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

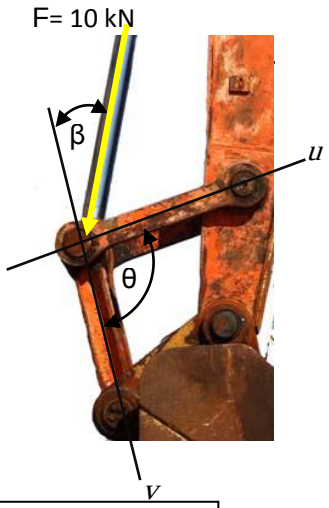
Model : C

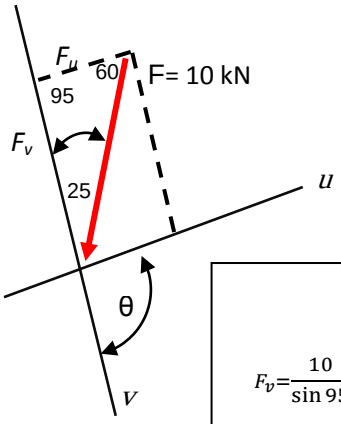
Engineering Mechanics I
Midterm Exam (2011-2012)
Time: One hour

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

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

Question 1: (*5 Points*)
Resolve the 10 kN force F in Fig. (P1) into components acting along the u and v axes and determine the magnitudes of these components. Take θ=95° and β=25°.





~~F_u= -10 cos 25°~~
~~= -9.063 N~~

~~F_v = 10 sin 25°~~
~~= 4.226 N~~

$$\frac{F_v}{\sin 60}=\frac{10}{\sin 95}$$

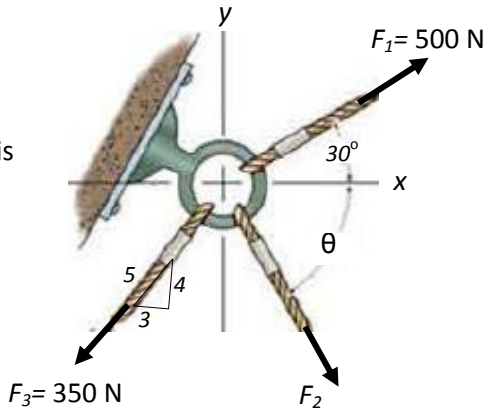
$$F_v=\frac{10}{\sin 95}\sin 60 = 8.693\ kN$$

$$\frac{F_u}{\sin 25}=\frac{10}{\sin 95}$$

$$F_u=\frac{10}{\sin 95}\sin 25 = 4.242\ kN$$

(in the negative *u* direction

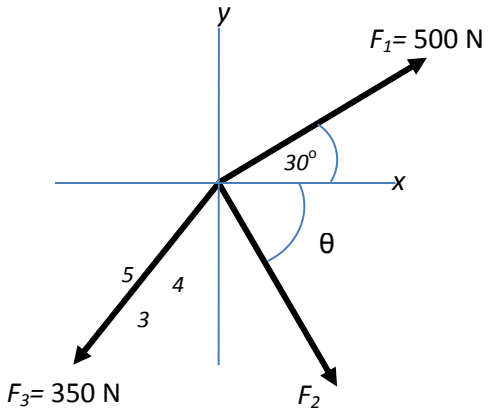
Question 2: (*5 Points*)
I If the magnitude of the resultant force acting on the eyebolt is 1000 N and is directed along the positive *x* axis, determine the magnitude of F_2 and the angle θ.



Given: R_x= *1000* N
R_y= *0*

$R_x = 500\cos 30^o + F_2\cos\theta - 350$ (3/5)
$1000 = 433 + F_2\cos\theta - 210$
$F_2\cos\theta = 777$ N ..... (1)

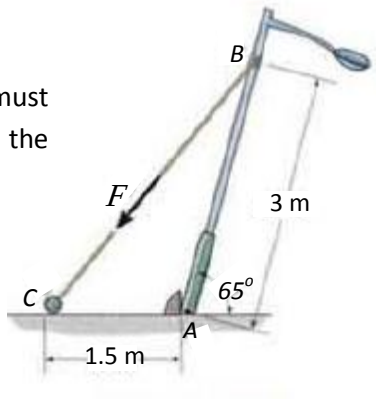
$R_y = 500\sin 30^o - F_2\sin\theta - 350$ (4/5)
$0 = 250 - F_2\sin\theta - 280$
$F_2\sin\theta = -30$ ..... (2)



Dividing (2) by (1),
$\tan\theta = (-30)/(777) = -0.039$
$\therefore\ \theta = -2.21^o$ (the negative means that F_2 in the first quadrant)
Substituting in either (1) or (2)
$\therefore\ F_2 = 777.6\ N$

Question 3: (*5 Points*)

In order to raise the lamp post from the position shown, the force **F** on the cable must create a counterclockwise moment of 2100 N.m about point *A.* Determine the magnitude of **F** that must be applied to the cable



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:

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

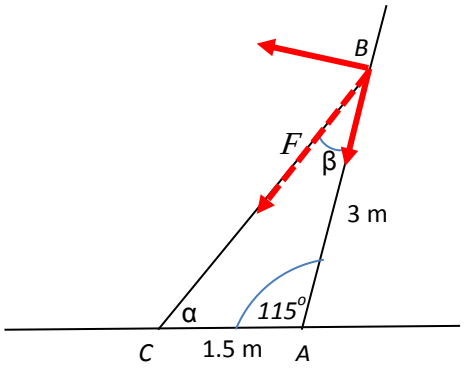
$$\therefore sin\beta = 0.35$$

The moment about A:

$M_A = (F\ sin\beta\ )(3)$

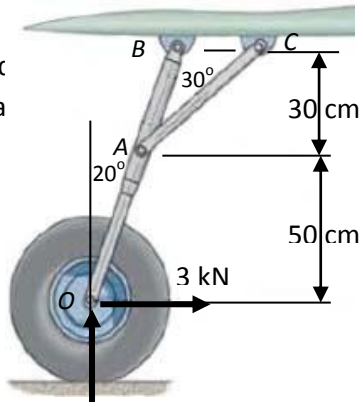
$\therefore$ $2100 = F \times 0.35 \times 3$

$\therefore$ $F = 2000$ N



Question 4: (*5 Points*)

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



From the FBD:

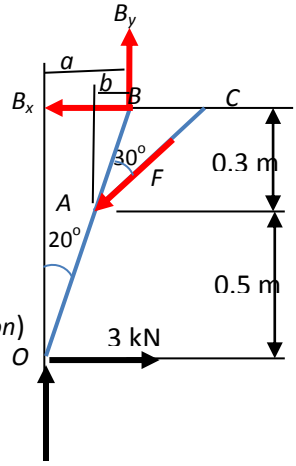
a=0.8 tan 20°= 0.291 m

b= 0.3 tan 20°=0.109 m

Equilibrium conditions:

$\sum M_B = 0;$

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



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*)