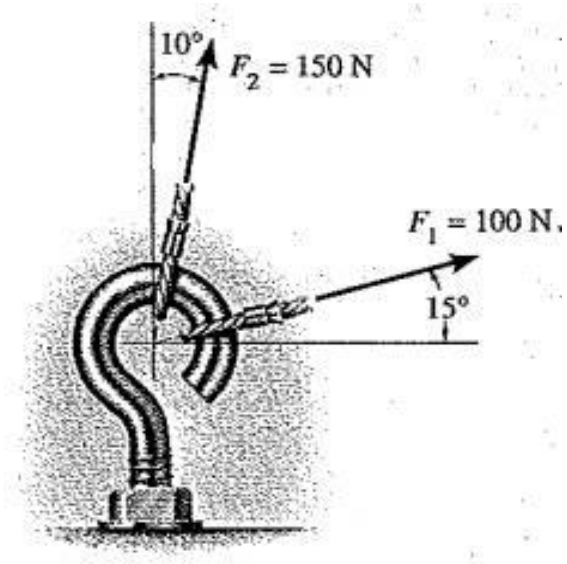
Universitas
Pembangunan Jaya

CASE 1 :

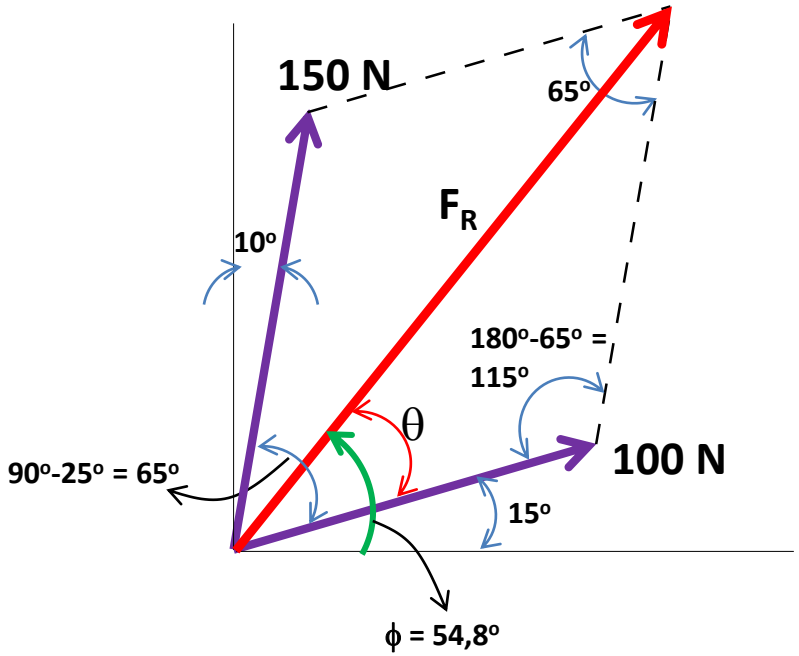
The screw eye in figure is subjected to two forces $\mathbf{F}_1$ and $\mathbf{F}_2$. Determine the magnitude and direction of the resultant force



