Outline solution to the class exercise “Big N”

1. Create vertex tables for the object in World coordinate system.
   (a vertex table is called P, see the coordinates listed under 6).

2. Find the axes of the Viewing (camera) coordinate system, vectors **V**, **U** and **N** (from VRP and the Target point).

   N = [-1 -3 -2 1]^T, **U** = [-3 5 -6 1]^T, **V** = [-2 0 1 1]^T

3. Find the transformations which change the coordinates of the object from the World system (RH) to the Viewing system (LH); this is the same transformation which aligns the axes of the Viewing system (**V**,**U**,**N**) with the axes of the World system (**X**,**Y**,**Z**). Create the combined transformation matrix for these transformations.

$$T = \begin{vmatrix} 1 & 0 & 0 & -12 \\ 0 & 1 & 0 & -36 \\ 0 & 0 & 1 & -22 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

$$R = \begin{vmatrix} -0.89 & 0 & 0.45 & 0 \\ -0.36 & 0.59 & -0.72 & 0 \\ -0.27 & -0.80 & -0.53 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

$$S = \begin{vmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

4. Create the perspective projection matrix and combine all the matrices.

$$PP = \begin{vmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0.1 & 0 \end{vmatrix}$$

$$CM = S*PP*R*T = \begin{vmatrix} 0.89 & 0 & -0.45 & -0.89 \\ -0.36 & 0.59 & -0.72 & -1.43 \\ -0.27 & -0.80 & -0.53 & 43.83 \\ -0.03 & -0.08 & -0.05 & 4.38 \end{vmatrix}$$

5. Transform all the object vertices through the combined matrix calculated in (4).

   P’ = CM*P

6. Calculate the homogeneous coordinates of the points transformed in (6), so that the last (fourth) coordinate for each point is 1. As a check see that the z coordinate of each point is equal to D, the viewing distance.

	Original coordinates					Projected coordinates			
	x	y	z	h		x	y	z	h
V1	0	0	2	1		-0.4	-0.7	10	1
V2	2	0	2	1		0	-0.8	10	1
V3	2	0	0	1		0.2	-0.5	10	1
V4	0	0	0	1		-0.2	-0.3	10	1
V5	0	6	2	1		-0.5	0.2	10	1
V6	2	6	2	1		0	0	10	1
V7	2	6	0	1		0.2	0.4	10	1
V8	0	6	0	1		-0.2	0.5	10	1
V9	6	0	2	1		0.9	-1.2	10	1
V10	8	0	2	1		1.3	-1.4	10	1
V11	8	0	0	1		1.5	-1.0	10	1
V12	6	0	0	1		1.1	-0.8	10	1
V13	6	6	2	1		1.0	-0.4	10	1
V14	8	6	2	1		1.5	-0.6	10	1
V15	8	6	0	1		1.7	-0.2	10	1
V16	6	6	0	1		1.2	0	10	1

7. Plot the 2D points.