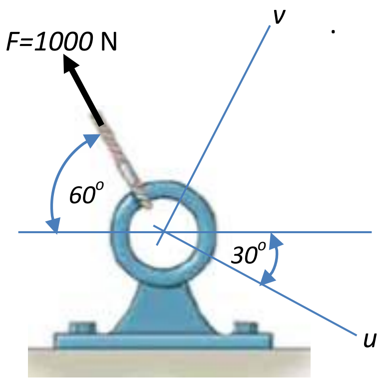
Mansoura University
Faculty of Engineering
Eng. Math. & Physics Dept.

Model : A

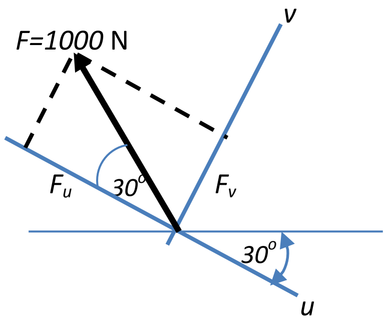
Engineering Mechanics I
Midterm Exam (2011-2012)
Time: One hour

Instructors: Prof. Dr. Bishri Abdel-Mo'emen, Assoc. Prof. Ayman Ashour, and Dr. Waleed Albeshbeshy

Student Name: .... :الإسم	*Section No*: ....

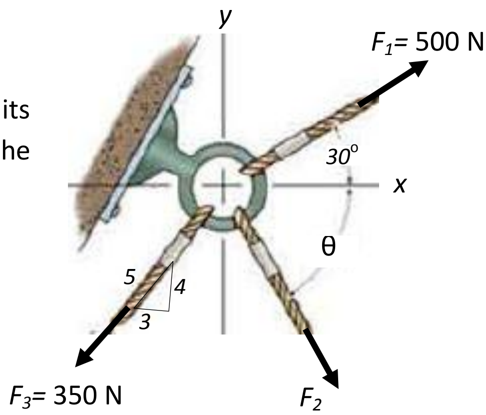


Question 1: (*5 Points*)
Determine the *u* and *v* components of the 1000 N force shown in Figure.



$F_u = -1000 \cos 30^o$
$= -866$ N

$F_v = 1000 \sin 30^o$
$= 500$ N



Question 2: (*5 Points*)
If the magnitude of the resultant force acting on the eyebolt is 800 N and its direction measured clockwise from the positive *x* axis is 60°, determine the magnitude of F_2 and the angle θ.

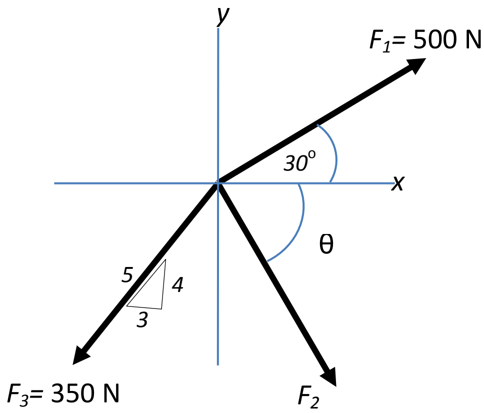
Given: $R_x = 800 \cos 60^o = 400$ N
$R_y = 800 \sin 60^o = 692.82$ N

$R_x = 500 \cos 30^o + F_2 \cos\theta - 350\ (3/5)$
$400 = 433 + F_2 \cos\theta - 210$
$F_2 \cos \theta = 177$ .... (1)

$R_y = 500 \sin 30^o - F_2 \sin\theta - 350\ (4/5)$
$692.82 = 250 - F_2 \sin\theta - 280$
$F_2 \sin \theta = -722.82$ .... (2)

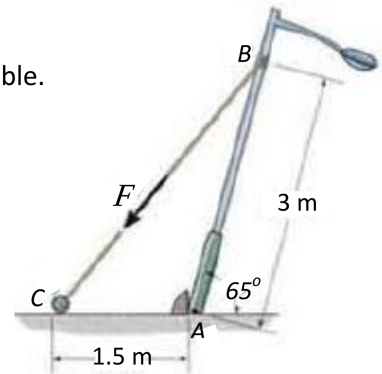
Dividing (2) by (1),
$\tan \theta = (-722.82)/(177) = -4.08$
$\therefore\ \theta = -76.24^o$ (the negative means that F in the first quadrant)

Substituting in either (1) or (2)
$\therefore\ F = 744.18\ N$



Question 3: (*5 Points*)

In order to raise the lamp post from the position shown, force **F** is applied to the cable. If *F* equals 1000 N, determine the moment produced by **F** about point *A*.



