

Appendix 5. Uses of DRS in revising rubric: The case of group 1

Step 1: N strategy in table 4 changes the unknown for the amount of change in the time interval from t to a in the revised rubric.

	score	criteria in the original rubric of (1)
(1)	0	In case of a blank or meaningless statement
	1	In case that $h(x) = at^3 + bt^2 + ct + d$ is denoted
	2	In the case of establishing a system of four equations by substituting $h(0)$
	3	In the case of where $h(t)$ was not found correctly because a, b, c, d was obtained incorrectly due to a calculation mistake in the process of performing the system of equations.
	4	When the system of equation is solved correctly without calculation errors and $h(t)$ is obtained correctly.
	score	criteria in the revised rubric of [1-1]
[1-1]	0	A blank or meaningless statement
	1	$h(x) = ax^3 + bx^2 + cx + d$ is denoted
	2	A system of three equations is provided $a + b + c + d = 80$ $3a + 2b + c = 80$ $64a + 16b + 4c + d = 140$
	3	A system of four equations by substituting $h(0) = 0$ is provided
	4	$h(t)$ was not found correctly; a, b, c, d was obtained incorrectly due to calculation errors
	5	The system of equation is solved correctly without calculation errors; and $h(x) = -5x^3 + 10x^2 + 75x$ is provided

Step 2: W strategy in table 5 changes contents related to the time interval and the range of a from the original rubric of (2) to the revised rubric of [1-2].

	score	criteria in the original rubric of (2)
(2)	0	In case of a blank or meaningless statement
	2	When only mathematical meanings such as instantaneous rate of change are described
	4	In the case of correlating revenue with mathematical meaning, such as the instantaneous rate of change of revenue when the time interval is 11 minutes
	score	criteria in the revised rubric of [1-2]
[1-2]	0	A blank or unclear statement or incorrect descriptions
	2	The profit increases is mentioned but the mathematical meaning i.e., "when the time interval becomes larger than $(10 + a)$ minutes, the profit is greater than when it is $(10 + a)$ minutes" is not provided

4	The profit increases is mentioned but the mathematical meaning i.e., “Since ‘ $h'(a) > 0$, the function of $h(x)$ increases in some interval containing $x = a$ and when the time interval becomes larger than $(10 + a)$ minutes, the profit is greater than when it is $(10 + a)$ minutes” is not provided
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Step 3: B strategy in table 7 changes contents related to two separate problems from the original rubric of (4) to two revised rubrics of [2-2] and [2-3].

	score	criteria in the original rubric of (4)
(4)	0	In case of a blank or meaningless statement
	1	When $g(t)$ and $h(t)$ are factored separately
	2	If only one of the case where the profit increases and the case of where the profit is maximum is found correctly
	3	If one solved the problem logically but didn't write the exact meaning like $3 < x < 15$ ($x \neq 10$), $x=13$
	4	When the time interval is between 3 and 10 minutes or between 10 and 15 minutes, the profit increases, and when the time interval is 13 minutes, the profit is maximum, etc.

	score	criteria in the revised rubric of [2-2]
[2-2]	0	A blank or unclear statement
	1	$g(x) = \frac{9}{8}x(x-8)(x+7) > 0$ <u>and</u> the solution of $-7 < x < 0$ <u>OR</u> $h(x) = -5x(x+3)(x-5) > 0$ <u>and</u> the solution of $0 < x < 5$
	2	$g(x) = \frac{9}{8}x(x-8)(x+7) > 0$ <u>and</u> the solution of $-7 < x < 0$ <u>AND</u> $h(x) = -5x(x+3)(x-5) > 0$ <u>and</u> the solution of $0 < x < 5$
	3	For each inequality, the range of x is obtained correctly, but the range of the time interval expected to increase the profit is incorrect
	4	The description is accurate, i.e. “when the time interval is between 3 and 10 minutes or between 10 and 15 minutes, the profit increases.”

	score	criteria in the revised rubric of [2-3]
[2-3]	0	A blank or unclear statement
	1	The change in average revenue has a maximum value when $x = 3$ in the function of $h(x)$, but the description of the time interval is not clear
	2	The function of $h(x)$ has a maximum value when $x = 3$ When the time interval is 13 minutes, the average profit during the rush hour is maximum