PENDAHULUAN

- Konsep Dasar Dinamika
- Besaran Dan Sistem Satuan
- Trigonometri
- Operasi Vektor

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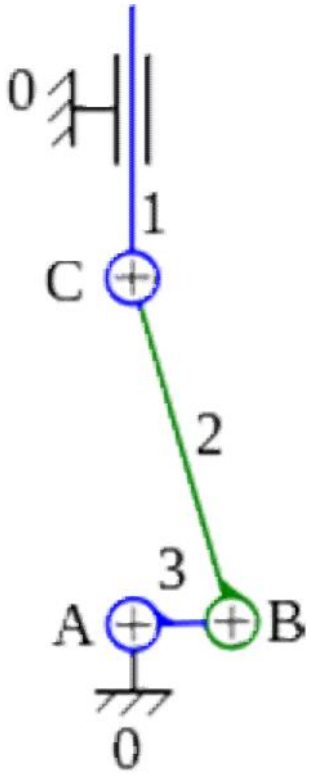
KONSEP DASAR DINAMIKA

Konsep Dasar
Kinematika & Dinamika Mesin

- Ilmu yang mempelajari pergerakan-pergerakan suatu mesin dan komponennya.
- Membicarakan seputar masalah kecepatan dan percepatan link dari suatu mesin atau mekanisme, dengan batasan-batasan tertentu.



Konsep Dasar
Kinematika & Dinamika Mesin

- **Kinematika** ➔ mempelajari pergerakan link dari suatu mekanisme dengan secara grafis, tanpa mempertimbangkan dari mana asal pergerakan link tersebut diperoleh.

- **Dinamika** ➔ mempelajari pergerakan link dari suatu mekanisme dengan secara analisis (hitungan) dengan mempertimbangkan darimana asal pergerakan link tersebut diperoleh.

1.6 General Procedure for Analysis

The most effective way of learning the principles of engineering mechanics is to *solve problems*. To be successful at this, it is important to always present the work in a *logical* and *orderly manner*, as suggested by the following sequence of steps:

- Read the problem carefully and try to correlate the actual physical situation with the theory studied.
- Tabulate the problem data and draw any necessary diagrams.
- Apply the relevant principles, generally in mathematical form. When writing any equations, be sure they are dimensionally homogeneous.
- Solve the necessary equations, and report the answer with no more than three significant figures.
- Study the answer with technical judgment and common sense to determine whether or not it seems reasonable.

TAHAP-TAHAP PROSES PERENCANAAN MEKANISME

1. Pengenalan problem yang dirancang.
2. Konsep mekanisme yang dirancang dalam bentuk sederhana (skema atau bagan mekanisme).
3. Analisa kinematis atau tinjauan karakteristik gerakan mekanisme berdasarkan bentuk geometris mekanisme secara murni, yang mungkin nantinya membutuhkan modifikasi mekanisme.
4. Analisa statis atau penentuan sifat dan besar gaya – gaya yang terjadi akibat gerak utama mekanisme.
5. Pemilihan bahan yang sesuai dengan hasil perhitungan dengan memperhatikan faktor ekonomis.
6. Analisa dinamika atau penentuan gaya – gaya inersia dan akibatnya terhadap keselamatan, serta memenuhi persyaratan operasional mekanisme.

BESARAN
DAN SISTEM SATUAN

BESARAN DAN SISTEM SATUAN

No	Besaran Fisik	Vektor (V) atau Skalar (S)	Simbol	Satuan	
				BS	SI
1.	Jarak (Displacement)	V	$\underline{s}$, $\underline{x}$	in	m
2.	Waktu (Time)	S	t	sec	sec
3.	Gaya (Force)	V	$\underline{F}$, $\underline{R}$	lb	N
4.	Kecepatan (Velocity)	V	$\underline{v}$	in/sec	m/sec
5.	Percepatan (Acceleration)	V	$\underline{a}$	in/sec^2	m/sec^2
6.	Jarak Sudut (Angular Displacement)	V	$\underline{\theta}$, $\underline{\phi}$	rad	rad
7.	Kecepatan Sudut (Angular Velocity)	V	$\underline{\omega}$	rad/sec	rad/sec
8.	Percepatan Sudut (Angular Acceleration)	V	$\underline{\alpha}$	rad/sec^2	rad/sec^2
9.	Massa (Mass)	S	m	$lb.sec^2/in$	$N.sec^2/m$
10.	Momentum Linier (Linear Momentum)	V	$\underline{Z}$	lb.sec	N.sec
11.	Torsi (Torque)	V	$\underline{T}$	lb.in	N.m
12.	Kerja (Work)	S	W	lb.in	N.m
13.	Enersi (Energy)	V	$\underline{E}$	lb.in	N.m

Catatan :

1. Tabel di atas dibuat berdasarkan *F*, *t* dan *s* sebagai satuan dasar.
2. Simbol dengan tanda garis bawah menandakan besaran vektor.
3. Simbol tanpa garis bawah menandakan besaran skalar.

BESARAN DAN SISTEM SATUAN

Awalan	Singkatan	Nilai
Tera	T	10^{12}
Giga	G	10^{9}
Mega	M	10^{6}
Kilo	k	10^{3}
Hektar	h	10^{2}
Deka	da	10^{1}
Desi	d	10^{-1}
Centi	c	10^{-2}
Mili	m	10^{-3}
Mikro	μ	10^{-6}
Nano	n	10^{-9}
Piko	p	10^{-12}
Femto	f	10^{-15}

KONVERSI SATUAN

VOLUME	1 liter = 1000 cm^3 = 10^{-3} m^3
PERCEPATAN	1 ft/s^2 = 0,3048 m/s^2
PANJANG	1 A = 1 x 10^{-10} m 1 ft = 0,3048 m 1 in = 2,54 x 10^{-2} m 1 mile = 1609 m 1 mil = 2,54 x 10^{-5} in 1 ft = 12 in
GAYA	1 dyne = 10^{-5} N 1 lb = 4,448 N
DAYA	1 BTU/s = 1054 W 1 kal/s = 4,184 W 1 ft.lb/s = 1,356 W 1 hp = 746 W
ENERGI	1 BTU = 1054 Joule 1 kal = 4,184 Joule 1 erg = 10^{-7} Joule 1 ft.lb = 1,356 Joule 1 kWh = 3,6 x 10^6 Joule

