

**CPSC 314, Written Homework 2**

**Out: Fri 05 Feb 2016**

**Due: Fri 12 Feb 2016 2pm (hand in at start of lecture)**

**Value: 4% of final grade**

**Total Points: 100**

**Name:** \_\_\_\_\_

**Student Number:** \_\_\_\_\_

<i>Q1</i>	/10
<i>Q2</i>	/10
<i>Q3</i>	/10
<i>Q4</i>	/10
<i>Q5</i>	/10
<i>Q6</i>	/10
<i>Q7</i>	/10
<i>Q8</i>	/30
<i>Total</i>	/100

Please check one of the following:

- I did not collaborate with anyone in the completion of this homework.
- I collaborated with people named below in the completion of this problem set:

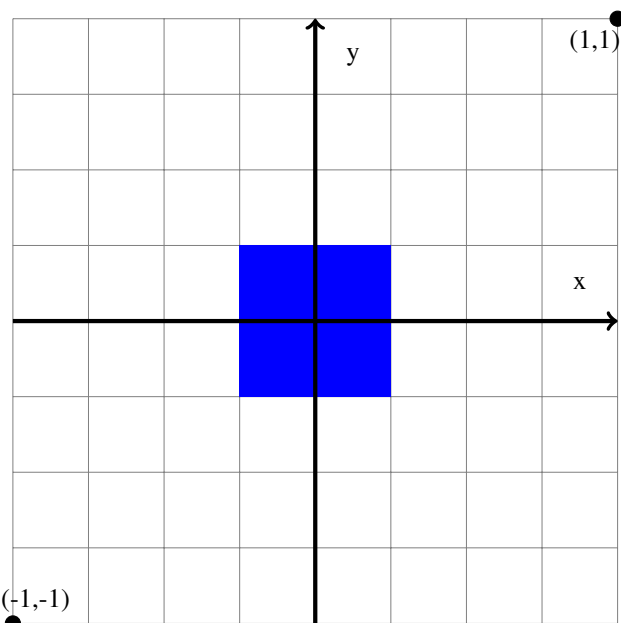
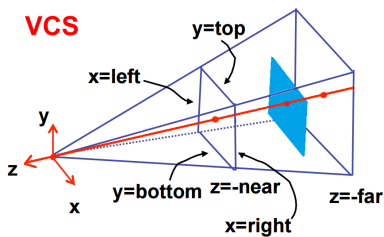
Name: \_\_\_\_\_ Student Number: \_\_\_\_\_

Name: \_\_\_\_\_ Student Number: \_\_\_\_\_

Name: \_\_\_\_\_ Student Number: \_\_\_\_\_

1. (10 pts) Give the camera/viewing transformation matrix for an eye position  $(-5,3,-2)$ , a lookat point  $(-5, 0, -2)$  and an up vector  $(1,0,0)$ .
2. (10 pts) Give the perspective projection matrix for a view volume with a near plane  $z = -2$ , far plane  $z = -16$ , a left plane  $x = -2$ , a right plane  $x = 2$ , a top plane  $y = 2$ , and a bottom plane  $y = -2$ .
3. (10 pts) Give the NDC-to-display transformation matrix for a viewport 800 pixels wide and 600 pixels high, with the origin in the upper left of the display.
4. (10 pts) In world coordinate system, given a point  $(-3, 5, 1)$ , what are its coordinates in the camera coordinate system, after the viewing transformation from problem 1 above has been applied to it. **Update Feb 05: given a point  $(-3, 5, 1)$**
5. (10 pts) Now calculate its coordinates in the clipping coordinate system, by applying the perspective warp for the view frustum specified in problem 2 to the point in camera coordinates (that is, the answer from problem 4).
6. (10 pts) Calculate its coordinates in the normalized device coordinate system, by applying the perspective divide to your answer from problem 5.
7. (10 pts) Finally, calculate its coordinates in the display coordinate system, by applying the viewport transformation matrix from problem 3 to your answer from problem 6.
8. (30 pts) In the camera coordinate system of problem 2, using perspective projection, we put a planar square object on  $z = -8$ , perpendicular to  $z$ -axis, so that the negative  $z$ -axis pierces the centre of the object. Given the edge of the square to be 4, we would have an image in NDCS of the square object as shown below.
  - a) If the near value is doubled, what would the observed effect be on the resulting image of the object?
  - b) if we change top plane to be  $y = 4$  and bottom plane  $y = -4$ , what would the observed effect be on the resulting image of the object?
  - c) considering tilting the top of the square towards the near plane, by rotating it about a vector parallel to the  $x$  axis in camera coordinate and passing through the centre of the square, by an angle of 45 degree, so that the top of square gets nearer and the bottom is farther from the near plane. What is the shape of the projection of the square (a square, rectangle, parallelogram or trapezoid)?

For each question sketch your result in the graph and **provide reasons** to get full credit.



NDCS