UNIVERSITY OF TORONTO
Faculty of Applied Science and Engineering
CIV100F – MECHANICS
Quiz No. 1 – Sections 1, 2, 3, 4, 5, 6, 7, 8
Tuesday, 23rd September 2025
Examiner: Staff in Civil Engineering
Time allowed: ½ hour

SURNAME: _____SEICA_____GIVEN NAME(S): _____MICHAEL_____
(Please print clearly)

STUDENT NUMBER: _____Solution_____ DEPT. (ECE, Track One, etc.)_____

CIRCLE YOUR SECTION AND THE NAME OF YOUR INSTRUCTOR:

1. Seica, Michael
2. Seica, Michael
3. El-Diraby, Tamer
4. Mercan, Oya
5. Haghighi, Mohammad
6. Saxe, Shoshanna
7. Panesar, Daman
8. Pavlidis, Christian

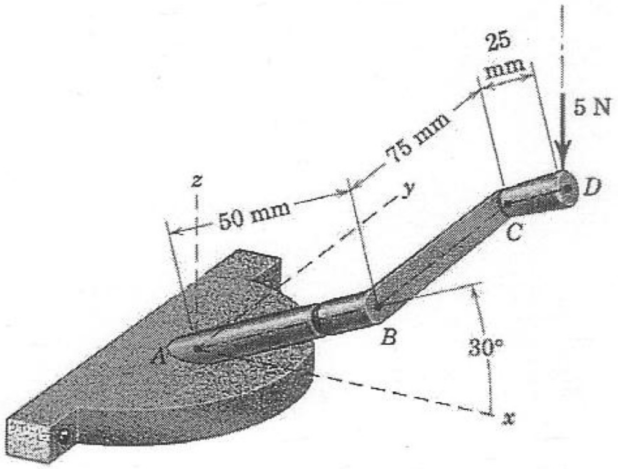
CIRCLE YOUR CALCULATOR TYPE:

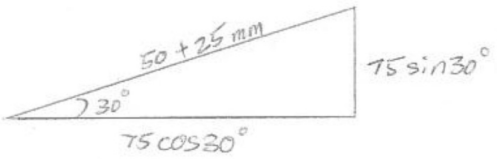
☐ **CASIO FX-991** ☐ **SHARP EL-W516** ☐ **SHARP EL-520**

Notes: 1. Ensure that you have all 4 pages of the examination paper.
2. Answer the question(s) provided. The value of the question(s) is indicated below
3. If you need more space for a question, continue on the page indicated at the bottom
4. If information appears to be missing, make reasonable assumptions and state them clearly
5. The only calculators permitted are listed above. Please indicate your model
6. This is a closed-book examination. No other paper will be allowed on the desk
7. Turn OFF all electronic equipment and place it in your bag
8. Do <u>not</u> remove the staple

NAME: _____

1. A 5 N vertical force is applied to the knob of the window-opener mechanism when the crank arm *BC* is horizontal, i.e. parallel to the *y*-axis. Determine the moment of the force (Cartesian vector expression and magnitude) about point *A* and about line *AB*.





Moment of the force about point A:

$\vec{r}_D = 75\cos 30^\circ \vec{i} + 75\vec{j} + 37.5\vec{k}$ mm

$\vec{F} = -5\vec{k}$ N

$$\vec{M}_A = \vec{r}_D \times \vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 37.5\sqrt{3} & 75 & 37.5 \\ 0 & 0 & -5 \end{vmatrix}$$

$$= \vec{i}\begin{vmatrix} 75 & 37.5 \\ 0 & -5 \end{vmatrix} - \vec{j}\begin{vmatrix} 37.5\sqrt{3} & 37.5 \\ 0 & -5 \end{vmatrix} + \vec{k}\begin{vmatrix} 37.5\sqrt{3} & 75 \\ 0 & 0 \end{vmatrix}$$

$= -375\vec{i} + 325\vec{j}$ N·mm

$= -0.375\vec{i} + 0.325\vec{j}$ N·m

$M_A = \sqrt{(-0.375)^2 + (0.325)^2}$

$= 0.496$ N·m

Solution can be continued on Page 3

Question 1 can be continued on this page.

Moment of the force about line AB:

$$\vec{u} = \frac{\vec{r}}{r} = \frac{50\cos 30^\circ \vec{i} + 50 \sin 30^\circ \vec{k}}{50} = \frac{\sqrt{3}}{2}\vec{i} + \frac{1}{2}\vec{k}$$

- We can reuse the same position vector ($\vec{r}_D$) in this question i.e. $\vec{r}_D = 37.5\sqrt{3}\,\vec{i} + 75\,\vec{j} + 37.5\,\vec{k}$

$$M = \vec{u} \cdot (\vec{r} \times \vec{F})$$

$$= \begin{vmatrix} \frac{\sqrt{3}}{2} & 0 & \frac{1}{2} \\ 37.5\sqrt{3} & 75 & 37.5 \\ 0 & 0 & -5 \end{vmatrix}$$

$$= \frac{\sqrt{3}}{2}\begin{vmatrix} 75 & 37.5 \\ 0 & -5 \end{vmatrix} + \frac{1}{2}\begin{vmatrix} 37.5\sqrt{3} & 75 \\ 0 & 0 \end{vmatrix}$$

$$= -325 \text{ N-mm} = \underline{-0.325 \text{ N-m}}$$

$$\vec{M} = M\vec{u} = (-0.325)\left(\frac{\sqrt{3}}{2}\vec{i} + \frac{1}{2}\vec{k}\right)$$

$$= \underline{-0.281\,\vec{i} - 0.1625\,\vec{k}}$$

Solution can be continued on Page 4

Question 1 can be continued on this page.