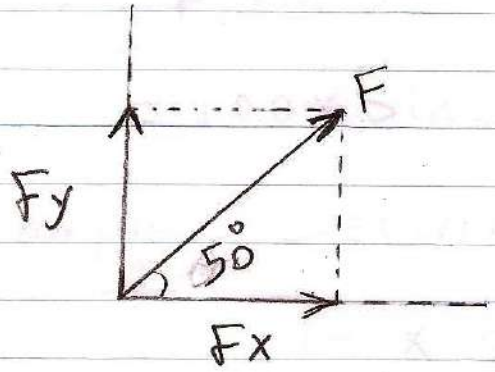
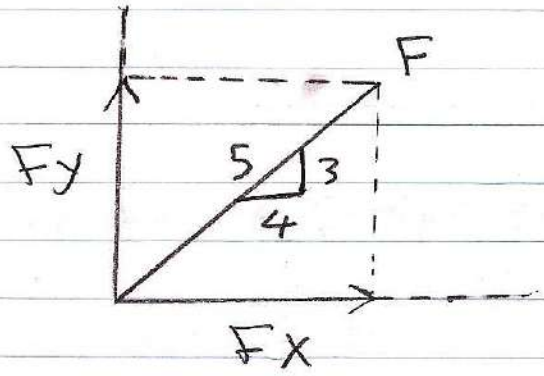
Composition & Resolution of forces

Composition: The process of replacing a force system by its Resultant

Resolution: The process of replacing a force by its Components





$Fx = F \cos 50$

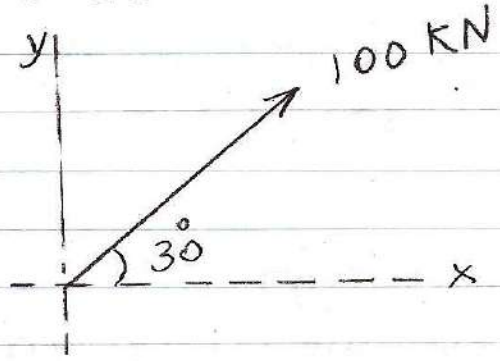
$Fy = F \sin 50$

$Fx = \frac{4}{5} F$

$Fy = \frac{3}{5} F$

$$F = \sqrt{Fx^2 + Fy^2}$$

Example Determine the force Components in x and y directions



$F_x = F \cos\theta$

$= 100 * \cos 30$

$= 86.603 \text{ KN}$

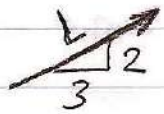
$F_y = F \sin\theta$

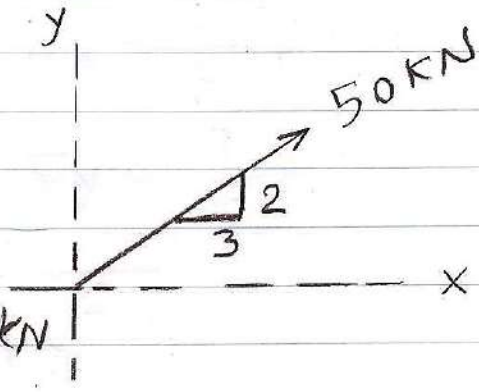
$= 100 * \sin 30 = 50 \text{ KN}$

Example Determine the force components in x and y directions

$L = \sqrt{2^2 + 3^2}$

$= 3.606$





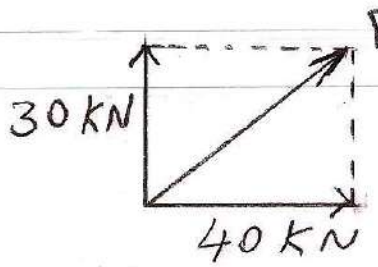
$F_x = \frac{3}{3.606} * 50 = 41.597 \text{ KN}$

