

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	15	10	25	10	15	15	10	100

1. Give the Maple commands to

(a) generate a sequence s of 100 numbers using the formula $\frac{1}{k(k+1)}$, $k = 1, 2, \dots, 100$:

(b) use s to create a new sequence S ;
the k th element of S is the sum of the first k elements of s :

(c) show that the sum of the first n elements in s equals $\frac{n}{(n+1)}$:

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2. (a) Give an example illustrating the conversion of a formula into a function.

(b) Give an example illustrating the conversion of a function into a formula.

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3. Consider a procedure `nH` which returns the nested Horner form of a polynomial. The argument of the procedure is the variable of the polynomial. The coefficients of the polynomial are given by a sequence as index to the procedure, for example `nH[a3,a2,a1,a0](x)` returns $a_0 + x(a_1 + x(a_2 + a_3x))$. Observe that `nH[a0](x) = a0` and `nH[a3,a2,a1,a0](x) = a0 + x*nH[a3,a2,a1](x)`.

- (a) Use these observations to write a recursive procedure for `nH`. For simplicity, assume there is always at least one element in the index sequence to `nH`. Write your procedure so that Maple remembers the results of all calls of `nH`.

- (b) Execute `nH[a,b,c,d](x)`. Give the Maple command(s) to find the result of `nH[a,b,c](x)` without calling `nH` again.

4. (a) Explain the difference between automatic and symbolic differentiation.
Give the Maple commands for both types of differentiation.

- (b) When is automatic differentiation better than symbolic differentiation?
Give an example and explain why automatic differentiation is preferred.

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5. Find the number of candidate extremal values of $f(x, y) = 3xy + y^2 + 6$
for points (x, y) satisfying $g(x, y) = x^2 + y^2 - 1 = 0$.
It suffices to find *only* the number of candidate extrema, **not** their actual values.
Give all relevant Maple commands you used. **Justify your final answer.**

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6. Consider the curve defined by $p(x, y) = x^3 - y^2 = 0$. Give all commands to

(a) make a plot of this curve for x and y both in the interval $[-2, +2]$.

(b) convert p into polar coordinates (give the final result too):

(c) plot the curve in polar coordinates, using the **right** range for t :

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7. Consider the initial value problem $\frac{dy}{dt} - 3y = e^t$, $y(0) = A$, $y'(0) = B$.

(a) Give the Maple command(s) to define this problem.

(b) Give the Maple command(s) to compute a series solution with error $O(t^4)$.

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