1. (1) Matrix A is the viewport matrix, M_{VP}. It is responsible for mapping the points to their final position within the viewport on the screen. It's matrix value is this:

$$\begin{bmatrix} \frac{n_x}{2} & 0 & 0 & \frac{n_x-1}{2} \\ 0 & \frac{n_y}{2} & 0 & \frac{n_y-1}{2} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Matrix B is the orthographic projection matrix, M_{ORTH}. It is responsible for transforming the vertices within a box with a width, height and near and far planes. If parts of an object are outside this area, then they are clipped out of view. Objects within will be in view. It can be represented by the following matrix, where r=right, l=left, t=top, b=bottom, n=near, and f=far.

$$\begin{bmatrix} \frac{2}{r-l} & 0 & 0 & -\frac{r+l}{r-l} \\ 0 & \frac{2}{t-b} & 0 & -\frac{t+b}{t-b} \\ 0 & 0 & \frac{2}{n-f} & -\frac{n+f}{n-f} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Matrix C is the perspective matrix, P. This matrix transforms the view so objects will appear to be in perspective, where objects are smaller with more distance to the camera. It can be represented by the following matrix, where n represents the near plane and f represents the far plane.

$$\begin{bmatrix} n & 0 & 0 & 0 \\ 0 & n & 0 & 0 \\ 0 & 0 & n+f & -fn \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

Matrix D is the camera transformation matrix, M_{CAM}. This matrix transforms into the eye coordinates, the coordinate system of the camera consisting of u, v, w vectors. Vector w is represented using the gaze vector g where w = -g / ||g||. Vector u is found using the view-up vector t where u = (w x t) / ||(w x t)||. Vector v is found by taking the cross product of the previous vectors, so v = w x u.

Matrix E is the model matrix, M_M. This matrix is responsible for transforming an object's local coordinates to world coordinates via the basic translation, scaling, and rotation matrices we used in Homework 1.

1. (2)

$$A = \begin{bmatrix} \frac{near_x}{2} & 0 & 0 & \frac{near_x - 1}{2} \\ 0 & \frac{near_y}{2} & 0 & \frac{near_y - 1}{2} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

For matrix B, I'm assuming there is a point (l, b, n) on the bottom left corner of the near plane and a point (r, t, f) on the top right corner of the far plane.

$$B = \begin{bmatrix} \frac{2}{r-l} & 0 & 0 & -\frac{r+l}{r-l} \\ 0 & \frac{2}{t-b} & 0 & -\frac{t+b}{t-b} \\ 0 & 0 & \frac{2}{n-f} & -\frac{n+f}{n-f} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$C = \begin{bmatrix} near & 0 & 0 & 0 \\ 0 & near & 0 & 0 \\ 0 & 0 & near + far & -near * far \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

$$D = \begin{bmatrix} \frac{\frac{-look}{||look||} x\ up}{|| \frac{-look}{||look||}\ x\ up\ ||} & \frac{-look}{||look||} & x & \frac{\frac{-look}{||look||} x\ up}{|| \frac{-look}{||look||}\ x\ up\ ||} & \frac{-look}{||look||} & 1 \end{bmatrix}^{-1}$$

E = the model matrix for whatever points we are transforming, there was no info given for this.