Universitas
Pembangunan Jaya



Using Parallelogram Law



$$F_R = \sqrt{100^2 + 150^2 - 2(100)(150)cos115^o} = 212{,}6N$$

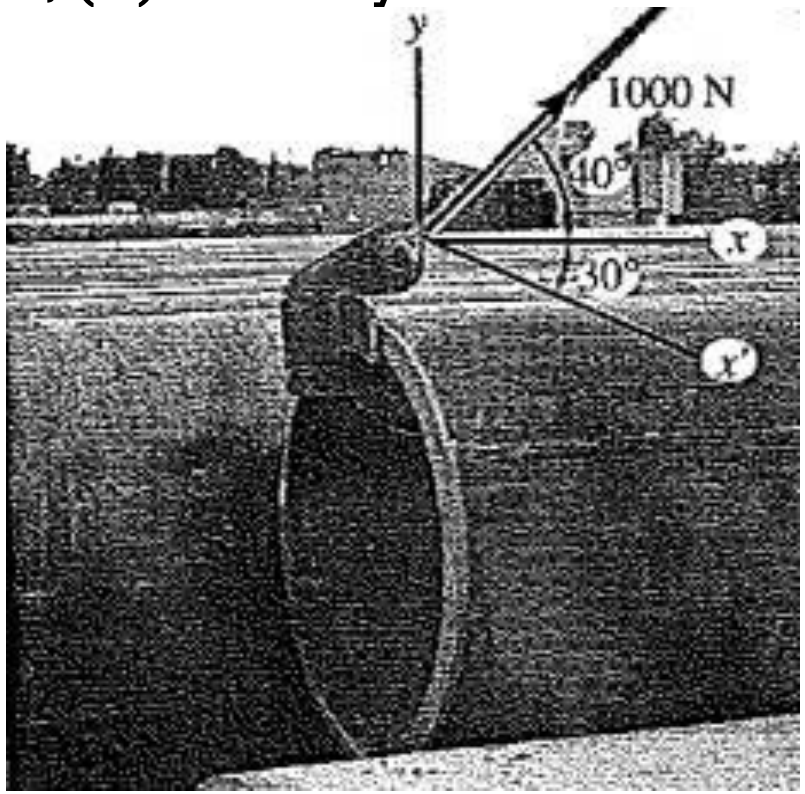
sine law : $\frac{150}{sin\theta} = \frac{212{,}6}{sin115^o} \Rightarrow sin\theta = \frac{150}{212{,}6} \times sin115^o = 39{,}8^o$

Direction, ϕ = 15 + θ = **54,8°** from horizontal axis

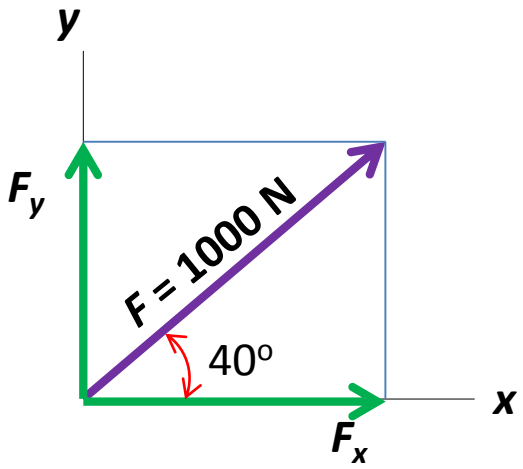
Universitas
Pembangunan Jaya

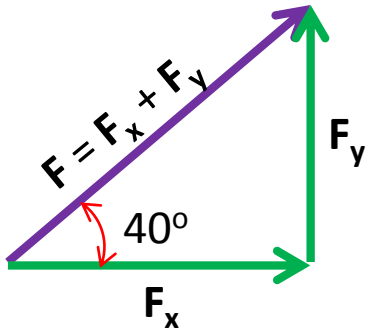
CASE 2 :

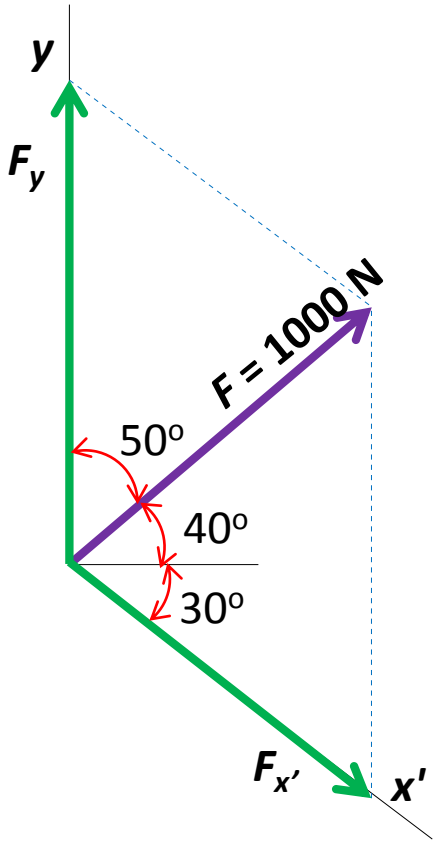
Resolve the 1000-N force acting on the pipe, into components in the :
(a) x and y direction; (b) x' and y direction