KONVERSI SATUAN

Faktor Konversi dari satuan US ke SI

1 Cubic inch (in^3)	=	16.387	Cubic centimeters (cc)
1 Foot (ft)	=	0.3048	Meters (m)
1 Horsepower (hp)	=	745.699	Watts (W)
1 Inch (in)	=	0.0254	Meters (m)
1 Mile	=	1609.344	Meters (m)
1 Pound force (lb)	=	4.4482	Newton (N)
1 Pound mass (lbm)	=	0.4536	Kilograms (kg)
1 Pound foot (lb-ft)	=	1.3558	Newton-meters (N-m)
	=	1.3558	Joules (J)
1 Pound-foot/second (lb-ft/s)	=	1.3558	Watts (W)
1 Pound-inch (lb-in)	=	0.1128	Newton-meters (N-m)
	=	0.1128	Joules (J)
1 Pound-inch/second (lb-in/s)	=	0.1128	Watts (W)
1 Revolution/minute (rpm)	=	0.1047	radians/second (rad/sec)

BESARAN DAN SISTEM SATUAN

Rules for Use. Here are a few of the important rules that describe the proper use of the various SI symbols:

- Quantities defined by several units which are multiples of one another are separated by a *dot* to avoid confusion with prefix notation, as indicated by $N = kg \cdot m/s^2 = kg \cdot m \cdot s^{-2}$. Also, $m \cdot s$ (meter-second), whereas ms (milli-second).
- The exponential power on a unit having a prefix refers to both the unit *and* its prefix. For example, $\mu N^2 = (\mu N)^2 = \mu N \cdot \mu N$. Likewise, mm^2 represents $(mm)^2 = mm \cdot mm$.
- With the exception of the base unit the kilogram, in general avoid the use of a prefix in the denominator of composite units. For example, do not write N/mm, but rather kN/m; also, m/mg should be written as Mm/kg.
- When performing calculations, represent the numbers in terms of their *base or derived units* by converting all prefixes to powers of 10. The final result should then be expressed using a *single prefix*. Also, after calculation, it is best to keep numerical values between 0.1 and 1000; otherwise, a suitable prefix should be chosen. For example,

$$\begin{aligned}(50\ kN)(60\ nm) &= [50(10^3)\ N][60(10^{-9})\ m] \\ &= 3000(10^{-6})\ N \cdot m = 3(10^{-3})\ N \cdot m = 3\ mN \cdot m\end{aligned}$$

BESARAN DAN SISTEM SATUAN

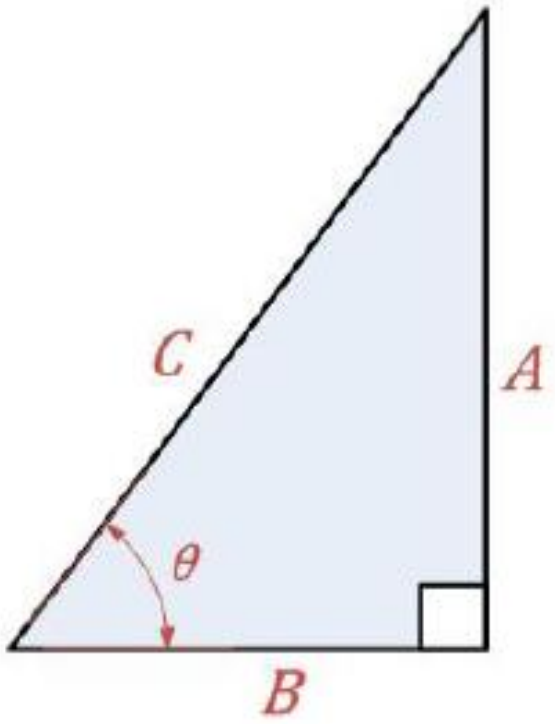
1. Hitunglah konversi 60 km/jam → .....m/dt →.....ft/dt

