MET 107
Homework 11 – Functions

1. Construct a worksheet that determines the rectangular components of a force given the magnitude of the force and its direction angle. The direction angle is measured counter-clockwise from the x-axis.

![Diagram of force components]

- **Force, F**
- **Angle θ**
- **Horizontal Component Fx = F Cosθ**
- **Vertical Component Fy = F Sinθ**

### A | B | C | D | E | F
--- | --- | --- | --- | --- | ---
5  | TITLE: | Rectangular Components |
6  | DESCRIPTION: | Given the magnitude of a force and its angle from the +x-axis, the sheet determines the rectangular components of the force. |
7  | INPUT: | |
8  | Magnitude of the Force, F = | 1000 lbs |
9  | Angle from x-axis = | -20 degrees |
10 | COMPUTATIONS: | |
11 | Fx = | 940 lbs |
12 | Fy = | 342 lbs |
13 | If (Fy < 0, “f”, “g”) | |
14 | If (Fx > 0, “h”, “i”) | |

Include the above pictures in your worksheet.

The arrows are Wingdings3 font. The arrow characters are f for left, g for right, h for up and i for down. Format the cell font as Wingdings3 and use an IF function to determine left or right and up or down.

```
=ABS(D12*COS(RADIANS(D13)))
=IF(D12*COS(RADIANS(D13))<0,"f","g")
```

Be sure to use the ABS, COS, IF, RADIANS and SIN functions in this sheet.

Substitute F = 600 lbs and angle = 30 degrees into the worksheet.
- Print the spreadsheet using the Grid and Header macro.
- Print your spreadsheet using the Copy Cell Formulas macro.
2. Create a new worksheet that finds the magnitude and direction angle for the resultant of two given rectangular components. This is the inverse process of problem 1. The user will input horizontal and vertical force components, \( F_x \) and \( F_y \). The resultant force, \( R \), is determined by

\[
R = \sqrt{F_x^2 + F_y^2}
\]

The direction angle is determined using the formula

\[
\theta = \tan^{-1}\left( \frac{F_y}{F_x} \right)
\]

Format your results (\( R \) and \( \theta \)) to 0 decimal places

Be sure to use the SQRT, DEGREES and ATAN functions in this worksheet and to use the standard worksheet format for solving the problem.

<table>
<thead>
<tr>
<th>Case</th>
<th>Fx</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>2</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>3</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>4</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>

Substitute the following for Case 1 through 4

Fx = 250 lbs and Fy = 300 lbs.
Fx = -250 lbs and Fy = 300 lbs
Fx = -250 lbs and Fy = -300 lbs
Fx = 250 lbs and Fy = -300 lbs

- Print the spreadsheet using the Grid and Header macro.
- Print your spreadsheet using the Copy Cell Formulas macro
3. The stress in an axially loaded bar is found by dividing the applied load, \( P \), by the cross sectional area, \( A = bh \). On an inclined surface at an angle, \( \theta \), from the vertical, two component stresses exist: one normal and one shear. The following equations are used to determine the component stresses on the inclined surface:

\[
\text{Normal stress} = \frac{P}{A} \cos^2 \theta \\
\text{Shear stress} = \frac{P}{A} \sin \theta \cdot \cos \theta
\]

In a new worksheet, format cells to be input cells for load \( P \) and the width, \( b \), and height, \( h \), of the bar. Use \( P = 1000 \, \text{lbs} \), \( b = 2 \, \text{in} \) and \( h = 3 \, \text{in} \).

*Build a table of theta values (\( \theta \)) from 85 to -85 degrees in 5 degree intervals.*

For each theta value, compute the normal stress and the shear stress on the inclined plane acting at an angle theta from the vertical.

*Be sure to use the \( \text{SIN} \), \( \text{COS} \), \( \text{MAX} \), \( \text{MIN} \), \( \text{RADIANS} \) and \( \text{AVERAGE} \) functions.*

a. Near the top of the worksheet, include a cell that determines the maximum, minimum and average values for both stresses. Include units. Your worksheet should be similar to the following, noting the number of decimal places:

<table>
<thead>
<tr>
<th>Angle, ( \theta ) (degrees)</th>
<th>Normal Stress (psi)</th>
<th>Shear Stress (psi)</th>
<th>Results Normal Stress (psi)</th>
<th>Shear Stress (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>1.3</td>
<td>14.5</td>
<td>Maximum 188.7</td>
<td>83.3</td>
</tr>
<tr>
<td>90</td>
<td>5.6</td>
<td>29.5</td>
<td>Minimum -4.3</td>
<td>-83.3</td>
</tr>
<tr>
<td>75</td>
<td>11.2</td>
<td>41.7</td>
<td>Average 85.7</td>
<td>0</td>
</tr>
<tr>
<td>70</td>
<td>19.6</td>
<td>53.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>28.8</td>
<td>63.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>41.7</td>
<td>72.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. *Print the spreadsheet using the Grid and Header macro.*

c. *Print your spreadsheet using the Copy Cell Formulas macro.*

d. Change the input values to \( P = 1825 \) pounds, \( b = 2.1 \, \text{in} \) and \( h = 3.4 \, \text{in} \).

e. *Print the spreadsheet using the Grid and Header macro.*

f. *Using an angle of 40 degrees, verify your answer by hand calculation (\( P=1825 \) data set). You should have 8 sheets.*

The \( \theta \) can be found under Insert - Symbol. Select the \( \Theta \) from the Font: Arial.