CIV100 - SECTION 3-GB - 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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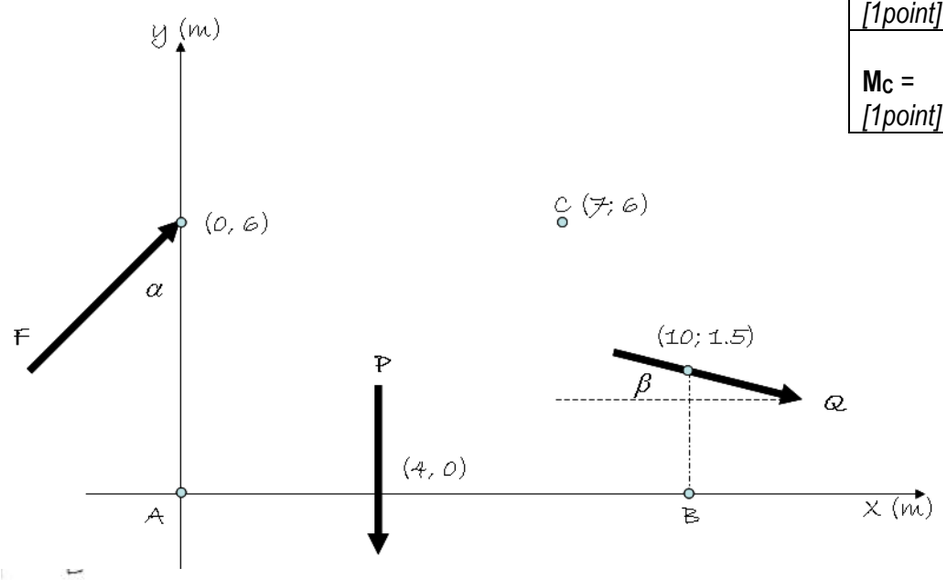
GB VERSION

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= 40 KN P= 20 KN Q= 30 KN
α=60 deg β=20 deg

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



GB VERSION

$F = 40\,KN \quad P = 20\,KN \quad Q = 30\,KN$

$(0,6) \quad (4,0) \quad (10, 1.5)$

$\alpha = 60° \quad \beta = 20°$

$\vec{F} = 40 \cdot \sin 60\,\vec{i} + 40\cos 60\,\vec{j} =$

$= (20\sqrt{3}\,\vec{i} + 20\,\vec{j})\,KN = (34.641\,\vec{i} + 20\,\vec{j})\,KN$

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

$\vec{Q} = (30\cos 20\,\vec{i} - 30\sin 20\,\vec{j})\,KN$

$\vec{R} = \vec{F} + \vec{P} + \vec{Q} = (62.832\,\vec{i} - 10.26\,\vec{j}) = (62.8\,\vec{i} - 10.3\,\vec{j})\,KN$

$\circlearrowleft M_A = -F_x \cdot 6 - P \cdot 4 - Q_x \cdot 1.5 - Q_y \cdot 10 = -432.74\ KN \cdot m$

$\vec{M}_A = (-432.7\,\vec{k})\,KN \cdot m$

$\circlearrowleft M_B = -F_x \cdot 6 - F_y \cdot 10 + P \cdot 6 - Q_x \cdot 1.5 = -330\ KN \cdot m$

$\vec{M}_B = (-330\,\vec{k})\,KN \cdot m$

$\circlearrowleft M_C = -F_y \cdot 7 + P_y \cdot 3 + Q_x \cdot 4.5 - Q_y \cdot 3 = 16.08\ KN \cdot m$