2. Konversikan menjadi satuan SI
   300 lb.s....?
   52 slug/ft^3 ..... ?

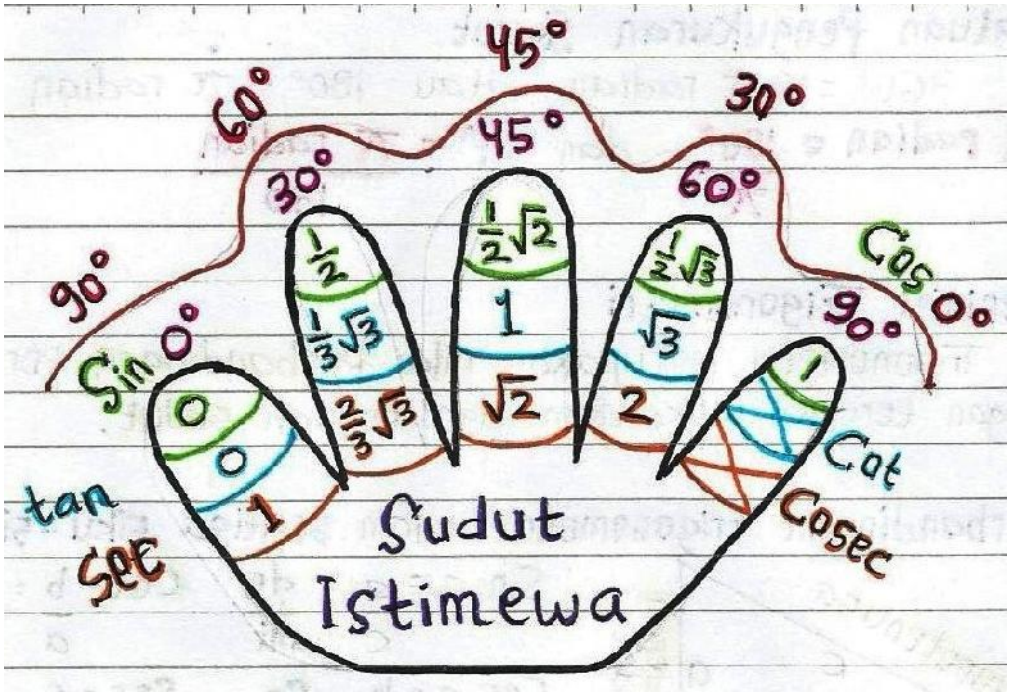
DINAMIKA MESIN

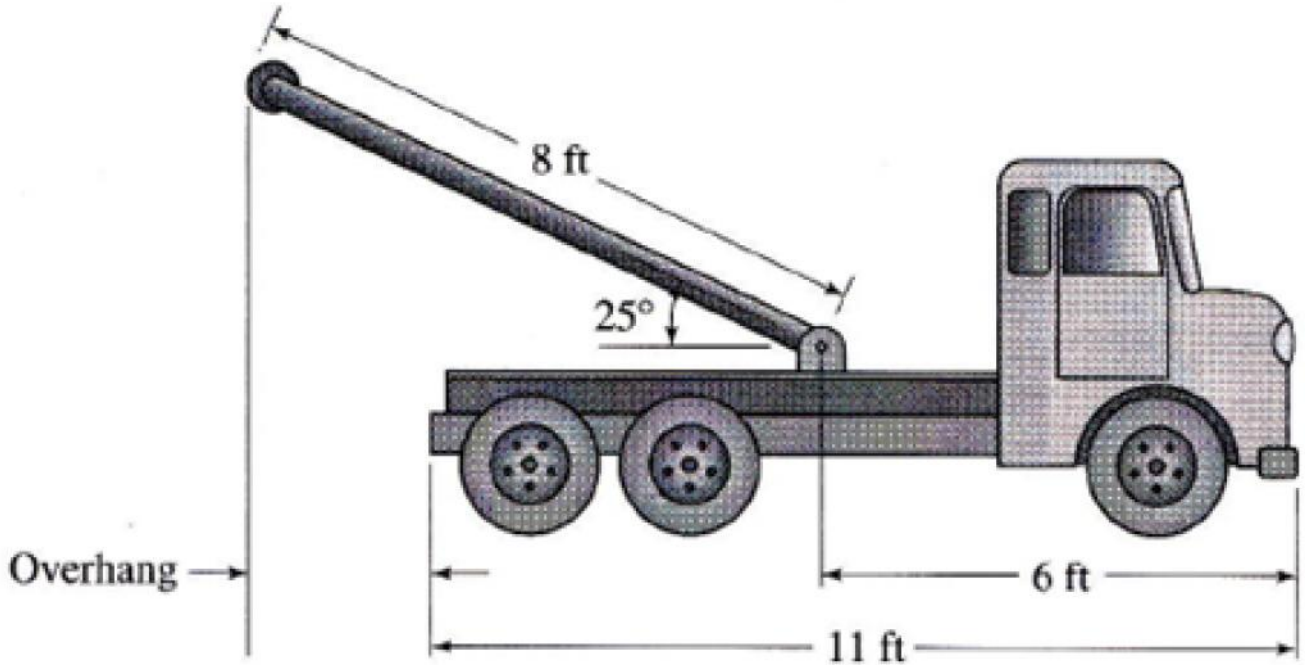
TRIGONOMETRI

TRIGONOMETRI

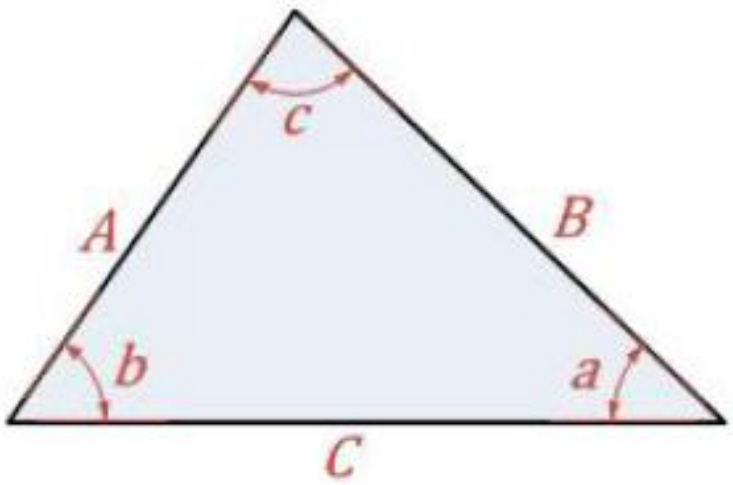


sin θ =.....?
cos θ =.....?
tan θ =.....?




