CIV100 - SECTION 3 - MECHANICS – QUIZ #1 – 1 HOUR – SEPTEMBER 29, 2016

READ CAREFULLY THE RULES:

No aids are permitted. Only one of the three specified non-programmable calculators are permitted:
- CasioFX991 - SharpEL520

Answers must include the appropriate units. Draw a Free Body Diagram (FBD) for each problem.
Use 5 significant digits (two decimal points for angles) in the calculations and 3 significant digits in the answers.

Family name: Given name: Student ID

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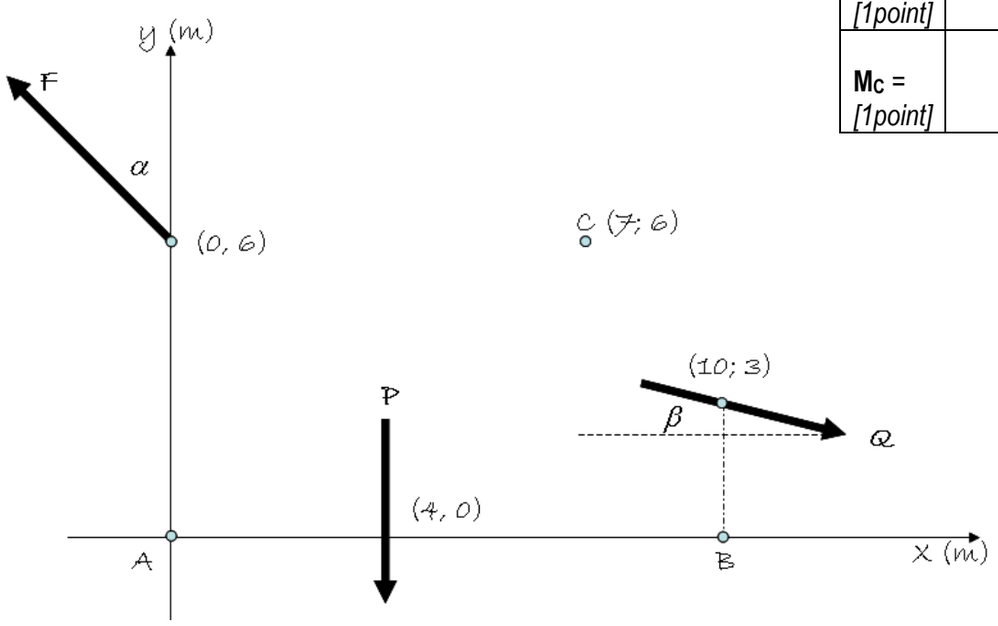
Question #1 ***[4 points]***

Using the Cartesian notation, calculate the resultant force of the system.
Determine the sum of the moments of forces **F, P, Q** about points A, B, C
Use one sketch for all calculations.
[Report the final answers in Cartesian form on the grid besides]
Assume:
F= 50 KN P= 20 KN Q= 30 KN
α=45 deg β=30 deg

R = *[1point]*	
M_A = *[1point]*	
M_B = *[1point]*	
M_C = *[1point]*	



$F = 50\,KN$ $P = 20\,KN$ $Q = 30\,KN$

$(0,6)$ $(4,0)$ $(10,3)$

$\alpha = 45^\circ$ $\beta = 30^\circ$

$\vec{F} = -50\sin 45^\circ \vec{i} + 50\cdot\cos 45^\circ \vec{j} = \left(-25\sqrt{2}\,\vec{i} + 25\sqrt{2}\,\vec{j}\right) KN$

$\vec{P} = \left(-20\,\vec{j}\right) KN$

$\vec{Q} = \left(30\cos 30\,\vec{i} - 30\sin 30\,\vec{j}\right) = \left(15\sqrt{3}\,\vec{i} - 15\,\vec{j}\right) KN$

$\vec{R} = \vec{F} + \vec{P} + \vec{Q} = \left(9.37\,\vec{i} + 0.355\,\vec{j}\right) KN$

$\circlearrowleft + \quad M_A = F_x \cdot 6 - P \cdot 4 - Q_x \cdot 3 - Q_y \cdot 10 = 95.8\ KN \cdot m$

$\vec{M}_A = \left(95.8\,\vec{k}\right) KN \cdot m$

$\circlearrowleft + \quad M_B = F_x \cdot 6 - F_y \cdot 10 + P \cdot 6 - Q_x \cdot 3 = -99.4\ KN \cdot m$

$\vec{M}_B = \left(-99.4\,\vec{k}\right) KN \cdot m$

$\circlearrowleft + \quad M_C = -F_y \cdot 7 + P \cdot 3 + Q_x \cdot 3 - Q_y \cdot 3 = -154.5\ KN \cdot m$

