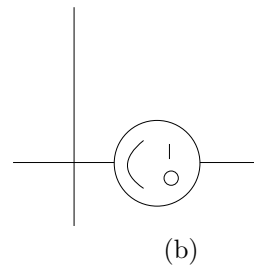
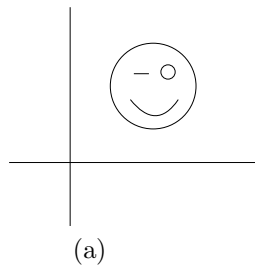


Homework 2  
CS 354  
Due Feb 21 at the beginning of class

**Name**

**UT EID**

- (5 points) Vector  $\mathbf{v} = [x\ y\ z\ 0]^T$  is rotated about the x-axis until it lies in the xz plane. The new vector is  $\mathbf{v}'$ . What is  $|\mathbf{v}'|$  (the length of  $\mathbf{v}'$ )?
- (5 points) Using  $\mathbf{v}'$  from problem 1,  $\mathbf{v}''$  is the projection of  $\mathbf{v}'$  onto the z axis. What is  $|\mathbf{v}''|$ ?
- (10 points) Happy Harry is happy even when he's sleeping. Give a series of 3x3 2D transformation matrices (using homogeneous coordinates) in the proper order to transform Happy Harry from his awake position centered at  $(x, y)$  (figure a) to his sleeping position centered at  $(x, 0)$  (figure b). Leave any trigonometric functions unevaluated (leave rotation matrices in terms of sine and cosine).



4. (5 points) A wireframe cube (see wikipedia: “wire-frame model”) is placed at the origin. The camera is placed using `gluLookAt(0, 0, 5, 0, 0, 0, 0, 1, 0)`. Using perspective projection, sketch what will be rendered on the screen.

5. (10 points) The camera is placed using `gluLookAt(0, 10, 5, 0, 5, 0, 0, 1, 0)`. What are the coordinate axes  $\mathbf{u}, \mathbf{v}, \mathbf{n}$ ? Show your work.

6. Consider the following code:

```
glutInitWindowSize(500, 500);
glMatrixMode(GL_PROJECTION);
glLoadIdentity();
glFrustum(-1, 1, -1/3.0, 1/3.0, 1, 3);
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
gluLookAt(0, 0, 2,
          0, 0, 0,
          0, 1, 0);
glColor3f(0, 0, 0);
glutWireCube(2);
```

(a) (5 points) Sketch what will be rendered.

(b) (10 points) What percentage of the cube's volume lies inside the view frustum?