

Instructions: Answer all 4 questions in the bluebook provided. 75 min closed book/notes.

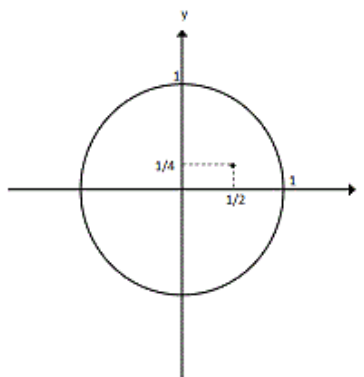
1. A stereoscopic camera system has a 10 cm baseline. When the system is at rest, the two optical axes are parallel, and are perpendicular to the baseline. When operating, each camera can independently rotate its optical axis up to 30 degrees in any direction from its rest position.

(a) Let M be the midpoint of the baseline, and X the closest point to M which can be fixated. How far away from M is X ?

(b) What set of scene locations are fixated with zero disparity? Assume the intrinsic camera models of the two cameras are identical.

2. Specify 3-4 ways in which the designs of digital camera and the human eye are very different. For each of the differences you cite, justify why camera manufacturers have chosen the solutions we see in their cameras today, rather than using the solutions chosen by nature. In each case, also state why nature designed the human eye the way it did, rather than using the camera manufacturer's design choices.

3. Consider an orthographic image of a unit Lambertian sphere centered at $(x,y,z)=(0,0,5)$ in camera coordinates. The scene is lit by a single light source very far from the origin, so all source light rays are parallel. The brightest point on the image is at the point in the image plane $(x,y)=(1/2,1/4)$ as shown in the diagram. The brightness there is b .



(a) Specify the 3-D vector direction of the source light rays.

(b) What will the brightness at the point $(x,y)=(0,0)$ in the image plane be? Specify the answer in terms of b .

4. A scene initially looks like Figure 1, with three visible points A, B and C. Note that the z-axis points into the paper. After we walk a few paces while maintaining fixation on point A, the scene now looks like Fig 2. In order to maintain fixation while we walked, our head rotated clockwise in the xz plane (z axis points into the paper).

(a) Determine the order of distance from the camera of these three points, closest to farthest. Justify your answer.

(b) Which point is farthest from the point A? Justify your answer.

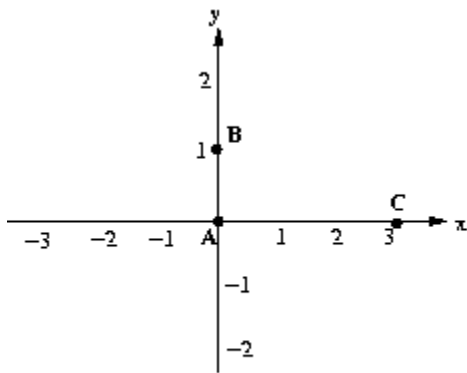


Figure 1

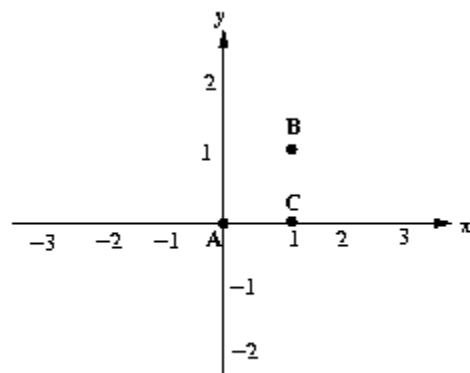


Figure 2