Name _____ Class Time _____

Math 2270 Maple Project 1
August 2008

Due date: See the internet due dates. Maple lab 1 has two problems L1.1, L1.2.

Submitted work. Please submit one stapled package, the top sheet handwritten. The final pages are appendices made by printing one or more maple work sheets. Hand work should do the steps shown in examples below. Maple code is expected to parallel the code given in the examples below.

Tutorials. Students without maple exposure should attend the maple tutorial held for 2270 in the second week of the semester. The brave may start their own tutorial by attempting this lab unaided or by starting with the maple online tutorial; see Example 3 below.

References: Code in `maple` appears in `2270mapleL1-F2008.txt` at URL `http://www.math.utah.edu/~gustafso/`. This document: `2270mapleL1-F2008.pdf`.

Problem L1.1. (Quadratic equation)

Solve the quadratic equation $ax^2 + bx + c = 0$ and display its factorization:
(A) $a = 8$, $b = 22$, $c = 15$;
(B) $a = 1$, $b = 2$, $c = 6$;
(C) $a = 2$, $b = 16$, $c = 32$.
In your solution, show the **solution steps by hand** and also the `maple` code which checks the answer. Details should parallel those of Example 1, below.

Problem L1.2. (Functions and plotting)

Define the following functions and plot domains, then plot them.
(A) $\sin(10\pi x)$, $0 \le x \le 1$.
(B) $|5\ln(4 + x) - 1|$,$-1 \le x \le 3$.
(C) Let $a = 7$, $b = 6$, $c = \pi/12$, $t_0 = 15$. Plot $a + b\cos(c(t - t_0))$, $0 \le t \le 48$.
(D) $\sinh(2\sin(\theta) + 3\cos(\theta))$, $-\pi \le \theta \le \pi$.
In the four solutions, show only the maple code and the graphics. Please shrink the graphics to 2×2 inches, before printing. See Example 2 and Hint L1.2 below.

Start the hand solution on this page. Staple this page on top of the maple work sheets.
Examples on the next page ...

Hint on L1.2: Investigate the help panels for `cos`, `abs`, `exp`, `sinh` and `sin`. See Example 3 for details on how to do this. The constant π is coded in `maple` as `Pi`, the upper and lowercase letters being significant. A common error is to code `c=Pi;` instead of the correct `c:=Pi;`. The error message *empty plot* can mean that a variable name is undefined. For example, `plot(x+PI,x=0..1);` will not plot. To see why, use `p:=plot(x+PI,x=0..1);` to display the plot data. The offending undefined variable name is `PI`, which is different than `Pi` or `pi`.

Example 1. Solve $2x^2 + 8x + 12 = 0$ by hand and check using `maple`.

Solution: Divide by 2. Then square-completion $(x+2)^2 + 2 = 0$ gives conjugate roots $x = -2 + \sqrt{2}i$, $x = -2 - \sqrt{2}i$. By the root-factor theorem of college algebra, the quadratic equation has factors $(x - \text{root 1})$ and $(x - \text{root 2})$. Then the factorization is $2(x + 2 - \sqrt{2}i)(x + 2 + \sqrt{2}i) = 0$, because FOIL expansion gives leading term $2x^2$.

The roots may also be found from the quadratic formula, in which case the root and factor theorems of algebra apply to translate each root $x = r$ into a factor $x - r$ of the quadratic equation.

The maple check reproduces the original quadratic equation from its factors and leading coefficient. The `maple` code is

```
eq:=2*x^2+8*x+12:
ans:=[solve(eq=0,x)];
eq1:=2*(x-ans[1])*(x-ans[2])=0;
expand(eq1);
```

Notation: Square brackets delimit an array, e.g., `F:=[-1,3,5];` defines array `F` with three elements -1, 3, 5. Symbol `F[1]` extracts the first element from array `F`, while `F[2]` extracts the second element.

Example 2. Define a function $y = x^2 + 5x + 6$ on $-4 \le x \le -1$ using `maple` and plot it.

Solution: The `maple` code which applies is

```
f:=unapply(x^2+5*x+6,x): a:=-4: b:=-1:
plot(f(x),x=a..b);
```

The construct `f:=unapply(x^2+5*x+6,x)` is an inline function definition. Subsequent use of the symbol `f` requires two parentheses and a function argument, e.g., `f(x)`, `f(-1.1)` are valid.

The inline function definition `f:=x->x^2+5*x+6` uses a minus sign `-` and a greater than sign `>` to separate the variable name `x` from the function definition `x^2+5*x+6`. This alternative construction may appear in later maple code. In this elementary example, there is no difference between the two constructs. The maple function `unapply` is more robust and produces fewer surprises for novice maple users.

Example 3. Get `maple` help.

Solution: Get help on maple's *unapply* function by entering `?unapply` into a `maple` worksheet. The question mark precedes the maple keyword. All maple help has examples, normally at the end of the help sheet. Here are some keywords to try:

> `unapply, plot, expand, factor, ifactor, solve, fsolve, array, set, for, do, parse, plot3d, dsolve, int, diff, newuser, exp, sin, cos, tan, sinh, cosh, ln, log`

Example 4. Run the `maple` tutorial in `maple` versions 6,7,8,9.

Solution: In a `maple` worksheet, enter `?newuser` and choose the *New User's Tour*. In the tour, you will learn some basics of `maple`.

End of Maple Lab 1.