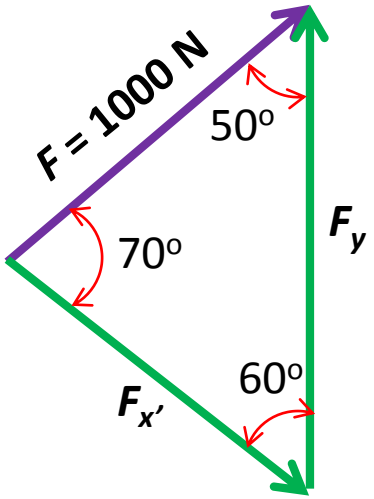


Universitas
Pembangunan Jaya









$$F_x = 1000 \cos 40^o = 766N$$

$$F_y = 1000 \sin 40^o = 643N$$

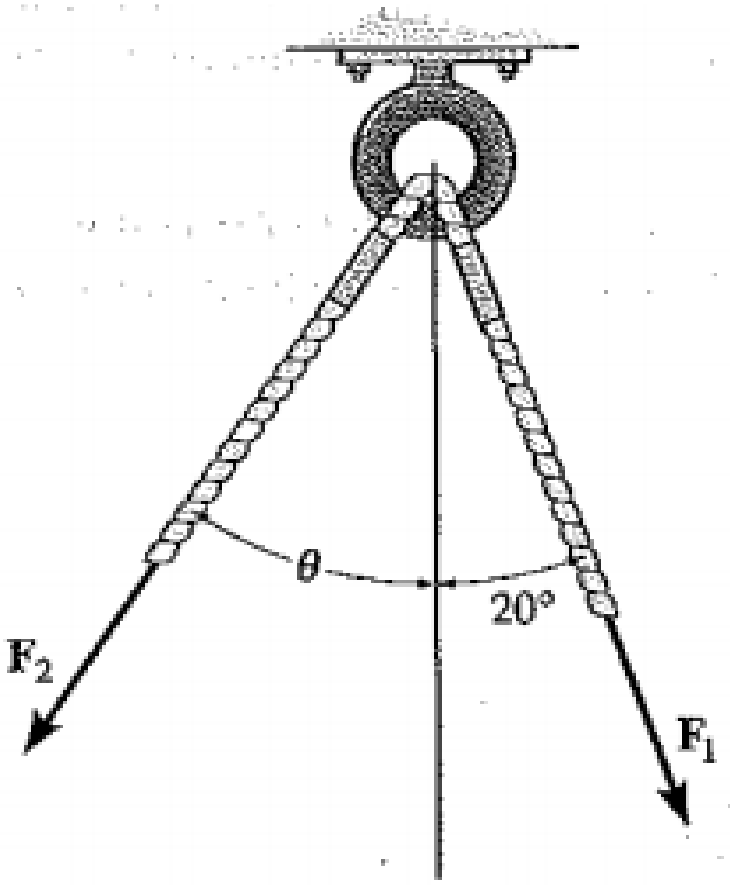
$$\frac{F_{x'}}{\sin 50^o} = \frac{1000}{\sin 60^o} \Rightarrow F_{x'} = 884{,}6N$$

$$\frac{F_y}{\sin 70^o} = \frac{1000}{\sin 60^o} \Rightarrow F_y = 1085N$$

Universitas
Pembangunan Jaya

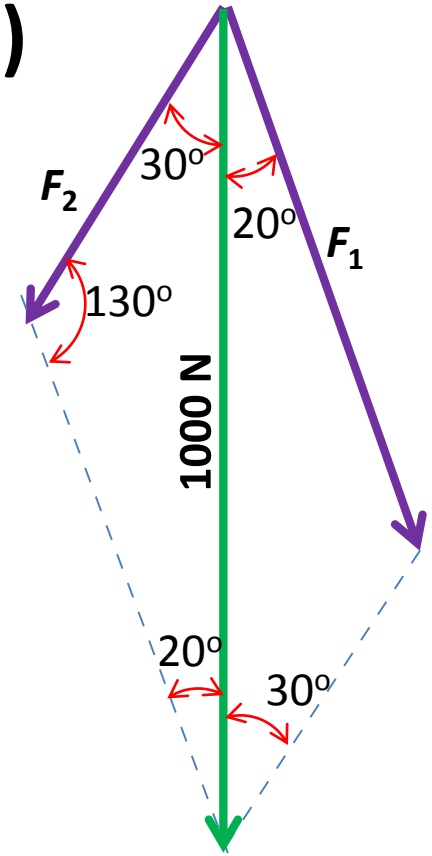
CASE 3 :

