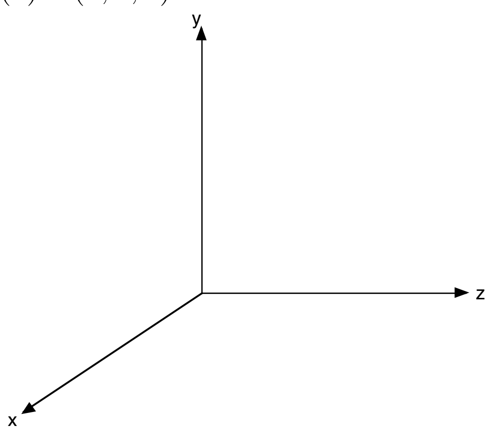
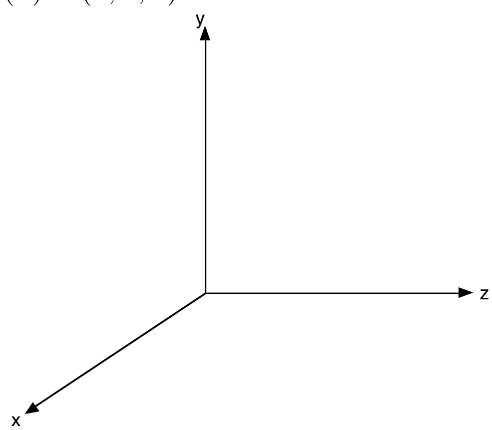
1. Please plot the following points on a set of 3-D coordinate axes (using the coordinate system used for this course rather than the standard coordinate system.) Mark units on your axes, and show enough dashed lines so I can see how you found where to put your points.

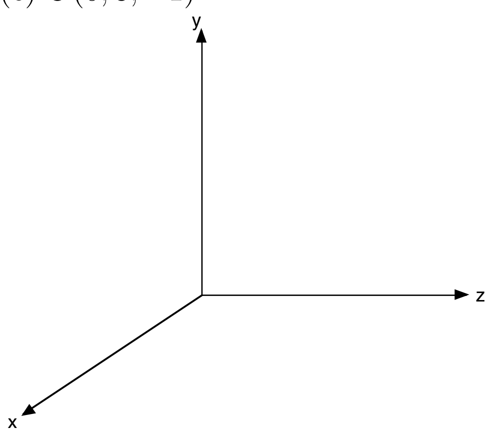
(a) $A(1, 3, 4)$



(b) $B(2, 4, 0)$



(c) $C(0, 3, -1)$



2. Assume a viewer (or artist) who is located with one eye on the negative z-axis is looking at two points $A(3,3,2)$ and $B(4,2,7)$.

   (a) Which point is higher?

   (b) Which is closer to the viewer?

   Note: Usually, to determine which is closer to the viewer, we would need to know the viewer's exact location and then use the distance formula to calculate how far the viewer is from each point. However, in this case one point is *much* closer to the picture plane, and hence closer to the viewer on the other side of the picture plane, than the other. Which?

   (c) Which is further left, to the viewer?

3. In this problem, you're going to be considering a box whose faces are parallel to the coordinate planes. Suppose the corners of this box have the following coordinates:

Bottom	Top
$A(1,3,4)$	$E(1,7,4)$
$B(8,3,4)$	$F(8,7,4)$
$C(8,3,10)$	$G(8,7,10)$
$D(1,3,10)$	$H(1,7,10)$

Note 1: You do not have to plot each of the 8 corners and draw the box in order to do this question, although you certainly can if you think that will help you think about the problem clearly.

Note 2: When using words like "wide" and "deep" below, I am thinking about how the box would appear to a person with their eye at a viewing position on the negative z-axis.

(a) How wide is the box (that is, in the x direction)?

(b) How tall is the box in the y direction?

(c) How deep is the box (that is, how far back in the z direction does it go)?

4. Now I want you to look for patterns in Problem 3, and use them. We again have a box whose faces are parallel to the coordinate planes. Suppose the coordinates of two opposing corners of a box (the front-left-bottom corner and the rear-right-top corner) have coordinates $(3, -1, 5)$ and $(10, 7, 10)$.

   (a) How wide is the box, to the viewer?