8 ft
25°
Overhang
6 ft
11 ft

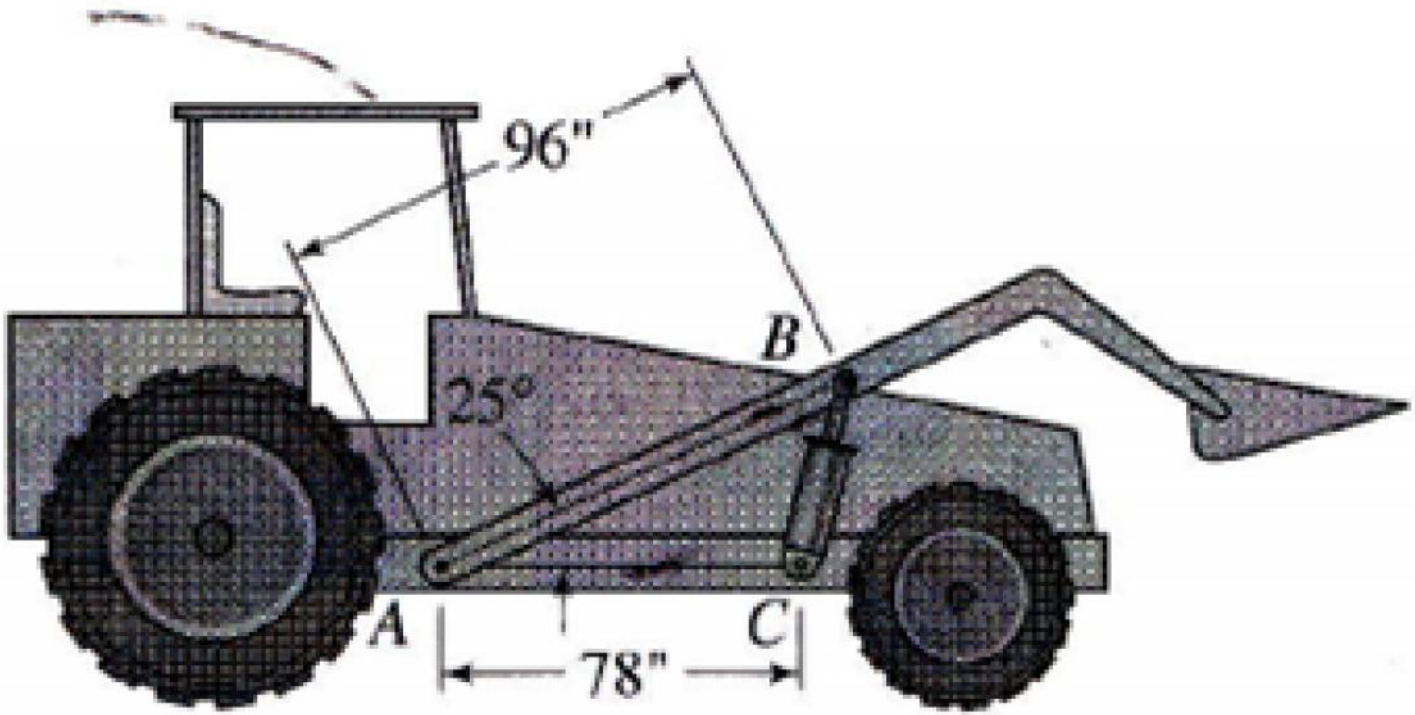
ATURAN SINUS COSINUS



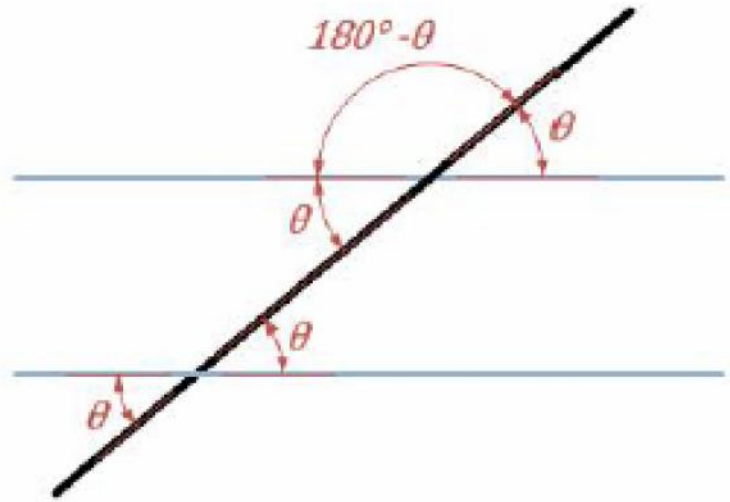
$$\frac{A}{\sin a} = \frac{B}{\sin b} = \frac{C}{\sin c}$$

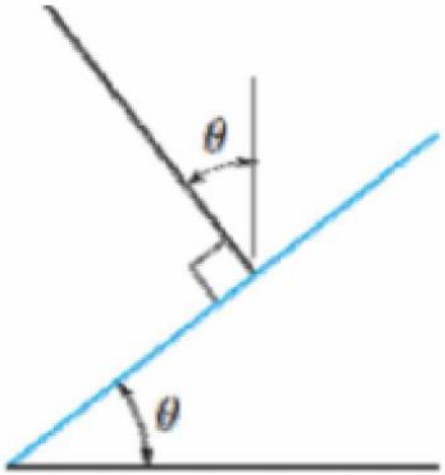
Aturan Cosinus

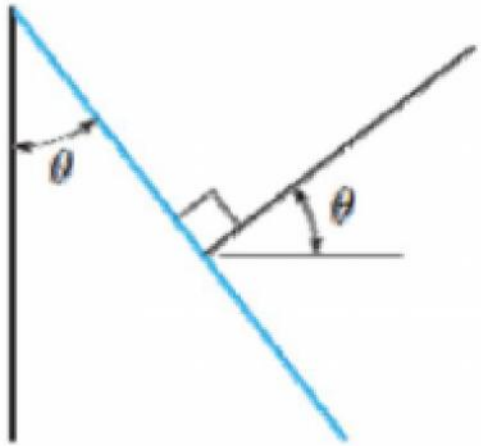
$$C = \sqrt{A^2 + B^2 - 2AB\cos c}$$


96"
B
25°
A
C
78"

SUDUT





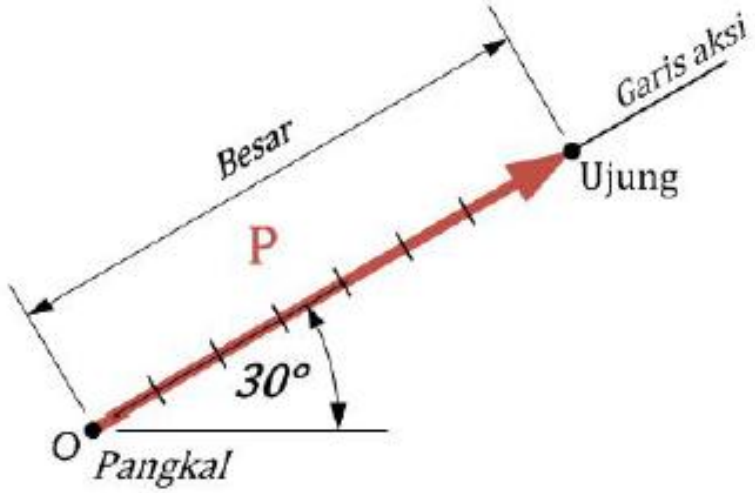


OPERASI VEKTOR

OPERASI VEKTOR

- **Skalar** : besaran yang hanya memiliki besar saja (jarak, luas)
- **Vektor** : besaran yang memiliki besar dan arah. (kecepatan, gaya, percepatan)