$F_y = \frac{2}{3.606} * 50 = 27.732 \text{ KN}$

Example Determine the force F

$F = \sqrt{F_x^2 + F_y^2}$

$= \sqrt{(40)^2 + (30)^2} = 50 \text{ KN}$



Moment of a force

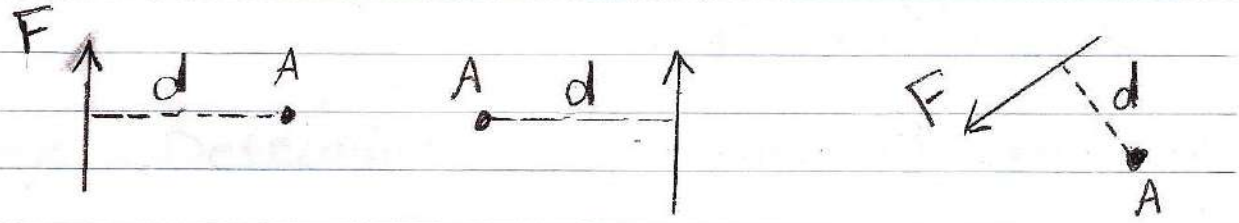
Moment = Force * distance

$M = F * d$

N.m, KN.m, ----

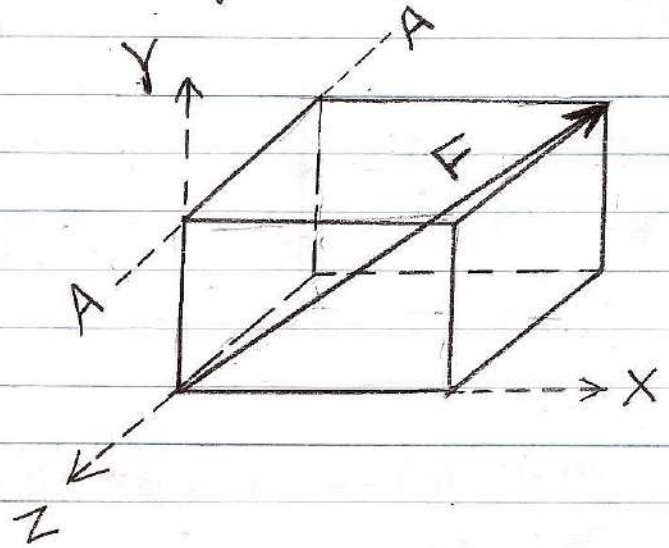
lb.ft, ----

2-D M with respect to point A

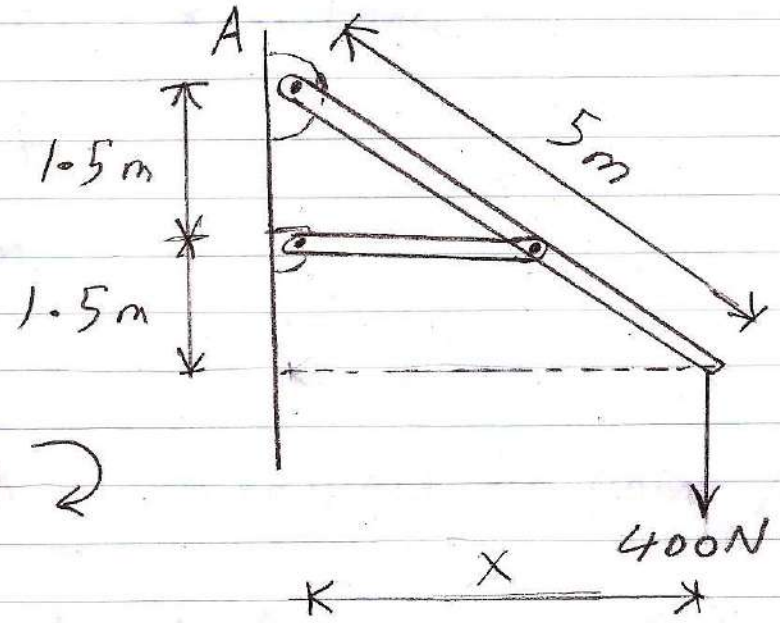


$M = Fd$ ↻ CW $M = Fd$ ↺ CCW $M = Fd$ ↺ CCW

