Name: Solutions

- I will count your best 8 of the following 10 questions.
- You may only use Julia during this exam. No calculators or cell phones or notes.

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<td>Overall</td>
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(1) Convert the following Julia expressions to standard mathematical expressions. Do not simplify.

(a) \( x - \frac{y}{z+x} \)

\[
\frac{x}{2} + x
\]

(b) \( \frac{\sin(x^2)}{4x} \)

\[
\frac{x}{4} \sin(x^2)
\]
(2) Convert the following Julia expressions to standard mathematical expressions. Do not simplify.

(a) \( \cos(4x^2)^2/2 \)

\[
\frac{1}{2} \cos^2(4x^2)
\]

(b) \( x/y/z-1 \)

\[
\frac{x}{yz} - 1
\]
(3) Convert each of the following expressions to its Julia equivalent:

(a) $\frac{y + x}{x - y}$

$\frac{(y + x)}{(x - y)}$

(b) $\frac{1}{\frac{b}{1+c} - a}$

$\frac{1}{(b/(1+c) - a)}$
(4) Convert each of the following expressions to its Julia equivalent:

(a) \( \frac{\tan^2(3x)}{3} \)

\[ \frac{\tan(3x)}{2/3} = \sqrt{\tan(3x)} \]

(b) \( \frac{\sqrt{x-1}}{2} \)

\[ \exp(\sqrt{x-1})/2 \]
(5) You want to compute a decimal approximate to $1/\sqrt{11}$. Explain what the following Julia commands compute, or why they give an error.

(a) $1/11 \cdot 1/2$

\[
1/4/2 = \frac{1}{22}
\]

(b) $1/(11 \cdot 1/2)$

\[
1/(4/2) = \frac{2}{11}
\]

(c) Write down a Julia command which produces a decimal approximate to $1/\sqrt{11}$. Explain how to check your result.

\[
1/\sqrt{11} \approx 0.3015
\]

check: $1/(0.3015...)^2 \approx 11$
(6) Plot the function \( f(x) = \frac{e^x}{\sin(5x) + 2} \) on the interval \((2, 5)\).

(a) Sketch the graph.

(b) How many local maxima are there for the function? (Exclude endpoints)
(7) Write down Julia commands to define two functions \( f(x) = \frac{x+2}{3x} \) and \( g(x) = \cos^2(\frac{1}{3x}) \), and compute \( g(f(2)) \).

\[
\begin{align*}
  f(x) &= \frac{x+2}{3x} \\
  g(x) &= \cos \left( \frac{1}{3x} \right)^2 \\
  g(f(2)) &\approx 0.77015\ldots
\end{align*}
\]
(8) Write down Julia commands to define a function \( f(x) \) which has value \( x^2 \) for \(-1 \leq x \leq 1\) and 1 for other values of \( x \), and plot its graph to check you are correct.

\[
f(x) = \begin{cases} 
  x^2 & \text{if } -1 \leq x \leq 1 \\
  1 & \text{otherwise}
\end{cases}
\]

\[\text{plot}(f, -5, 5)\]
(9) Write down Julia commands to make a list of numbers from 1 to 15, and then a list of their cubes.
   Hint: you may use linspace and map.

\[ x = \text{linspace}(1, 15, 15) \]
\[ f(x) = x^3 \]
\[ \text{map}(f, x) \]
(10) Find the minimum value of $f(x) = e^x + 2/x^2$, for positive values of $x$, to two decimal places.

$$f(x) = \exp(x) + 2/(x^2)$$

plot $(x, 0, 10)$

plot $(f, 0, 1.6)$

e.g. then zoom in

$x \approx 1.10$ to 2 decimal places

min value of $f(x) \approx 4.66$