Problem 1

a)

 is matched to the point  in world coordinate, and the same applies to  which is  in world coordinate. Therefore we could have line



and



and the intersection of the two line is the 3D location of that point, which is 

b)

We have  ,



Therefore the essential matrix is



c)

Since the focal point is at , and all the points on the line are at , we can consider only the *xz*-plane.

For the porjection of point x in camera1 we have



and the projection point x in camera2 which is also u is





Therefore the disparity  is



Problem 2

1. Pure Horizontal Translation: , 

i. For essential matrix E we have



and



Sinceand, we have the epipoles , 

ii. Set and , we have



Therefore the epipolar line 

iii. First construct 3 mutually orthogonal unit vectors , set the first vector the direction of translation , and set the second vector the normalized cross product of  with the direction vector of the optical axis , then set the third vector the normalized cross product of the first two vector . Thus we have the rectification matrix , therefor the solution to rectifying transforms is and .

1. Pure Translation Orthogonal to the Optical Axis: , 
2. For essential matrix we have



Sinceand, we have the epipoles  and 

ii. Set and , we have



Therefore the epipolar line 

iii. Set the first vector ,

the second vector ,

and the third vector 

Thus we have the rectification matrix ,

therefor the solution to rectifying transforms is



1. Pure Translation Along the Optical Axis , 

i. For essential matrix we have



Sinceand, we have the epipoles  and 

ii. Set and , we have



Therefore the epipolar line 

iii. Set the first vector ,

the second vector ,

We found that  doesn’t exist, therefore we are not able to find its rectifying transform matrices, the epipolar rectification is impossible.

1. Pure Rotation , R is an arbitrary rotation matrix

i. For essential matrix we have



Sinceand, the epipoles  and  could be any existing matrix.

ii. Set and , we have



Therefore does not exist.

iii. For ,  doesn’t exist, therefore we are not able to find its rectifying transform matrices, the epipolar rectification is impossible.