3-D M with respect to axis A-A



Ex Determine the Moment of the force with respect to the point A



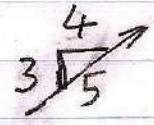
$5 = \sqrt{3^2 + X^2}$

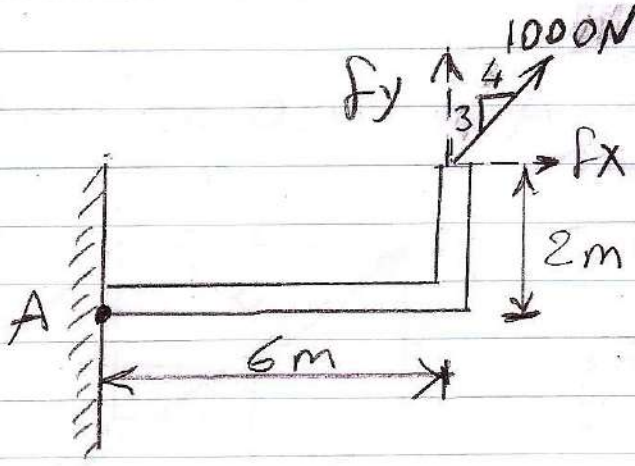
$X = 4m$

$M = 400 * 4$

$= 1600\ N.m$ ↷

Ex Determine the Moment of the force with respect to the point A





$Fx = \frac{4}{5} * 1000$

$= 800\ N$

$Fy = \frac{3}{5} * 1000$

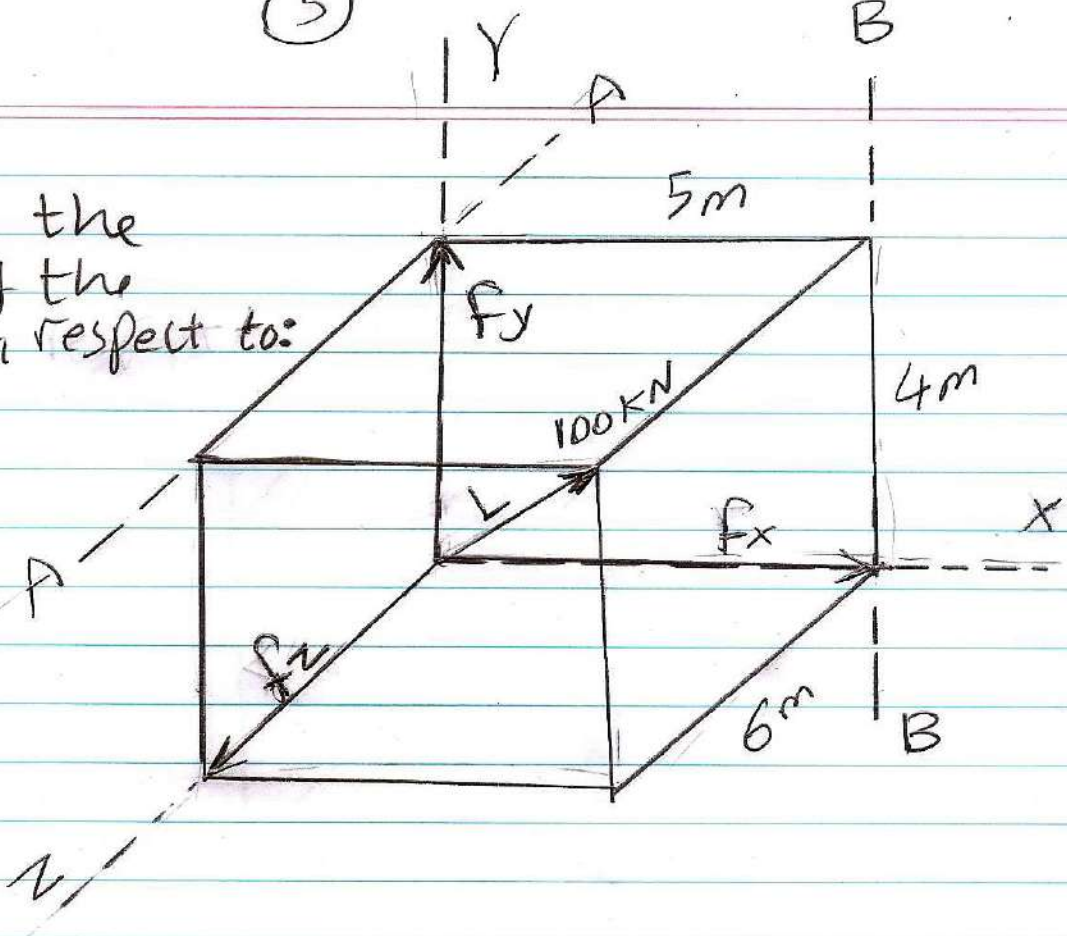
$= 600\ N$