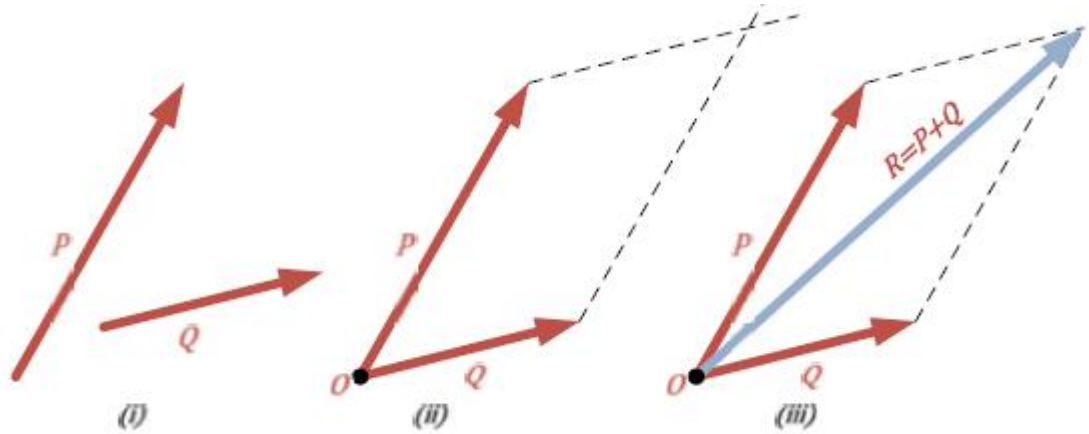
Vektor dapat dinyatakan dengan sebuah garis lurus dengan arah panah, dimana panjang garis menunjukkan besarnya dalam skala tertentu.



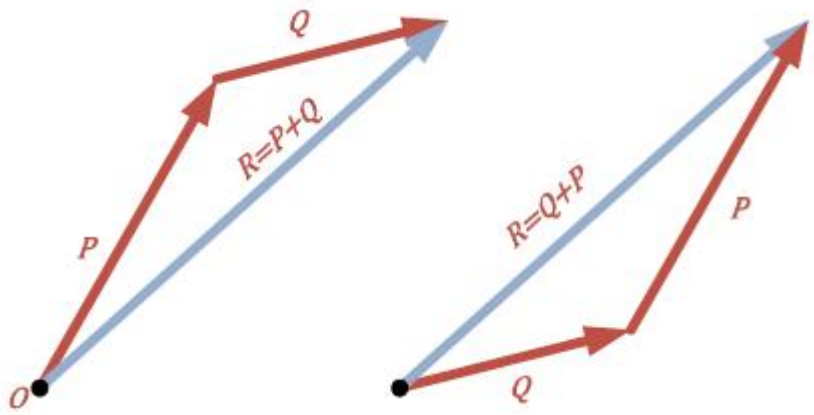
Penulisan dengan cetak tebal **P**, atau simbol panah di atas vektor $\vec{P}$

