Exercise 9

Task 1:

1. We assign priorities to tasks so that the system can choose which task to complete when we have several tasks who require the same resources.
2. A scheduler must be predictable in order for it to be usable in real-time systems.

Task 2:

1. Gantt chart without priority inheritance

Task/Time-step	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A					E							Q	V	E	
B			E	V		V	E	E	E						
C	E	Q								Q	Q				E

2. Gantt chart with priority inheritance:

Task/Time-step	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A					E			Q		V	E				
B			E	V					V			E	E	E	
C	E	Q				Q	Q								E

Task 3:

1. Priority inversion is when a task with lower priority is using resources that a higher prioritized task wants to use.
   Unbound priority inversion is a situation where a task with higher priority uses an infinite amount of time waiting for a lower prioritized task to finish using the resources.
2. Priority inheritance does not avoid deadlocks

Task 4:

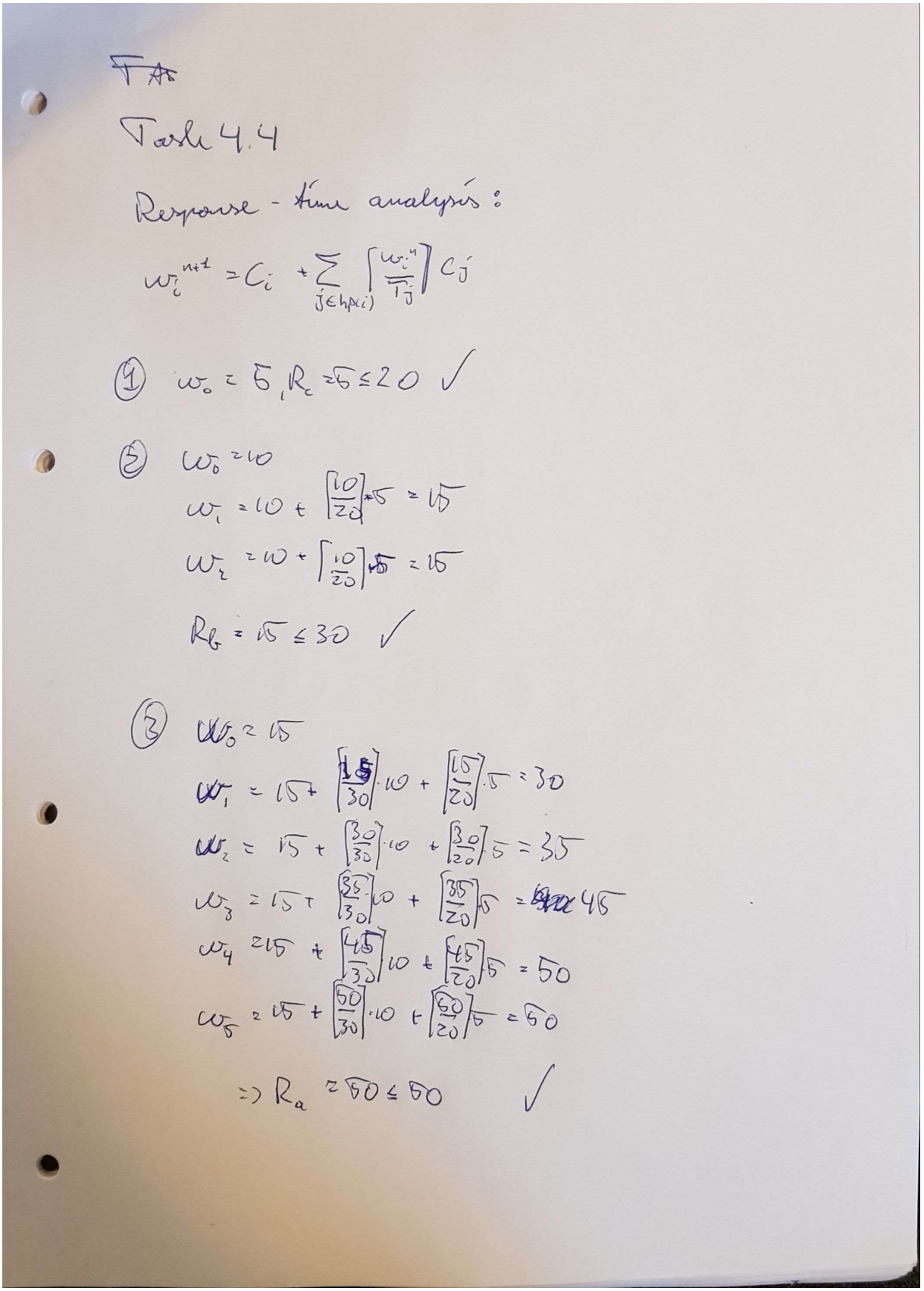
1. **There are a number of assumptions/conditions that must be true for the utilization and response time tests to be usable (The "simple task model"). What are these assumptions? Comment on how realistic they are.**
   The assumptions/conditions are:
   - Periodic tasks with a known execution time
   - A specified number of tasks independant of eachother
   - No Overhead

   It should be fairly realistic to fulfill these conditions.

2. **Perform the utilization test for the task set. Is the task set schedulable?**
   The utilization test: $U = \sum_{i=1}^{n} \frac{C_i}{T_i} \leq n(2^{\frac{1}{n}} - 1)$

   The left-hand side sums up to 0.88, and the right-hand side is approx 0.78, which mean the task set might **not** be schedulable.

3. **Perform response-time analysis for the task set. Is the task set schedulable? If you got different results than in 2), explain why.**



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Task 4.4

Response - time analysis:

$$w_i^{n+1} = C_i + \sum_{j \in hp(i)} \left\lceil \frac{w_i^n}{T_j} \right\rceil C_j$$

(1) $w_0 = 5, R_c = 5 \leq 20$ ✓

(2) $w_0 = 10$

$w_1 = 10 + \left\lceil \frac{10}{20} \right\rceil \cdot 5 = 15$

$w_2 = 10 + \left\lceil \frac{10}{20} \right\rceil \cdot 5 = 15$

$R_b = 15 \leq 30$ ✓

(3) $w_0 = 15$

$w_1 = 15 + \left\lceil \frac{15}{30} \right\rceil \cdot 10 + \left\lceil \frac{15}{20} \right\rceil \cdot 5 = 30$

$w_2 = 15 + \left\lceil \frac{30}{30} \right\rceil \cdot 10 + \left\lceil \frac{30}{20} \right\rceil \cdot 5 = 35$

$w_3 = 15 + \left\lceil \frac{35}{30} \right\rceil 10 + \left\lceil \frac{35}{20} \right\rceil 5 = 45$

$w_4 = 15 + \left\lceil \frac{45}{30} \right\rceil 10 + \left\lceil \frac{45}{20} \right\rceil 5 = 50$

$w_5 = 15 + \left\lceil \frac{50}{30} \right\rceil \cdot 10 + \left\lceil \frac{50}{20} \right\rceil 5 = 50$

$\Rightarrow R_a = 50 \leq 50$ ✓

As seen, the response-time analysis shows that the task set is in fact schedulable. In comparison to the test done in task 4.2, this test shows that the task set is sufficient and necessary, and not just sufficient.