$M = 800 * 2 - 600 * 6 = -2000\ N.m$

$= 2000\ N.m$ ↶

EX

Determine the Moment of the force with respect to:
- X axis
- A-A axis
- B-B axis



$$L = \sqrt{4^2 + 5^2 + 6^2} = 8.775\ m$$

$$fx = \frac{5}{8.775} * 100 = 56.98\ KN$$

$$fy = \frac{4}{8.775} * 100 = 45.584\ KN$$

$$fz = \frac{6}{8.775} * 100 = 68.376\ KN$$

$$M_X = 0$$

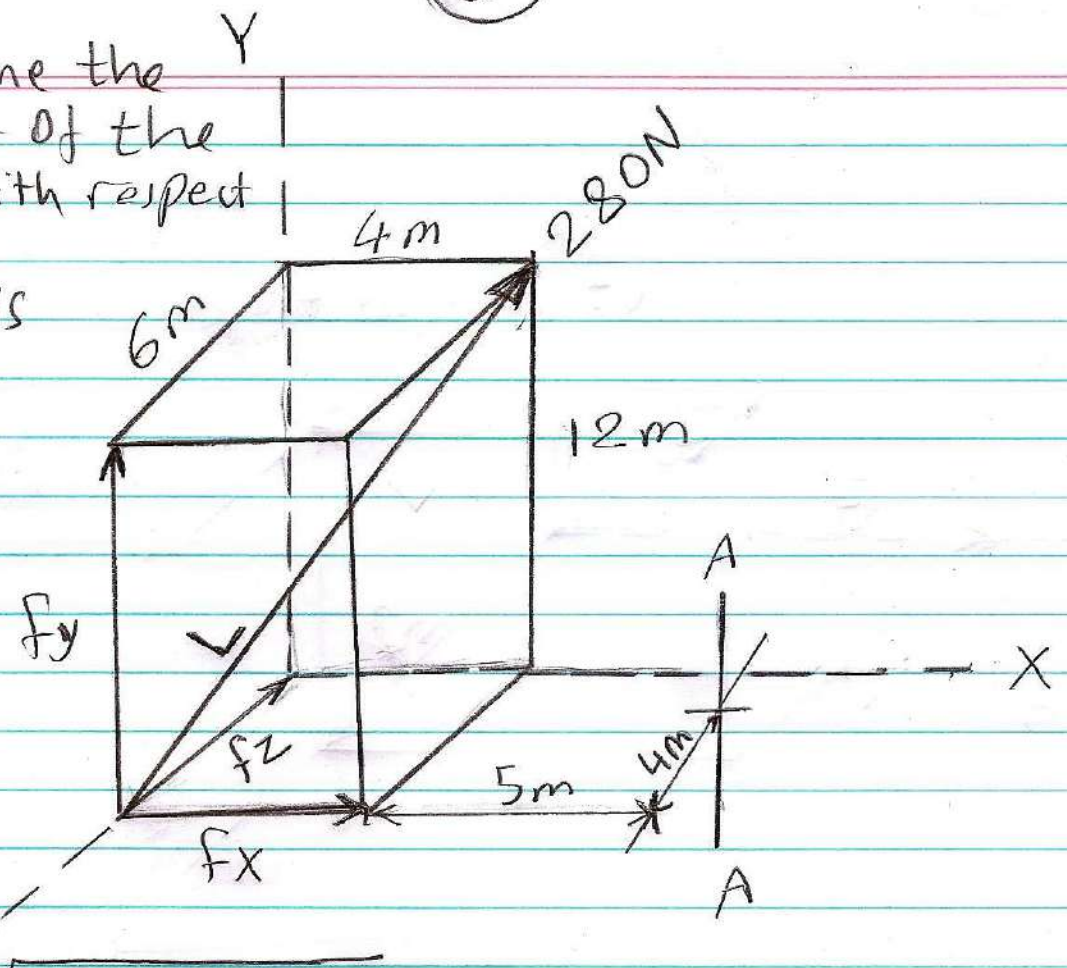
$$M_{A-A} = -56.98 * 4 = -227.92\ KN.m$$
$$= 227.92\ KN.m \circlearrowleft$$

