• **Plagiarism**
  
  – All work in CS 115 is to be done individually. The penalty for plagiarism on assignments (first offense) is an assigned mark of 0 percent on the assignment and a 5 percent reduction of the final grade, consistent with School of Computer Science policy. In addition, a letter detailing the offense is sent to the Associate Dean of Undergraduate Studies, meaning that subsequent offenses will carry more severe penalties, up to suspension or expulsion.
  
  – To avoid inadvertently incurring this penalty, you should discuss assignment issues with other students only in a very broad and high-level fashion. Do not take notes during such discussions, and avoid looking at anyone else’s code, on screen or on paper. If you find yourself stuck, contact the ISA or instructor for help, instead of getting the solution from someone else. Do not consult other books, library materials, Internet sources, or solutions (yours or other people’s) from other courses or other terms.

• Unless otherwise indicated by the question, you may only use the built–in functions and special forms introduced in the lecture slides from CS115 up to and including the modules covered by this assignment. A list of functions described in each module of the lecture slides can be found on the Course Website, at [https://www.student.cs.uwaterloo.ca/~cs115/built_in](https://www.student.cs.uwaterloo.ca/~cs115/built_in)

• **For this assignment only, you are not required to use the entire design recipe when writing functions. In each case, you are only required to include the function header and body. You are not required to include the purpose, contract, examples or tests.**

• The solutions you submit must be entirely your own work. Do not look up either full or partial solutions on the Internet or in printed sources.

• Do not send any code files by email to your instructors or tutors. Course staff will not accept it as an assignment submission. Course staff will not debug code emailed to them.

• Read each question carefully for restrictions.

• Test data for all questions will always meet the stated assumptions for consumed values.

• Download the interface file from the course Web page to ensure that all function names are spelled correctly, and each function has the correct number and order of parameters.

• Check Markus and your basic test results to ensure that your files were properly submitted. In most cases, solutions that do not pass the basic tests will not receive any correctness marks.

• Read the course Web page for more information on assignment policies and how to organize and submit your work. Follow the instructions in the Style Guide. Your solutions should be placed in files a01qY.rkt, where Y is a value from 1 to 3.

**Language level:** Beginning Student  
**Coverage:** Module 1

For this assignment you will be given mathematical formulæ that you must convert into Racket functions. The file a01interface.rkt contains the function header for each question. Define constants where appropriate.
1. The **volume**, $V$ of a cone with radius $r$ and height $h$ can be calculated as:

$$V = \frac{\pi r^2 h}{3}.$$ 

Write the function `cone-volume` that consumes the values of $r$ and $h$ (both real numbers), and produces the value of $V$ matching the given formula.  

For example, `(cone-volume 2.5 4)` produces approximately 26.17938779914945.

2. A stringed instrument with frets (like a mandolin or a guitar) must have its frets installed at the correct positions in order to play in tune. Let $S$ be the **scale length** in millimetres (a real number), i.e. the total length of the string that vibrates when it is not fretted anywhere. Let $n$ be the **fret number**, which is a natural number $0 \leq n \leq 24$. Then the required distance, $D$ (in millimetres), from the bridge to the $n^{th}$ fret is given by the formula:

$$D = \frac{S}{2^{\frac{n}{12}}}.$$ 

Write the function `distance-to-fret` that consumes the values $S$ and $n$, and produces the value of $D$ matching the given formula.  

For example, `(distance-to-fret 647.7 7)` produces approximately 432.28788677296563.

3. The **Lorentz factor** is an expression that appears in several equations in special relativity and is defined as:

$$\Gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}.$$ 

where $v$ is the relative velocity and $c$ is the speed of light in a vacuum which equals 299792458 m/sec. Write the function `lorentz-factor` that consumes the value $v$ (a real number), and produces the value of $\Gamma$ matching the given formula. You may assume that $1 > \frac{v^2}{c^2}$.

For example, `(lorentz-factor 50000000)` produces approximately 1.014205173377470.