PENJUMLAHAN VEKTOR

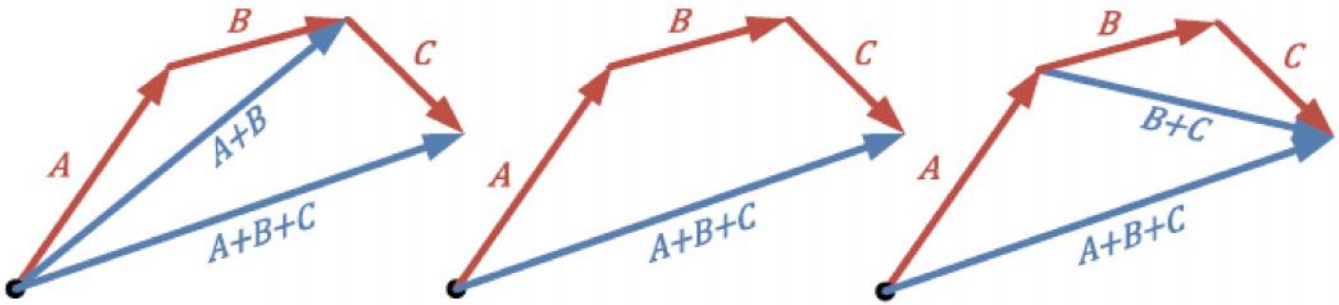
Aturan JajaranGenjang



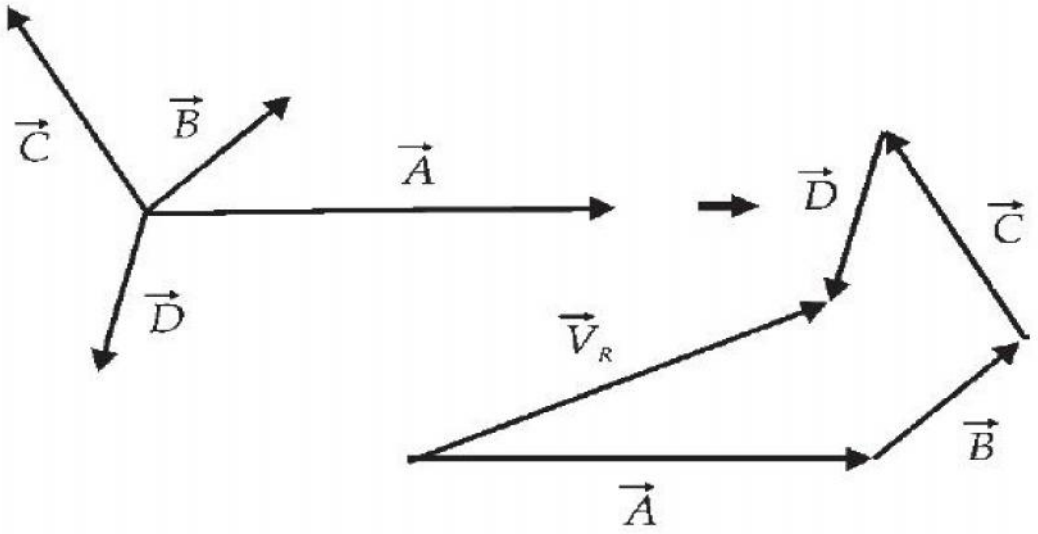
Aturan Segitiga



PENJUMLAHAN VEKTOR yang SEBIDANG

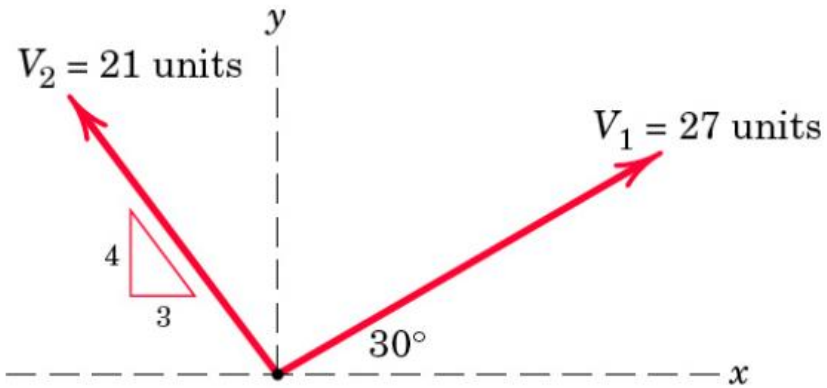


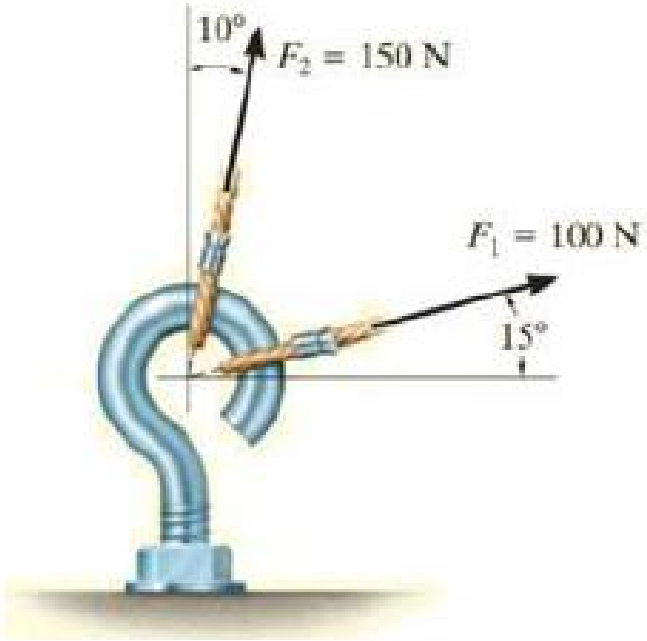
Asosiatif : $\vec{A}+\vec{B}+\vec{C}=\left(\vec{A}+\vec{B}\right)+\vec{C}=\vec{A}+\left(\vec{B}+\vec{C}\right)$

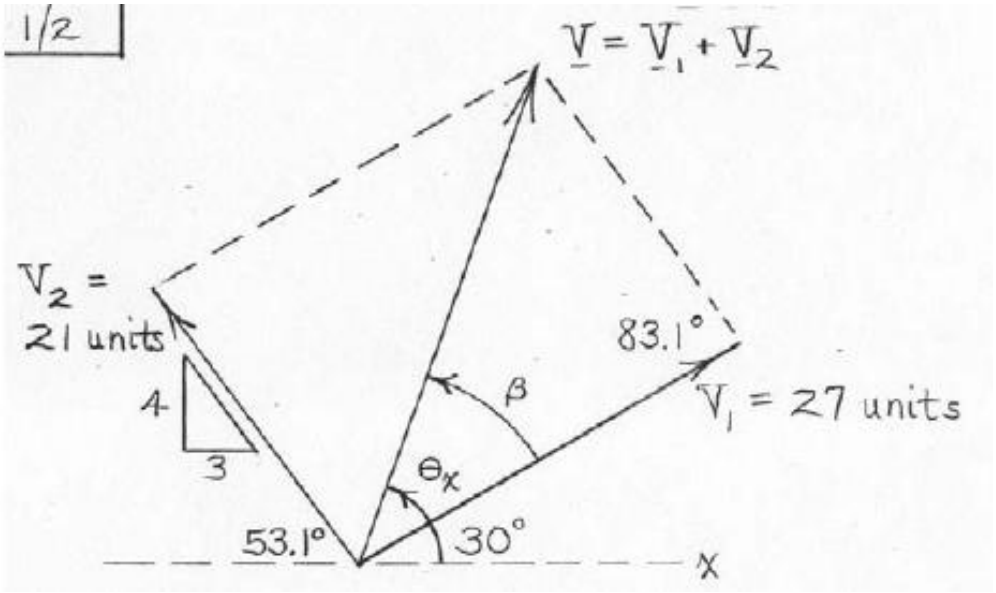


CONTOH SOAL

Tentukan besar dan arah Resultante, secara **ANALITIS** maupun **GRAFIS.!**







Metode Grafis:

V = 32 unit dan $\theta_x = 70^0$

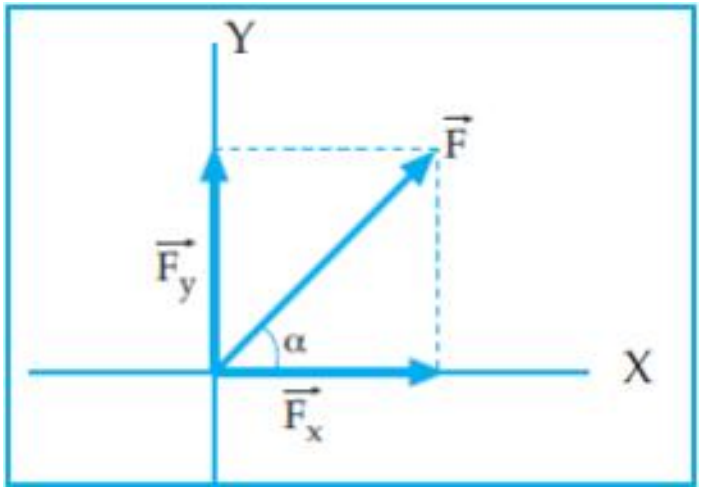
Metode Matematis:

$$V = \sqrt{27^2 + 21^2 - 2 \text{ x } 27 \text{ x } 21 \text{ x } \cos 83{,}1} = 32{,}2 \text{ unit}$$

$$\frac{\sin \beta}{21} = \frac{\sin 83{,}1}{32{,}2} \longrightarrow \beta = 40{,}4$$

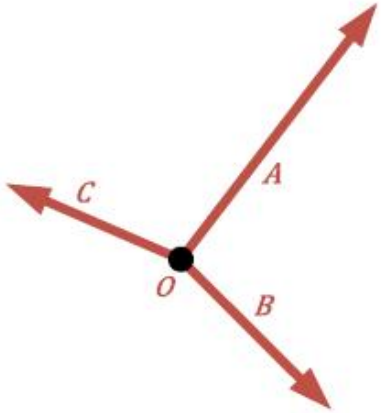
$$\theta x = \beta + 30^0 = 40{,}4^0 + 30^0 = 70{,}4^0 \text{ unit}$$

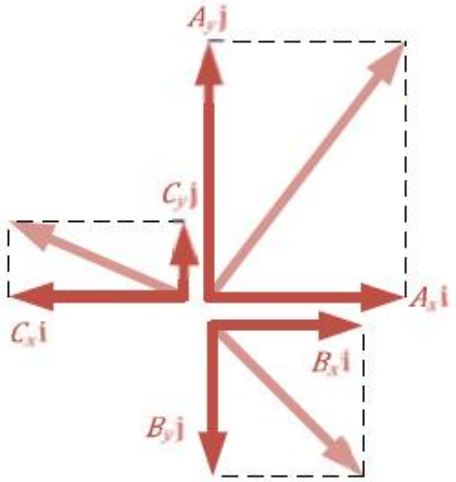
PENGURAIAN VEKTOR



F_x = ...?

