2. First, we have that:

We can see that this trace is created by a circle which is continuously moved along the y axis, so the x and z coordinates will be some variation of cos and sin of some expression.

We have

And so we know that when s =, then x = 0.

We also know that when s = 0, then, x = 0. In order to get 8 full circles in the span of 16 *,* we have to have the expression cos(s and in order to adjust for the starting and 0 points, we add to the angle, leaving us with cos(s+. The final adjustment is for the radius which is 1.5 (we have we get:  
**x = 1.5cos(s+**

Y changes constantly and ranges from so we get:

**y =**

The definition of z comes similarly to x; the only difference is that the circle radius is at a distance of 3.5 from the XY plane, because and so we get:

**z = 3.5 +1.5sin(s+**

1. (s) is the perspective projection of α(s), so for every point p we will define its projected point so we substitute the terms and get:

**Question 3 – Hough Transform**

\*\*We chose the canny edge detecting algorithm because of several reasons:\*\*

1. It uses a gaussian filter in order to smooth the image and remove some noise. This helps remove unwanted artifacts from the image and also makes the hough transform run faster because there are less edge points

2. It takes into considration only edge points that pass a certain threshold in terms of contrast, thus removing "weak" edge points.

\*\*The parameters\*\* where chosen as such in order to create an edge map that shows all the coin perimeters as edge points but ignores their insides, because we would like to perform circle detection in the next step.

\*\*We chose the following parameters:\*\*

1. \*\*minRadius = 10, maxRadius = 50\*\* -> all of the circles in the image are included in this radius range.

2. \*\*threshold = 10\*\* -> chosen as such

because the coins aren't "perfect" circles and we check 360/20=18 angles, so 10 points on the perimeter should be enough to determine a circle in the image

3. \*\*minDist = 10\*\* -> we didn't want multiple circles detected on the same coin, which can happen becuase again, they aren't perfect circles. But, the distance between coins is fairly low so 10 was the right balance.

4. The parameters for the Hough Transform are:

(x,y) in the code - which represent the circle centers

r - represent the circle radius

more details about the implementation appear in the code as comments as it more convient.