Sample 4b Steps

Step 1

For each node, write down the following two equations:

1) The sum of the x components of the forces acting on the node is 0
2) The sum of the y components of the forces acting on the node is 0

In these equations, whenever you get an external force (W or H) on the left of the equals sign, move it to the right. This method, called the method of joints, will give you 8 equations for the 8 unknown forces F_1-F_8:

$$
\begin{aligned}
F_{1x} + F_4 &= 0 \\
F_{1y} + F_6 &= 0 \\
-F_{2x} - F_4 + F_5 &= 0 \\
F_{2y} &= W \\
-F_{3x} - F_5 + F_8 &= 0 \\
F_{3y} + F_7 &= 0 \\
-F_{1x} + F_{2x} + F_{3x} &= H \\
-F_{1y} - F_{2y} - F_{3y} &= 0
\end{aligned}
$$

Step 2

Put the equations in final form by substituting what the x and y components of the forces are equal to:

$$
\begin{aligned}
F_1\cos(\alpha) + F_4 &= 0 \\
F_1\sin(\alpha) + F_6 &= 0 \\
-F_2\cos(\beta) - F_4 + F_5 &= 0 \\
F_2\sin(\beta) &= W \\
-F_3\cos(\gamma) - F_5 + F_8 &= 0 \\
F_3\sin(\gamma) + F_7 &= 0 \\
-F_1\cos(\alpha) + F_2\cos(\beta) + F_3\cos(\gamma) &= H \\
-F_1\sin(\alpha) - F_2\sin(\beta) - F_3\sin(\gamma) &= 0
\end{aligned}
$$

Step 3

Define the arrays d and a. The array d is the column on the right of the equals signs in the equations. The array a contains the coefficients of the unknown forces in the equations. The first column of the array a contains the coefficients of F1, the second column contains the coefficients of F2, etc. The first equation gives the first row of the array a, the second equation gives the second row, etc. If a force does not appear in an equation, its coefficient is 0 .

```
d=[ 0        a=[ cos(alpha)   0            0             1   0   0   0   0
    0            sin(alpha)   0            0             0   0   1   0   0
    0            0           -cos(beta)    0            -1   1   0   0   0
    W            0            sin(beta)    0             0   0   0   0   0
    0            0            0           -cos(gamma)    0  -1   0   0   1
    0            0            0            sin(gamma)    0   0   0   1   0
    H           -cos(alpha)   cos(beta)    cos(gamma)    0   0   0   0   0
    0 ];        -sin(alpha)  -sin(beta)   -sin(gamma)    0   0   0   0   0 ];
```