F_y = ...?



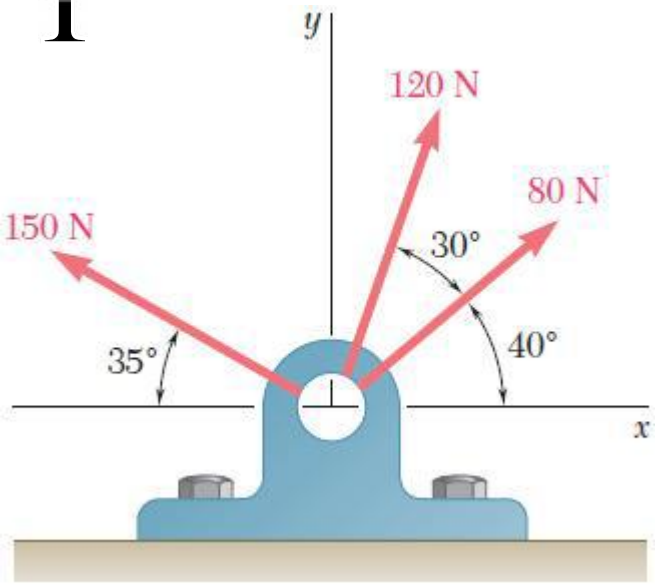


$$\vec{D} = \vec{A} + \vec{B} + \vec{C}$$

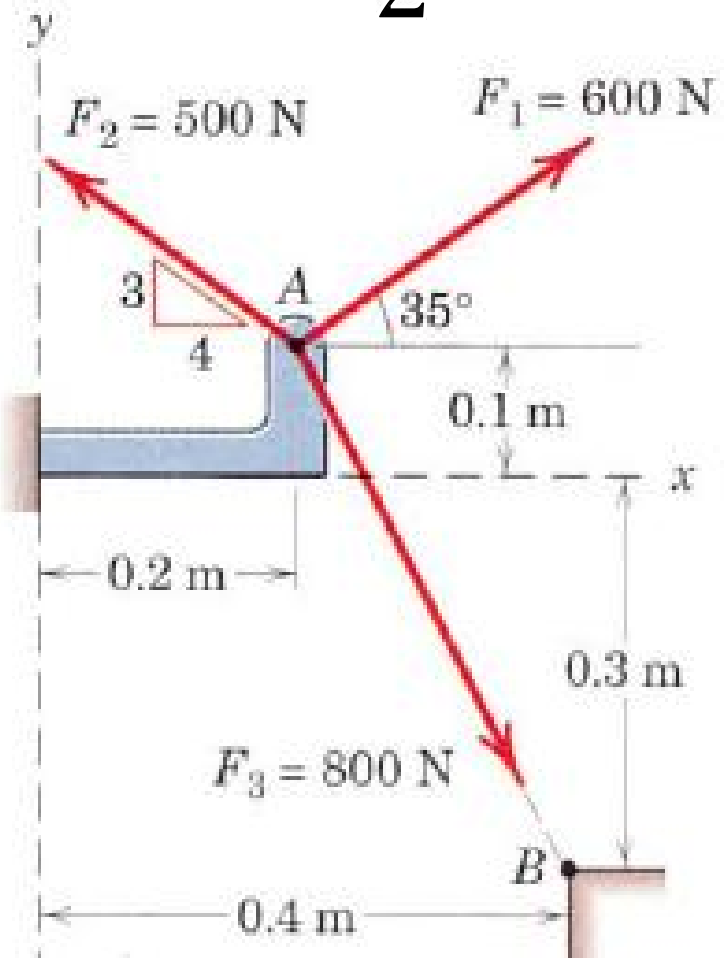
CONTOH SOAL-2

Tentukan besar dan arah Resultante, secara **ANALITIS...!**

1



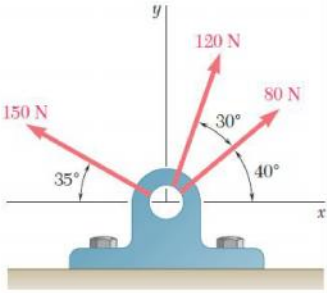
2



Penyelesaian secara analitis

Uraikan masing-masing vektor menjadi komponen-komponen skalar-nya sehingga dapat dijumlahkan

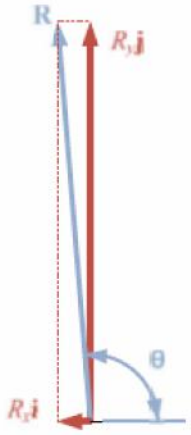
Gaya	Besar Gaya (N)	θ	Komponen x (N) $F\cos\theta$	Komponen y (N) $F\sin\theta$
F_1	80	40	61,3	51,4
F_2	120	70	41,0	112,8
F_3	150	145	-122,9	86,0
Σ			R_x = -20,6	R_y = 250,2