$$M_{B-B} = -68376 * 5 = -341.88\ KN.m$$
$$= 341.88\ KN.m \circlearrowleft$$

Ex

Determine the Moment of the force with respect to:

A-A axis
X axis
Y axis
Z axis



$$L = \sqrt{4^2 + 6^2 + 12^2} = 14\,m$$

$$fx = \frac{4}{14} * 280 = 80\,N$$

$$fy = \frac{12}{14} * 280 = 240\,N$$

$$fz = \frac{6}{14} * 280 = 120\,N$$

$$M_{A-A} = -80 * 4 + 120 * 9 = 760\ N.m \circlearrowright$$

$$M_x = 240 * 6 = 1440\ N.m \circlearrowright$$

$$M_y = -80 * 6 = -480\ N.m = 480\ N.m \circlearrowleft$$

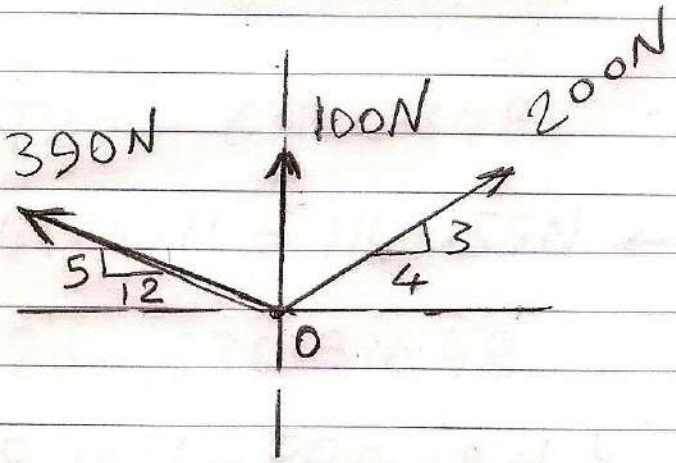
$$M_z = 0$$

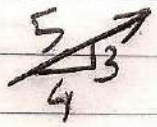
Resultant

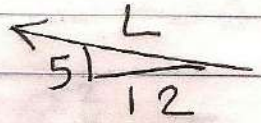
Resultant of Concurrent, Coplanar force System

Ex

Determine the resultant of the forces







$$L = \sqrt{5^2 + 12^2} = 13$$

for 200N

$$Fx = \frac{4}{5} * 200 = 160N \rightarrow$$

$$Fy = \frac{3}{5} * 200 = 120N \uparrow$$

for 390N

$$fx = \frac{12}{13} * 390 = 360N \leftarrow$$

$$fy = \frac{5}{13} * 390 = 150N \uparrow$$

for 100N $fx = 0$, $fy = 100N \uparrow$

$$R_x = \Sigma Fx$$
$$= 160 - 360$$
$$= -200N$$
$$= 200N \leftarrow$$

$$R_y = \Sigma Fy$$
$$= 120 + 150 + 100$$
$$= 370N \uparrow$$

$$R = \sqrt{R_x^2 + R_y^2}$$
$$= \sqrt{(200)^2 + (370)^2}$$
$$= 420.6\ N$$

$$\tan\theta = \frac{R_y}{R_x} = \frac{370}{200}$$

$$\theta = 61.6^\circ$$