**ECE 661 Homework 1**

**Weichen Xu**

**xu1363@purdue.edu**

**Question 1**

The general form of a point in the representational space is , which is the homogeneous coordinate of the point in the physical space .

We have and when .

For the origin in , and , we get and .

**Conclusion:**  where and are points in the representational space that are the homogeneous coordinates of the origin in the physical space .

**Question 2**

Since points at infinity in the physical space are ideal points with the form of in . For two points and , they are both points at infinity in since their coordinates in are infinity. However, their coordinates in are not necessarily the same, i.e. they are not the same point.

**Conclusion:** Not all points at infinity in the physical space are the same.

**Question 3**

Since degenerate conic , .

For , since ’s columns are linearly dependent, . Similarly, .

, so the rank of a degenerate conic cannot exceed 2.

**Question 4**

Step 1:

Step 2:

Step 3: , then its coordinate in is

If the second line pass through and , it takes two steps. Since the second line passes through the origin as well as the first line also passes through the origin, the intersection is the origin.

**Question 5**

Since the third coordinate of in is 0, which means the intersection point is at infinity, i.e. the two lines are parallel.

**Question 6**

We can write the conic as , simplified as .

Let

So the polar line is , it intersects with x-axis at , intersects with y-axis at

**Question 7**

The intersection of and is