Sehingga besarnya resultan gaya adalah

$$R=\sqrt{R_x^2+R_y^2}=\sqrt{(-20,6)^2+250,2^2}$$

$$\vec{R}=-251,0\ \text{N}$$



Arah dari vektor resultan $\vec{R}$ dinyatakan dengan sudut θ yang besarnya

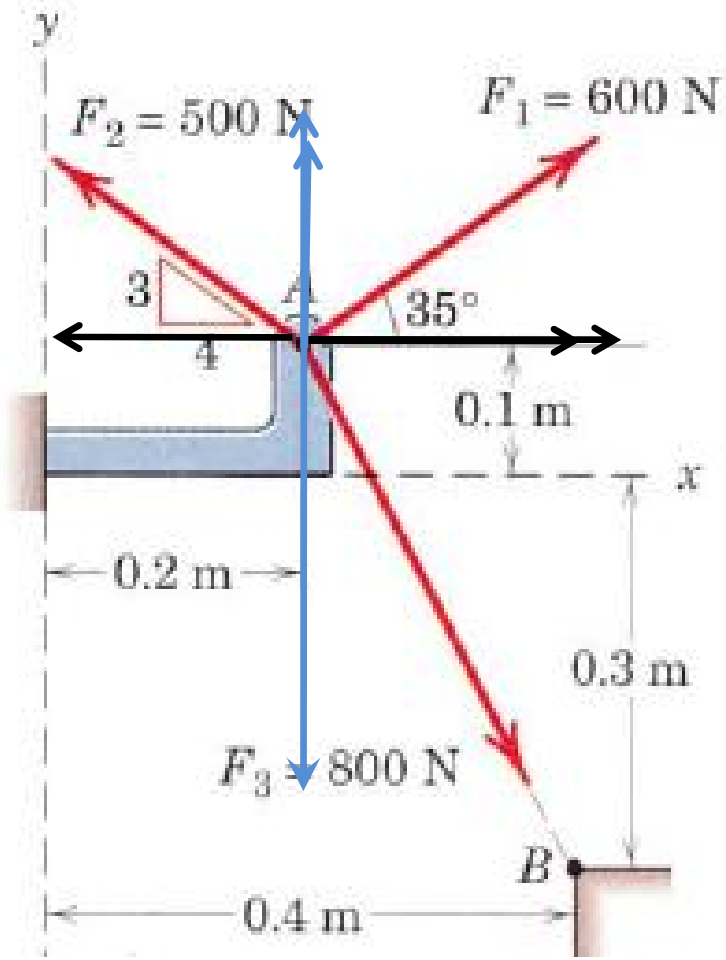
$$\theta=\arctan\frac{F_y}{F_x}=\arctan\left(\frac{250,2}{-20,6}\right)=\arctan(-12,1)$$

$$\theta=-85,3°$$

Perhatikan pembilang dan penyebut dari fungsi arctan. Harga Sinus positif dan Cosinus negatif menunjukkan kuadaran II. Sehingga sudut θ yang sesuai adalah

$$\theta=-85,3°+180°=94,7°$$

b) ΣF_x dan ΣF_y



$$\Sigma F_x = F_{1x} + F_{3x} + F_{2x}$$

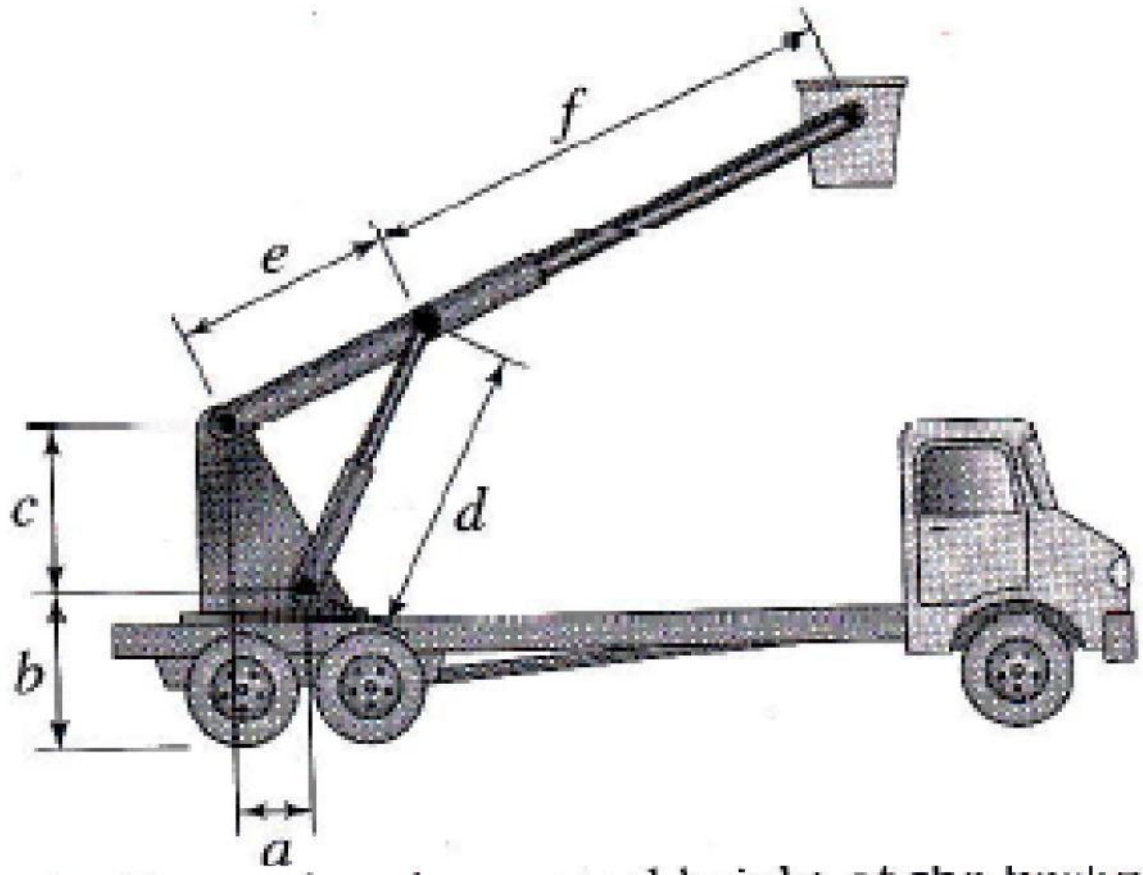
$$= 491 + 358 - 400$$

$$= 449 \text{ N}$$

$$\Sigma F_y = F_{1y} + F_{2y} + F_{3y}$$

$$= 344 + 300 - 716$$

$$= -72 \text{ N}$$



3–18. Determine the vertical height of the basket in Fig. P3.18 when $a = 24$ in., $b = 36$ in., $c = 30$ in., $d = 60$ in., $e = 6$ ft, and $f = 10$ ft.

3–19. For the lift described in Problem 3–18, determine the vertical height of the basket when the hydraulic cylinder is shortened to 50 in.