CS 100: Section Assignment 1

(For the week of February 1)

Section assignments are discussed in section and are not submitted for grading. They relate to recent lecture topics and usually to the current Programming Assignment. Prelim questions are based on Section Assignments, Programming Assignments, and Lecture examples.

1. Write a Java program that prints $\cos(3^o)$ and $\sin(27^o)$ without referencing the Java methods `Math.sin` and `Math.cos`. The idea is to use the facts $\cos(60°) = 1/2$ and $\cos(72°) = (\sqrt{5}-1)/4$ and various trigonometric identitites such as

$$\begin{aligned}
\cos(\theta/2) &= \sqrt{(1+\cos(\theta))/2} \\
\sin(\theta/2) &= \sqrt{(1-\cos(\theta))/2} \\
\sin(\theta) &= \sqrt{1-\cos(\theta)^2} \\
\cos(\theta_1+\theta_2) &= \cos(\theta_1)\cos(\theta_2)-\sin(\theta_1)\sin\theta_2) \\
\sin(\theta_1+\theta_2) &= \cos(\theta_1)\sin(\theta_2)+\sin(\theta_1)\cos(\theta_2) \\
\cos(-\theta) &= \cos(\theta) \\
\sin(-\theta) &= -\sin(\theta)
\end{aligned}$$

As an illustration of the required "formula exploitation", the fragment

```
c72 = (Math.sqrt(5.0)-1.0)/4.0;
s72 = Math.sqrt(1.0 – c72*c72);
c36 = Math.sqrt((c72 + 1.0)/2.0);
c18 = Math.sqrt((c36 + 1.0)/2.0);
s18 = Math.sqrt(1.0 – c18*c18);
s54 = c72*(-s18) + s72*c18;
```

assigns the value of $\sin(54°)$ to `s54.`(Review assignment statements and simple I/O.)

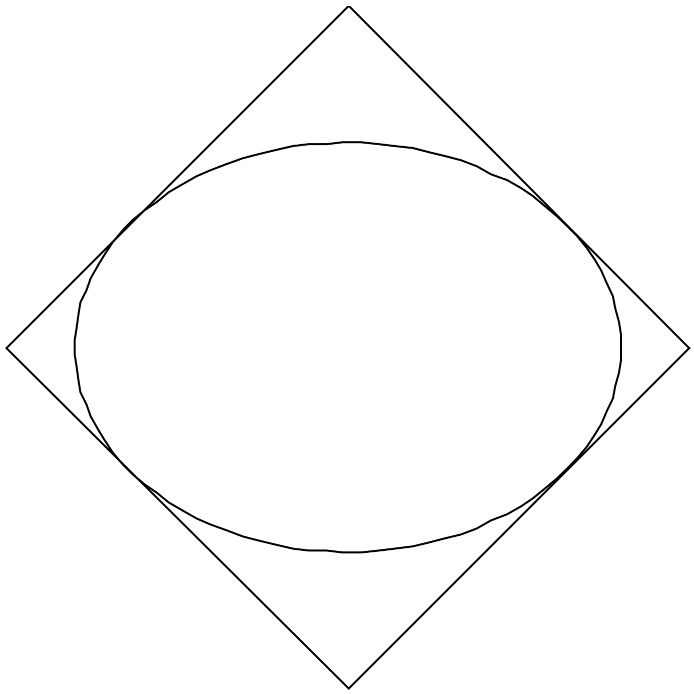
2. Write a Java program that solicits an integer time period T in seconds and then prints its equivalent in units of hours, minutes, and seconds. Thus, if T = 10000, then T = 2*3600 + 46*60 + 40 and your program should display the fact that 10000 seconds equals 2 hours, 46 minutes, and 40 seconds. (Review integer division and simple I/O.)

3. A sign on a taxi reads "5 dollars for the first eighth mile or fraction thereof and 2 dollars for each successive eighth mile or fraction thereof." Here is a small table that clarifies the method of charging:

Distance	Charge
0.10	5
0.20	7
0.99	19
1.00	19

Write a Java program that solicits the distance traveled (assumed to be a positive decimal) and prints the charge. (Try to use the method `Math.ceil` (see page 771) and think about the value of `Math.ceil(8*distance)`.)

4. The “bounding diamond” of an ellipse is amply defined in the following figure:



The diamond and the ellipse have the same center and the sides of the diamond are tangent to the ellipse. If the ellipse is specified by

$$\left(\frac{x - x_c}{a}\right)^2 + \left(\frac{y - y_c}{b}\right)^2 = 1,$$

then it can be shown that the vertices of the bounding diamond are on a circle with center (x_c, y_c) and radius $r = \sqrt{a^2 + b^2}$. Write a Java program that draws the above figure. Pick suitable values for a, b, x_c and y_c so that the plot occupies area sonable portion of the graphing window. (E.g., a = 100, b = 60, x_c = 250, y_c = 150.) Your program should encapsulate these four values as integer constants. (Browse through the program `P1A` and review the methods `drawOval` and `drawLine.`)