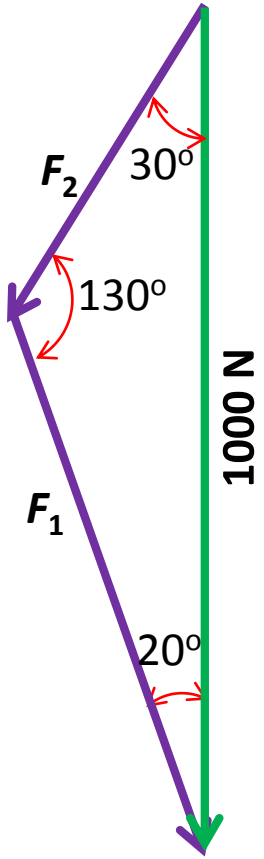
The ring show in figure is subjected to two forces $\mathbf{F}_1$ and $\mathbf{F}_2$. If it is required that the resultant force have a magnitude of 1 kN and be directed vertically downward, determine (a) the magnitudes of $\mathbf{F}_1$ and $\mathbf{F}_2$ provided Θ = 30°, (b) the magnitude of $\mathbf{F}_1$ and $\mathbf{F}_2$ if $\mathbf{F}_2$ is to be minimum



Universitas
Pembangunan Jaya

(a)



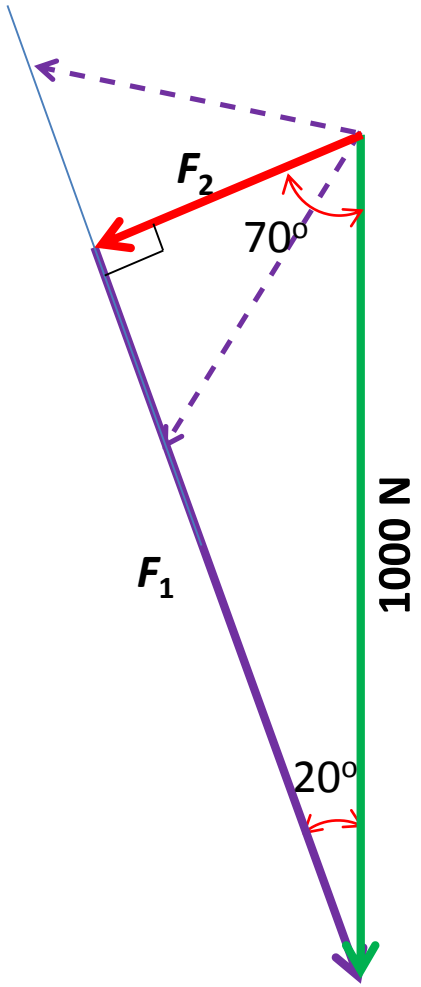


$$\frac{F_1}{\sin 30^o} = \frac{1000}{\sin 130^o} \Rightarrow F_1 = 653N$$

$$\frac{F_2}{\sin 20^o} = \frac{1000}{\sin 130^o} \Rightarrow F_2 = 446N$$

Universitas
Pembangunan Jaya

(b)



- If θ is not specified, then by the vector triangle, $\mathbf{F_2}$ may be added to $\mathbf{F_1}$ in various ways to yield the resultant 1000 N force.
- In particular, the minimum length or magnitude of $\mathbf{F_2}$ will occur when its line of action is perpendicular to $\mathbf{F_1}$.
- Hence, when $\theta = 90^o - 20^o = 70^o$, $\mathbf{F_2}$ is minimum

$$F_1 = 1000 \sin 70^o = 940N$$

$$F_2 = 1000 \cos 70^o = 342N$$

Universitas
Pembangunan Jaya

TAKE HOME WORK

- Make a group (1 group = at least 4 person, max 5 person)
- Do the task in Text Book (you can download in OCW)
  - Group 1, 3, & 5 : problems 2.1 – 2.19
  - Group 2, 4 & 6 : problems 2.20 – 2.38

DEADLINE NEXT WEEK **MONDAY / FEBRUARY 3RD 2020**

Note : do the task manually writting . 1 group 1 pack of task .

Good Luck !