From Triangle ABC: The cosine law gives

$$\overline{CB} = \sqrt{3^2 + 1.5^2 - 2(1.5)(3)cos115}$$
$$= \sqrt{15.054} = 3.88$$

From the sine law:

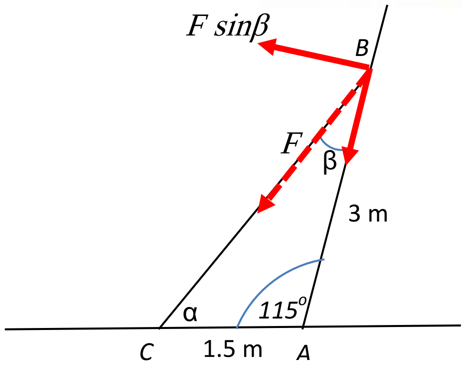
$$\frac{1.5}{sin\beta} = \frac{3.88}{sin115}$$

$$\therefore\ sin\beta = 0.35$$

The moment about A:

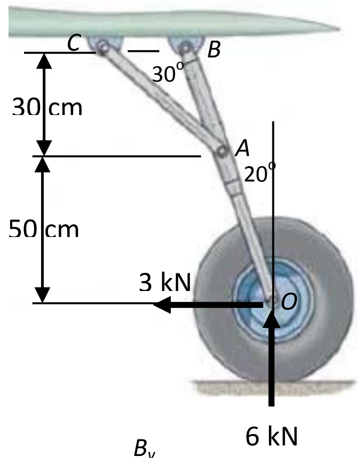
$M_A = (F\ sin\beta)(3) = 1000 \times 0.35 \times 3$

= 1051 N.m



Question 4: (*5 Points*)

As an airplane's brake are applied, the nose wheel exerts two forces on the end of the landing gear as shown. Determine the horizontal and vertical components of reaction at the pin *B* and the force in strut *AC*.



From the FBD:

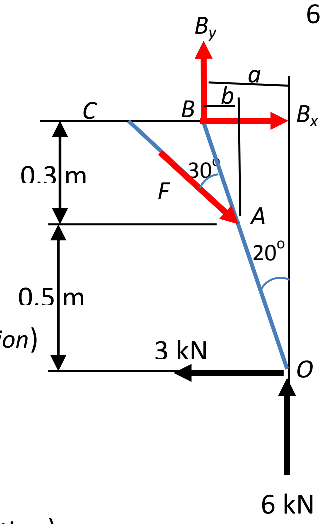
a=0.8 tan 20°= 0.291 m

b= 0.3 tan 20°=0.109 m

Equilibrium conditions:

$\sum M_B = 0;$

$$6 \times a - 3 \times 0.8 + Fsin50 \times 0.3 - Fcos50 \times b = 0$$
$$6 \times 0.291 - 3 \times 0.8 + Fsin50 \times 0.3 - Fcos50 \times 0.109 = 0$$
$$0.16\ F = 0.653$$
$$\therefore \quad F = 4.081\ \ kN$$



Equilibrium conditions:

$\sum F_x = 0;$

$$B_x + Fsin50\ - 3 = 0$$

$\therefore \quad B_x = 3 - 4.081\ sin50 = \ -0.126\ kN$ (*opposite to assumed direction*)

Equilibrium conditions:

$\sum F_y = 0;$

$$B_y - Fcos50 + 6 = 0$$

$\therefore \quad B_y = -6 + 4.081\ cos50 = \ -3.377\ kN$ (*opposite to assumed direction*)