MET 107
Homework #8 - Beam Reactions and Force Components

Purpose: To learn to use and format Mathcad worksheets.
To become familiar with documenting related Excel/Mathcad homework assignments.

Points to keep in mind for all Mathcad assignments:

When working in class, set the zoom (lower right corner) to about 150% or set the slider in the View region on the Document tab. There is a big difference between $:=$ and $=:. Both you and the instructor need to be able to see the screen clearly.

All information is to be aligned both horizontally and vertically

There doesn’t appear to be an effective way to box answers in Prime 2.

Your sheets will always have your name, MET 107, Homework # and date located in the upper right corner of the Header (Document Tab, Headers and Footers region). Note that this will not show when you are in Draft mode, but will if you select Page (Document Tab, View region). You will always have the Page X of Y value displayed in the lower right corner (Document Tab, Headers and Footers region).

Your input values will have units attached.

The output will match your Excel documentation for all test cases (data sets).

Use the following figures on your Mathcad worksheets for today’s assignment:

Duplicate the results of the two prior Excel spreadsheets related to computing the end reactions on a beam as well as determining the components of a force.

Mathcad does not have crop functionality. You can use the Snapshot tool in Adobe Reader to capture a select area from a .pdf file. To access this tool, right click on the upper menu area of the Adobe Reader and select More Tools. Scroll down to the Snapshot tool and turn it on. This tool will appear in the upper region of the menu area.

You can also use the Windows 7 Snipping Tool (Accessories) to do the same thing. Images can be dragged and re-sized.

To delete an image, select it then select Delete Region from the Regions area of the Math tab.
Example Output for Beam Reactions:
Include beam diagram
Make sure Title, Description, Input and Calculations are shown
Include Notes 1, with screen capture of the Unit System
Do not include any text in RED

Note: this input is for preliminary testing only. For documentation purposes, use the “correct” (match with Excel) input values!

Format results with Decimal Format and not General Format so that the result does not appear in scientific notation (Formatting tab)

Be sure to include this image!

A screen capture can be re-sized, as shown
Example Output, Force Vector:
Make sure Title, Description, Image, Input and Calculations are shown.

### Title: Components of a force vector

### Description:
Given the coordinates of two points and magnitude of a force vector, compute the X, Y and Z components.

### Input:
- Coordinates of Point A (ft):
  - \( X_a := 0 \cdot ft \)
  - \( Y_a := 0 \cdot ft \)
  - \( Z_a := 0 \cdot ft \)
- Coordinates of Point B (ft):
  - \( X_b := 0 \cdot ft \)
  - \( Y_b := 0 \cdot ft \)
  - \( Z_b := -1 \cdot ft \)
- Magnitude of Force (bs):
  - \( F = 100 \cdot \text{lb} \)

### Calculations:
- **Distance:**
  - \( dx := X_b - X_a \)
  - \( dx = 0.00 \ ft \)
  - \( dy := Y_b - Y_a \)
  - \( dy = 0.00 \ ft \)
  - \( dz := Z_b - Z_a \)
  - \( dz = -1.00 \ ft \)
  - \( AB := \sqrt{dx^2 + dy^2 + dz^2} \)
  - \( AB = 1.00 \ ft \)

- **Components:**
  - \( F_x := \frac{dx}{AB} \cdot F \)
  - \( F_x = 0.00 \ \text{lb} \)
  - \( F_y := \frac{dy}{AB} \cdot F \)
  - \( F_y = 0.00 \ \text{lb} \)
  - \( F_z := \frac{dz}{AB} \cdot F \)
  - \( F_z = 100.00 \ \text{lb} \)

### Direction:
- \( dirx := \text{if}(dx \geq 0, \text{"+X direction"}, \text{"-X direction"}) \)
- \( diry := \text{if}(dy \geq 0, \text{"+Y direction"}, \text{"-Y direction"}) \)
- \( dirz := \text{if}(dz \geq 0, \text{"+Z direction"}, \text{"-Z direction"}) \)

### Note:
This input is for preliminary testing only. For documentation purposes, use the “correct” (match with Excel) input values!

