

NAME :

**Open notes & computer, but please do not ask questions.
Write all answers on these sheets.**

question	1	2	3	4	5	6	7	total
points								
maximum	15	10	20	25	10	10	10	100

1. The logarithm of 2 with base π is computed in Maple as `log[Pi](2)`.

The number $\frac{1604}{2649}$ is a rational approximation for `log[Pi](2)`.

In addition to the answers to the questions below, give also all relevant Maple commands you used to obtain your answers.

- (a) How many decimal places are correct in this rational approximation?

- (b) Give a rational approximation for `log[Pi](2)`, accurate with 16 decimal places.

2. Consider the instructions: `restart; V := L*A; A := Pi*r^2; L := 2; r := 3;`

- (a) Explain the links between the variables V , L , A , and r .
Give the Maple command(s) executed to show these links.

- (b) Suppose the sequence started with `restart; L := 2; r := 3;`
What are the Maple commands for A and V to obtain the same links as before?

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3. Consider the polynomial $p = 25x^3 + 12x^2 + 26x + 4$ over the integer coefficients modulo 29 (over \mathbb{Z}_{29}).

- (a) Does the polynomial factor over \mathbb{Z}_{29} ?
- (b) Give the Maple commands to add sufficiently many formal roots to \mathbb{Z}_{29} so p has three roots over the extended number field.

- (c) Write the symbolic factorization of p in linear factors below.

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4. Type `restart; q := (x^2 - y)/(y^2 - x)`; and answer the following questions:

(a) Give the command (*not the output!*) to display the internal representation of `q`.

(b) Draw the directed acyclic graph of the internal representation of `q`.

(c) Explain the outcome of `subs(-1=z,q)`; why does `z` appear as it does?

5. Consider the polynomial $p = 97x^{45} - 62x^{46} - 73x^{31}$.

What is the best way to evaluate p ? How many arithmetical operations are needed?
Give all relevant Maple commands and output.

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6. Type `restart; f := a+b^2; q := x - f + 1/(x - f);`

and give all Maple commands to transform q into $\frac{1 + (x - a - b^2)^2}{x - a - b^2}$.

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7. Explain why Maple automatically simplifies fractions such as $4/8$,
but not rational polynomial expressions such as $(x^2 - 1)/(x - 1)$.

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