COS457
GROUP WORK : (30 POINTS)
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1) Provide the projection matrix that performs an orthographic projection on a world space with parameters (near : -2, far : -20, left : -5, right : + 5, top = 2, bottom = -2) to a canonical view volume. Provide the points that get generated when you use this matrix to convert the points of square with verticies (-3,-1,-4) (3,-1,-8) (3,1,-8) (-3,1,-4). Does your result make sense ?

$$\mathbf{ST} = \begin{bmatrix} \frac{2}{right-left} & 0 & 0 & -\frac{right+left}{right-left} \\ 0 & \frac{2}{top-bottom} & 0 & -\frac{top+bottom}{top-bottom} \\ 0 & 0 & -\frac{2}{far-near} & -\frac{far+near}{near-far} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

In[66]:=
```
T =MatrixForm[{{2/10,0,0,0},{0, 2/4, 0, 0},{0,0,2/18,22/18},{0, 0, 0, 1}}]
```

Out[66]//MatrixForm=

$$\begin{pmatrix} \frac{1}{5} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & \frac{1}{9} & \frac{11}{9} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

In[67]:=
```
MatrixForm[{{1/5, 0, 0, 0}, {0, 1/2, 0, 0}, {0, 0, 1/9, 11/9}, {0, 0, 0, 1}}.{-3,-1,-4,1}]
```

Out[67]//MatrixForm=

$$\begin{pmatrix} -\frac{3}{5} \\ -\frac{1}{2} \\ \frac{7}{9} \\ 1 \end{pmatrix}$$

In[68]:=
```
MatrixForm[{{1/5, 0, 0, 0}, {0, 1/2, 0, 0}, {0, 0, 1/9, 11/9}, {0, 0, 0, 1}}.{3,-1,-8,1}]
```

Out[68]//MatrixForm=

$$\begin{pmatrix} \frac{3}{5} \\ -\frac{1}{2} \\ \frac{1}{3} \\ 1 \end{pmatrix}$$

In[69]:=
```
MatrixForm[{{1/5, 0, 0, 0}, {0, 1/2, 0, 0}, {0, 0, 1/9, 11/9}, {0, 0, 0, 1}}.{3,1,-8,1}]
```

Out[69]//MatrixForm=

$$\begin{pmatrix} \frac{3}{5} \\ \frac{1}{2} \\ \frac{1}{3} \\ 1 \end{pmatrix}$$

In[70]:=
```
MatrixForm[{{1/5, 0, 0, 0}, {0, 1/2, 0, 0}, {0, 0, 1/9, 11/9}, {0, 0, 0, 1}}.{-3,1,-4,1}]
```

Out[70]//MatrixForm=

$$\begin{pmatrix} -\frac{3}{5} \\ \frac{1}{2} \\ \frac{7}{9} \\ 1 \end{pmatrix}$$

This result makes sense since all of the resulting points lie inside the canonical view volume.

2) Provide the perspective projection matrix that converts a world space with parameters (view angle 90 degrees pointing down -z axis, near : -2, far : -10) to a canonical view volume. Provide the points that get generated when you use this matrix to convert the points of square with verticies (-3,-1,-4) (3,-1,-4) (3,1,-4) (-3,1,-4) Does your result make sense ?

$$\mathbf{P = NSH} = \begin{bmatrix} \frac{2*near}{right-left} & 0 & \frac{right+left}{right-left} & 0 \\ 0 & \frac{2*near}{top-bottom} & \frac{top+bottom}{top-bottom} & 0 \\ 0 & 0 & -\frac{far+near}{far-near} & \frac{-2*far*near}{far-near} \\ 0 & 0 & -1 & 0 \end{bmatrix}.$$

In[61]:=
```
p =MatrixForm[{{(2*2)/4,0,0,0},{0, (2*2)/4, 0, 0},{0,0,-(12/8),-40/8},{0, 0, -1, 0}}]
```

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -\frac{3}{2} & -5 \\ 0 & 0 & -1 & 0 \end{pmatrix}$$

In[62]:=
```
MatrixForm[{{1,0,0,0},{0,1,0,0},{0,0,-3/2,-5},{0,0,-1,0}}.{-3,-1,-4,1}/4]
```

$$\begin{pmatrix} -\frac{3}{4} \\ -\frac{1}{4} \\ \frac{1}{4} \\ 1 \end{pmatrix}$$

In[63]:=
```
MatrixForm[{{1,0,0,0},{0,1,0,0},{0,0,-3/2,-5},{0,0,-1,0}}.{3,-1,-4,1}/4]
```

$$\begin{pmatrix} \frac{3}{4} \\ -\frac{1}{4} \\ \frac{1}{4} \\ 1 \end{pmatrix}$$

In[64]:=
```
MatrixForm[{{1,0,0,0},{0,1,0,0},{0,0,-3/2,-5},{0,0,-1,0}}.{3,1,-4,1}/4]
```

$$\begin{pmatrix} \frac{3}{4} \\ \frac{1}{4} \\ \frac{1}{4} \\ 1 \end{pmatrix}$$

In[65]:=
```
MatrixForm[{{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, -3/2, -5}, {0, 0, -1, 0}}.{-3, 1, -4, 1}/4]
```

$$\begin{pmatrix} -\frac{3}{4} \\ \frac{1}{4} \\ \frac{1}{4} \\ 1 \end{pmatrix}$$

This result does make sense since it both produces homogenized points which line within the CVV.