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**Page 2 of 4**
Example Output for Surface Area/Volume Calculator:

The following shows how the “nested” if statement would be written in Mathcad. TV and TS is the volume and surface area that was calculated as a function of the intermediate equations A1, A2 etc.

\[
\begin{align*}
V_{\text{Check}} &:= \text{if}(\text{Width} \geq \text{Hole Dia} \leq \text{Depth}, "\text{RESULT OK}"); "\text{INCOMPLETE OUTPUT; INPUT ERROR}" \\
S_{\text{Check}} &:= \text{if}(\text{Width} \geq \text{Hole Dia} \leq \text{Depth}, "\text{RESULT OK}"); "\text{INCOMPLETE OUTPUT; INPUT ERROR}" \\
\end{align*}
\]

Notice that the right portion of the equation is outside the page border and will be truncated upon printing. Until we can figure out a solution to this, ignore the problem.

TV and TS would then be displayed with units to two decimal places. The XXX is so the student is not influenced by the “correct” value.

\[
\begin{align*}
TV &= XXX \text{ in}^3 \\
TS &= XXX \text{ in}^2
\end{align*}
\]

Units must be set to in^2 and in^3 where appropriate!
Documentation (Homework 7 & 8)

You will be turning in the following 16 pages:

**Excel:**
Beam Reaction problem
- Spreadsheet using Grid and Header button for a=5, L=15, P=2000
- Spreadsheet using Copy Cell Formulas button (same data set)
- Hand Calculations on engineering paper (same data set)

Components of Force Vector problem
- Spreadsheet using Grid and Header button for A, B and F as given above the sample layout on the homework assignment page (i.e., non-zero values for all).
- Spreadsheet using Copy Cell Formulas button (same data set)
- Hand Calculations on engineering paper (same data set)

Surface Area/Volume problem
- Spreadsheet using Grid and Header button for H=10, W=4, D=6, Dia=2
- Spreadsheet using Copy Cell Formulas button (same data set)
- Spreadsheet using Grid and Header button for H=1, W=1, D=1, Dia=2

**Mathcad:**
Beam Reaction problem
- Mathcad worksheet as on page 2 of this document with the exact same data set as used in the Excel portion.

Components of Force Vector problem
- Mathcad worksheet as on page 3 of this document with the exact same data set as used in the Excel portion.

Surface Area/Volume problem
- Mathcad worksheet as on page 4 of this document with the exact same data set as used in the Excel portion, i.e., H=10, W=4, D=6, Dia=2 (2 pages).
- Mathcad worksheet with H=1, W=1, D=1, Dia=2 (2 pages)

--- continued on next page ---
**Summary Sheet:**
- Download the Summary Sheet and fill it in using WORD as follows:

**Excel/Mathcad Comparison**

<table>
<thead>
<tr>
<th></th>
<th>Excel</th>
<th>Mathcad</th>
<th>Check</th>
<th>Explanation if not exact match (X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam Reactions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reaction at Left</td>
<td>NV</td>
<td>NV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reaction at Right</td>
<td>NV</td>
<td>NV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Components of Force Vector</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fx</td>
<td>NV</td>
<td>NV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fy</td>
<td>NV</td>
<td>NV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fz</td>
<td>NV</td>
<td>NV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direction X</td>
<td>PM</td>
<td>PM</td>
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<td></td>
</tr>
<tr>
<td>Direction Y</td>
<td>PM</td>
<td>PM</td>
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<tr>
<td>Direction Z</td>
<td>PM</td>
<td>PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume/Surface Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume (H=10)</td>
<td>NV</td>
<td>NV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Area (H=10)</td>
<td>NV</td>
<td>NV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume (H=1)</td>
<td>NV</td>
<td>NV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Area (H=1)</td>
<td>NV</td>
<td>NV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Units not required

If you have an Explanation, it needs to be complete and compelling. You are permitted to attach an additional sheet explaining the situation if necessary.

Make your table look professional. Justify your text.

Use a “X” (if no match) or a “✓” (if a match) in this column. The ✓ is found in Wingdings.