Please state clearly all assumptions made in order for full credit to be given.

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<th>Problem</th>
<th>Points</th>
<th>Score</th>
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Problem #1 (25 %)

A rectangular sign over a store has a mass of 100 kg, with a center of mass in the center of the rectangle. The support against the wall at point C may be treated as a ball-and-socket joint. At corner D the support is only resisting motion along the y-axis.

a) Draw a complete and separate FBD for this problem (5 points)

b) Determine the magnitude of the tension in the two cables (8 points)

c) Determine the reaction at support D and express it in vector form (3 points)

d) Determine the reaction at support C and express it in vector form (9 points)
Problem #2 (25%)

For the plate shown below, determine the location of the centroid. Please record your intermediate answers in the table below. (Note the location of the axis-system origin: the intersection of the y and x axis)

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Problem #3 (25 %)

A Warren truss is loaded as shown below. $P = 4 \text{kN}$. Using the Method of Sections, determine the force in members $BC$, $CF$, and $FG$. The support at $A$ is a smooth pin and at $D$ is a roller. Specify tension (T) or compression (C) for the force in each member.

Note: For full credit, you must draw the appropriate free body diagrams.
Problem #4 (25%)  

\[ x_1 + 3x_2 + 2x_3 = -5 \]
\[ 4x_1 + 2x_2 + 3x_3 = 5 \]
\[ -2x_1 - x_2 + 3x_3 = 2 \]

a) Express the three equations in the form \( AX = B \)  
   (3 points)  
b) Using the method learned in class determine the inverse of matrix \( A \)  
   (12 points)  
c) Use the inverse found in b) to solve for \( x_1, x_2, \) and \( x_3 \).  
   (6 points)  
d) Using the method of cofactor expansion, determine the determinant of matrix \( A \) by expanding along the second column  
   (4 points)
Circular arc

\[ L = 2\alpha r \]
\[ x_C = \frac{r \sin \alpha}{\alpha} \]
\[ y_C = 0 \]

Quarter circular arc

\[ L = \frac{\pi r}{2} \]
\[ x_C = \frac{2r}{\pi} \]
\[ y_C = \frac{2r}{\pi} \]

Semicircular arc

\[ L = \pi r \]
\[ x_C = \frac{r}{2} \]
\[ y_C = \frac{2r}{\pi} \]

Rectangular area

\[ A = bh \]
\[ x_C = \frac{b}{2} \]
\[ y_C = h \]

Triangular area

\[ A = \frac{bh}{2} \]
\[ x_C = \frac{2b}{3} \]
\[ y_C = \frac{h}{3} \]

Triangular area

\[ A = \frac{bh}{2} \]
\[ x_C = \frac{a + b}{3} \]
\[ y_C = \frac{h}{3} \]

Circular sector

\[ A = \frac{\pi r^2 \alpha}{2} \]
\[ x_C = \frac{2r \sin \alpha}{3\alpha} \]
\[ y_C = 0 \]

Quadrant of a circle

\[ A = \frac{\pi r^2}{4} \]
\[ x_C = \frac{4r}{3\pi} \]
\[ y_C = \frac{4r}{3\pi} \]

Semicircular area

\[ A = \frac{\pi r^2}{2} \]
\[ x_C = \frac{4r}{3\pi} \]
\[ y_C = \frac{4r}{3\pi} \]

Quadrant of an ellipse

\[ A = \frac{\pi ab}{4} \]
\[ x_C = \frac{4a}{3\pi} \]
\[ y_C = \frac{4b}{3\pi} \]

Parabolic spandrel

\[ A = \frac{bh}{3} \]
\[ x_C = \frac{2b}{3} \]
\[ y_C = \frac{3h}{10} \]

Quadrant of a parabola

\[ A = \frac{2bh}{3} \]
\[ x_C = \frac{5b}{8} \]
\[ y_C = \frac{2h}{5} \]