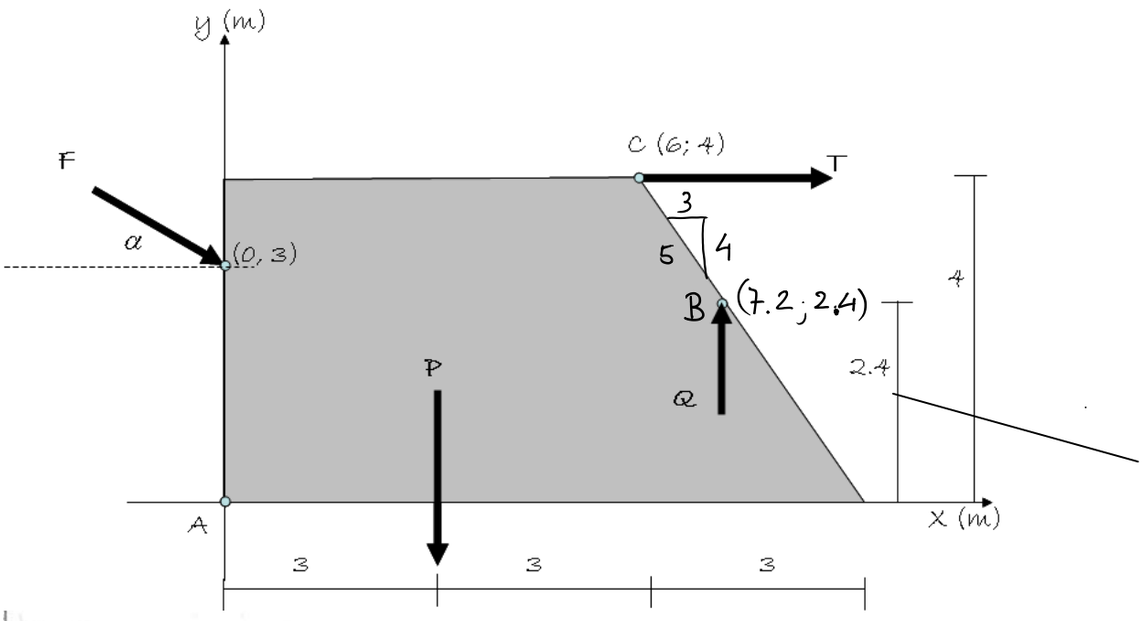
$\vec{M}_C = \left(-154.5\,\vec{k}\right) KN \cdot m$

Question #2 ***[5 points]***

Determine the equivalent resultant **R** to the system of forces and the location of its line of action with respect to the line y=2.
Calculate the sum of the moments of all forces about the point A.
Include appropriate sketches.
Assume:
F= 5000 N P= 10 KN Q= 12 KN T= 20KN
α=30 deg

[Report the final answers on the grid besides]

R = *[1point]*	
|R| = *[1point]*	
θ = *[1point]*	
x= *[1point]*	
$\mathbf{M_A}$ = *[1point]*	



$\vec{F} = \left[5.\frac{\sqrt{3}}{2}\vec{i} - 2.5\vec{j}\right]$ KN

$\vec{P} = \left[-10\vec{j}\right]$ KN

$\vec{Q} = \left[12\vec{j}\right]$ KN

$\vec{T} = \left[20\vec{i}\right]$ KN

$\vec{R} = \vec{F}+\vec{P}+\vec{Q}+\vec{T} = \left[24.33\,\vec{i} - 0.5\vec{j}\right]$ KN

$|R| = \sqrt{24.33^2 + 0.5^2} = 24.34$ KN

$\theta = \tan^{-1}\left(\frac{0.5}{24.33}\right) = 1.18°$

$B = (7.2; 2.4)$

$\circlearrowleft A \quad \Sigma M_A = -F_x \cdot 3 - P \cdot 3 - T \cdot 4 + Q \cdot 7.2$

$= -2.5\sqrt{3} \cdot 3 - 10 \cdot 3 - 20 \cdot 4 + 12 \cdot 7.2 = -36.6$ KN·m

$\Sigma M_A = \left(R_x \cdot 2 + R_y \cdot x\right) = -24.33 \cdot 2 - 0.5 \cdot x$

$\Rightarrow x = \frac{36.6 - 48.66}{0.5} = -24.14$ m

$\vec{M}_A = \left(-36.6\,\vec{k}\right)$ KN·m

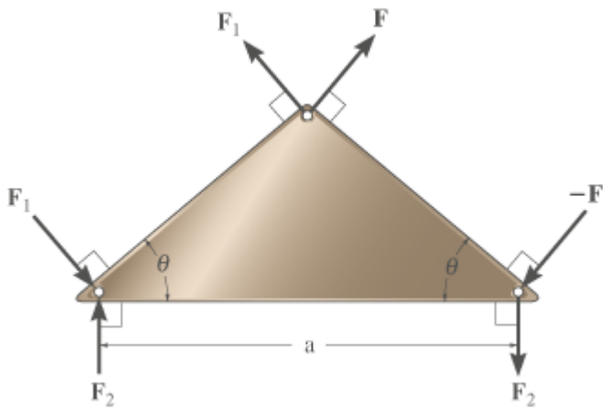
Question #3 ***[1 point]***

The ends of the triangular plate are subjected to three couples. Determine the magnitude of the force **F** so that the resultant couple moment is 400 N m clockwise.
Given:

F = *[1point]*	

$F_1 = 600$ N
$F_2 = 250$ N
$a = 1$ m
$\theta = 40°$

[Report the final answers on the grid besides]



$\overline{AB} = a = 1m$

$\overline{AC} = \overline{CB} = \dfrac{a}{2\cos\theta} = 0.6527\,m = b$

NOTE The two $\vec{F}_1$ form a couple moment with arm $= b$
The two $\vec{F}_2$ form a couple moment with arm $= a$
The two $\vec{F}$ form a couple moment with arm $= b$

$\vec{R} = 0$

$\circlearrowleft + \quad \Sigma M = -400\ N\cdot m = F_1 \cdot b - F \cdot b - F_2 \cdot a$

$\Rightarrow F = \dfrac{F_1 \cdot b - F_2 \cdot a + 400}{b} = \dfrac{600 \cdot 0.6527 - 250 + 400}{0.6527} = 829.8\,N = 830\,N$