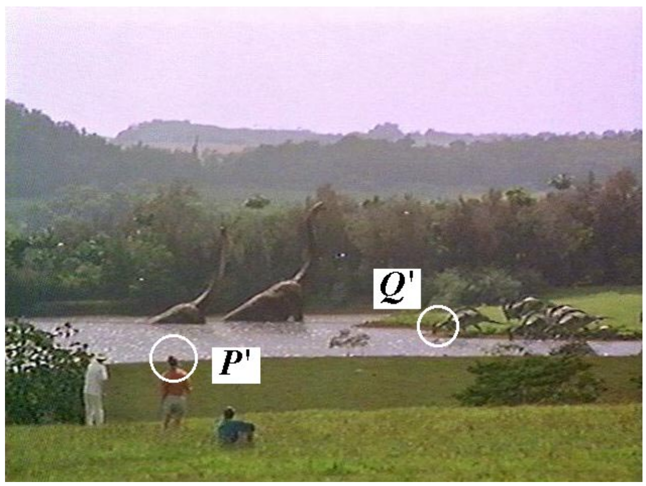
   (b) How tall is the box?

   (c) How deep is the box, to the viewer? (That is, how far back does it go?)

   (d) Use the insights gained from parts (a) through (c) to determine the coordinates of the remaining 6 corners.

5. Think of the Jurassic Park image in Figure 3 of Lesson 2, included below, as being an image of a *real* scene painted onto a picture plane.

   - $P(x, y, z)$ = top of woman's head in real 3D life
   - $Q(x, y, z)$ = top of the drinking dinosaur's head real life.
   - $P'(x, y)$ = *image* of woman's head in the 2D picture
   - $Q'(x, y)$ = *image* of drinking dino's head in the 2D picture



   Which is bigger:

   (a) the x-coordinate of P, or the x-coordinate of Q?

   (b) the y-coordinate of P, or the y-coordinate of Q?

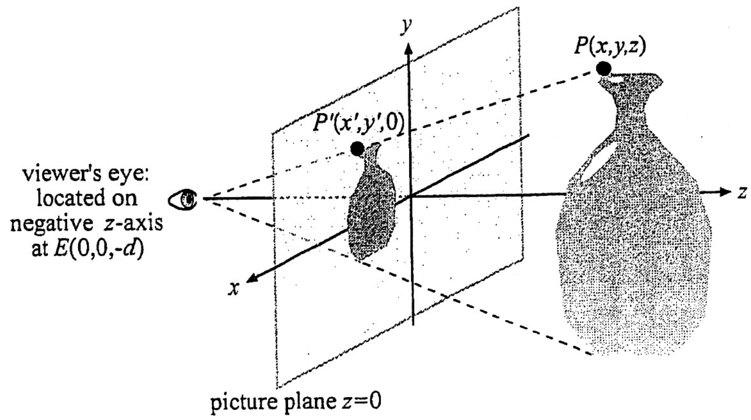
   (c) the z-coordinate of P, or the z-coordinate of Q?

   (d) the x-coordinate of P', or the x-coordinate of Q'?

   (e) the y-coordinate of P', or the y-coordinate of Q'?

   (f) the z-coordinate of P', or the z-coordinate of Q'? (This is a trick question)

6. In the figure below (from Lesson 1 of *Lessons in Mathematics and Art*), suppose that $d = 3$ and suppose that the point $P(x, y, z)$ were **moved** so that $x = 0$, $y = 4$, and $z = 5$.



(a) Which coordinate plane would the point $P(x, y, z)$ lie in?

Recall coordinate planes: The xz-plane, determined by the x and z axes, is the horizontal plane through the origin; like the "floor". The xy-plane, determined by the x and y axes, is the vertical plane through the origin; think of it as the picture plane or as a window. The yz-plane, determined by the y and z axes, is the vertical plane through the origin that we might think of a side wall. In the "Artist's View", the xy plane is directly facing us and the yz plane recedes away from us; in the "Omniscient View" (as in this diagram), we see the picture plane off to the side and the yz plane in front of us.

(b) Without using the Perspective Theorem (even once we discuss it in class, I want you to use **ideas** not a theorem), what would x', the image of x in the picture plane, be?

(c) Again without using the Perspective Theorem, what would y', the image of y in the picture plane, be?