Assessment of the exam in MEK4100, autumn 2018.

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1 Guidelines for evaluation of the exam papers

For each sub-problem the answer is split into a number of smaller topics/results/items. Each of these items are be rewarded by a given number of points, provided the item is presented correctly and with sufficient explanation and context. The general idea is that full score on the sub-problem corresponds to a complete and correct answer, that contains all the required parts. Larger errors, or omissions, may lead to a total loss of score on one or more items. Smaller errors, as algebraic ones, will generally lead to a penalty of one point. Generally, more points will not be withdrawn due to propagation of algebraic errors in derivations and in subsequent expressions. Minor errors may also go unpunished; it depends on the context.

For this exam the evaluation was performed according the limits
A: 92 (and above) , B: 77, C: 58, D: 46, E: 40

The list of points below and the brief rules above constitute only a tentative system of evaluation. An overall assessment of problems/sub-problems and the whole exam may lead to modifications in the total score.

Ex. 1 .

i. Transformation of the ODE, with the introduction of τ and ω. 3

ii. Stating of formal perturbation series for y and ω. 1

iii. Explicit statement of the requirement that y_j has period 2π. 1

iv. The $O(1)$ equations. 2

v. The $O(\epsilon)$ equations. 4

vi. Solution of the $O(1)$ equations. 1

vii. Rewriting of right hand side in the $O(\epsilon)$ equations as a combination of linear harmonics. 2

viii. Identification of secular terms, their removal, why they must be removed, and ω_1. 4

ix. The solution for y_1. 2

Maximum score on sub-problem: 3+1+1+2+4+1+2+4+2.

Ex. 2 .

a)

i. Finding $\vec{r}$, $\vec{v}$, T and V. 4

ii. Correct definition of L. 2

iii. Write out the Lagrange equations. 4

Maximum score on sub-problem: 4+2+4

b)

i. The first integral. 3

ii. Interpretation as energy. 2

Maximum score on sub-problem: 3+2

c)

i. Definition and introduction of p. 1

ii. Definition and expression for H. 4

Maximum score on sub-problem: 1+3

Ex. 3 .

a)

i. Transformation to Ricatti equation. 4

ii. The formulation of the dominant balance analysis. 4

iii. The k_0 (5) with check(1). 6

iv. The k_1 (5) with check(1). 6

Maximum score on sub-problem: 4+4+6+6

b)

i. Correct integral of k. 5

ii. Rewriting of solution (amplitude part $AW^{-\frac{1}{4}}$). 2

iii. Combining the two independent solutions. 3

Maximum score on sub-problem: 5+2+3

Ex. 4 .

a)

i. Scaling of concentrations and time. 4

ii. The elimination of x and y. 2

iii. Recognition of ϵ (3) and why small (1). 4

Maximum score on sub-problem: 4+2+4

A discussion of the dimensions of k and the concentrations are not required.

b)

i. State a power series in ϵ. 1

ii. Use of Taylor series for right hand side: 6

iii. The $O(1)$ equation. 2

iv. The $O(\epsilon)$ equation. 4

v. The $O(1)$ solution. 2

vi. Correct insertion in and re-writing of the right hand side of the $O(\epsilon)$ equation. 2

vii. The complete $O(\epsilon)$ solution. 3

Maximum score on sub-problem: 1+6+2+4+2+2+3

2 The results

There were few candidates and only the averaged score, broken down on each sub-problem, is reported. The marks correspond to application of the scale defined above on each sub-problem.

problem	% score	mark
1	90.0	B
2a	53.3	D
2b	70.0	C
2c	53.3	D
3a	90.0	B
3b	70.0	C
4a	68.3	C
4b	49.2	D

Comments

- The problem 1 is a standard problem, done as a week exercise, and was answered very well.
- Problem 3, concerning the WKB method, was also well answered, everything considered.
- The most alarming weakness was displayed in problem 2a. Most students were unable to do the very simple and standard kinematics that is needed to obtain the velocity of the particle.
- While 4a was well answered, in view of the uncommon context, the problem 4b was poorly answered. The main problem was the lack of ability to employ Taylor series expansion to the right hand side of the ODE in equation 3. This is disappointing since this has been stressed in class throughout the term.