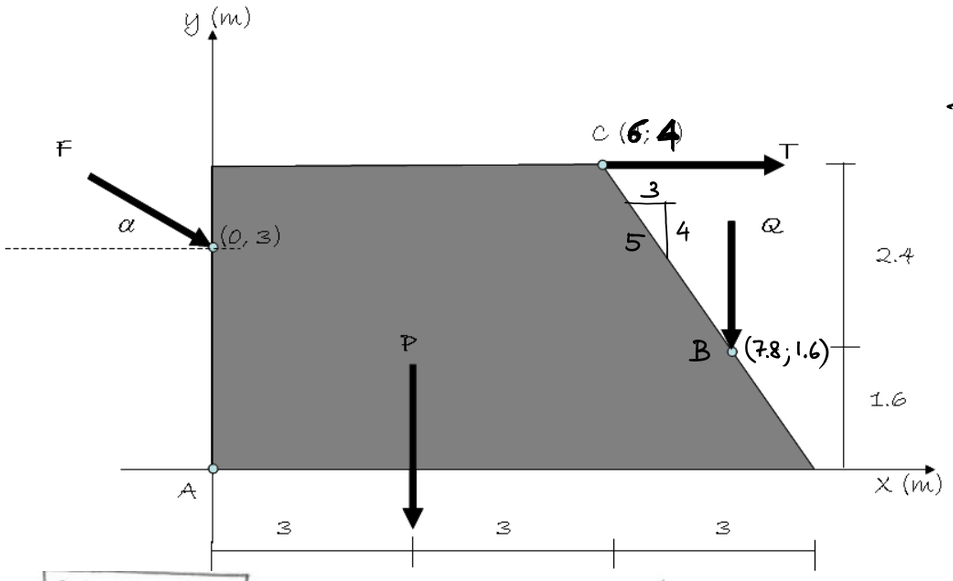
$\vec{M}_C = (16.1\,\vec{k})\,KN \cdot m$

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]*	



NOTE
5000 N = 5 KN

GB VERSION

$\vec{F} = [2.5\cdot\sqrt{3}\,\vec{\imath} - 2.5\,\vec{\jmath}]$ KN

$\vec{P} = [-10\,\vec{\jmath}]$ KN

$\vec{Q} = [-12\,\vec{\jmath}]$ KN

$\vec{T} = [20\,\vec{\imath}]$ KN

$\vec{R} = \vec{F}+\vec{P}+\vec{Q}+\vec{T} = [24.33\,\vec{\imath} - 24.5\,\vec{\jmath}]$ KN

$|R| = \sqrt{24.33^2+24.5^2} = 34.5$ KN

$\theta = \tan^{-1}\left(\frac{24.5}{24.33}\right) = 45.2°$

B = (7.8; 1.6)

@A (+) $\Sigma M_A = -F_x\cdot 3 + P\cdot 3 - T\cdot 4 - Q\cdot 7.8$

$= -2.5\sqrt{3}\cdot 3 - 30 - 80 - 12\cdot 7.8 = -216.6$ KN·m

$\Sigma M_A = R_x\cdot 2 + R_y\cdot x = 24.33\cdot 2 + 24.5\cdot x$

$\Rightarrow x = \frac{216.6 - 48.66}{24.5} = 6.85$ m

$\vec{M}_A = (-216.6\,\vec{k})$ KN·m

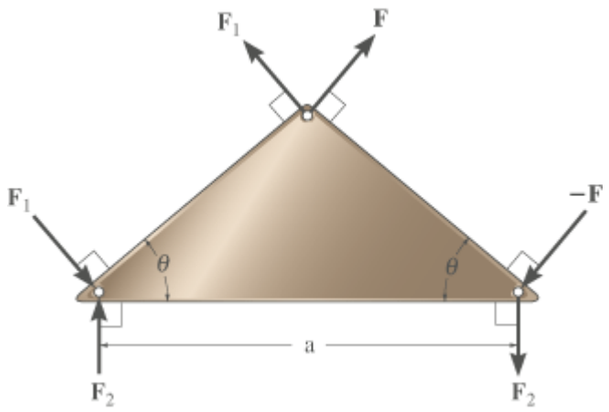
Question #3 ***[1 point]***

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 = *[2point]*	

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

[Report the final answers on the grid besides]



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

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

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 $= b$

$\vec{R} = 0$

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

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