NAME :

## Open book, open notes, open computer, but closed mouth!
## Write all answers on these sheets.

| question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | total |
|---|---|---|---|---|---|---|---|---|
| points | | | | | | | | |
| maximum | 10 | 15 | 15 | 10 | 20 | 15 | 15 | 100 |

1. Approximate $\sqrt{e}$ with 17 decimal places. Give the Maple command and its output.

/10

2. Give three examples of environment variables we have seen.

For each environment variable, write one line to explain the meaning of the variable.

/15

3. Consider the sequence `restart; r := t; t := s; s := "hello";`

   (a) Draw three pictures, one after each assignment, to illustrate the links between the variables.

   (b) Give the Maple commands to verify the links between the variables.

   (c) Complete the sequence `restart; s := "hello";` with the appropriate Maple command(s) to establish the same dependencies between the variables as the ones established by the sequence above.

   /15

4. Give the Maple commands to transform

   $$-85x^8 + 680x^6y - 2040x^4y^2 + 2720x^2y^3 + 55x^4 - 1360y^4 - 220x^2y + 220y^2$$

   into

   $$-5\left(x^2 - 2y\right)^2 \left(17\left(x^2 - 2y\right)^2 - 11\right).$$

   /10

5. Do `p := x*y + y - 8;` and consider the expression assigned to `p`.

    (a) Give the Maple command(s) (not the output!) to display the internal represen-
        tation of this expression.

    (b) Draw the directed acyclic graph which represents this expression.

    (c) Explain why `subs(1=Pi,p)` has $\pi$ in *every* term and also in the exponents.
        Be complete in your explanation.

/20

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6. Consider $r = \frac{6z^8 + 5z^4 + 1}{3z^8 + 4z^4 + 4}$.

   (a) How many operations does it take to evaluate $r$ in the form above?
       Give the Maple command(s) used to obtain this answer.

   (b) Convert $r$ into a continued fraction form and calculate again the number of
       operations it takes to evaluate $r$ in this form. List all Maple commands used.

   (c) What is the most efficient way to evaluate $r$?
       How many operations do you need in this case?

/15

7. Explain the difference between symbolic and numerical factorization of a polynomial
   in one variable.

   (a) Give an example where symbolic and numerical factorization are different.
       Give the polynomial and its symbolic and numerical factorization.

   (b) Give an example where symbolic and numerical factorization are the same.
       Give the polynomial and its symbolic and numerical factorization.

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