CCAP MATH 1100: Exam 2 Rubric

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Detailed Ratings

- **Meet Expectations:**
  1. Cogent solution which demonstrates good comprehension of the skill.
  2. Errors are insignificant. Explanation shows SUBSTANTIALLY understanding of the mathematical concepts used to solve the problem.
  3. Arguments are SUBSTANTIALLY constructed with relevant mathematical basis.
  4. A systematic approach, adequate correct reasoning and/or justification for reasoning is present.
- **Approaching Expectations:**
  1. Understandable solution which demonstrates reasonable comprehension of the skill.
  2. Errors are minor.
  3. Explanation shows SOME understanding of the mathematical concepts used to solve the problem.
  4. Arguments are made with some mathematical basis.
  5. Some correct reasoning or justification for reasoning is present with trial and error, or unsystematic trying of several cases.
- **Questionable/Not Yet Approaching Expectations:**
  1. Incomplete solution which demonstrates partial comprehension of the skill.
  2. Errors are significant.
  3. Explanation shows VERY LIMITED understanding of the underlying concepts needed to solve the problem(s).
  4. Arguments are made with NO mathematical basis.
  5. No correct reasoning nor justification for reasoning is present.
- **Unacceptable or No work:**
  1. Poor solution which demonstrates little to no comprehension of the skill.
  2. Errors are striking.
  3. No correct reasoning nor justification for reasoning is present.

Question 1(a) (4 points)

Criteria	Ratings		
Student demonstrates an attempt of using the quotient rule $f'(x) = \frac{g(x) \cdot h'(x) - h(x) \cdot g'(x)}{[g(x)]^2}$ where $f(x) = \frac{h(x)}{g(x)}$	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates the understanding of finding $g(x) \cdot h'(x)$ in the quotient rule.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates the understanding of finding $h(x) \cdot g'(x)$ in the quotient rule.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student has $[g(x)]^2$ in the numerator	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)

Question 1(b) (4 points)

Criteria	Ratings			
Student demonstrates that the understanding of the slope of a horizontal tangent line is zero by setting $f'(x) = 0$	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)	
Student correctly solve $f'(x) = 0$ for x.	Meet Expectations (3 pts.)	Approaching Expectations (2 pts.)	Questionable (1 pt.)	Not Assessable (0 point)

Question 1(c) (4 points)

Criteria	Ratings		
Student demonstrates the understanding of finding the critical values.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates the understanding of using the critical value to partition the number line into intervals.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates an attempt of using $f'(x)$ to determine the behavior of the graph of f (increasing/decreasing).	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates the understanding of using a test value to determine if the function is increasing or decreasing.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)

Question 2(a) (2 points)

Criteria	Ratings			
Student correctly finds $f'(x)$.	Meet Expectations (2 pts)	Approaching Expectations (1.5 pts.)	Questionable (1 pt.)	Not Assessable (0 point)

Question 2(b) (5 points)

Criteria	Ratings			
Student demonstrates the understanding of finding the critical values by solving the equation $f'(x) = 0$.	Meet Expectations (2 pts)	Approaching Expectations (1.5 pts.)	Questionable (1 pt.)	Not Assessable (0 point)
Student demonstrates the understanding of using the critical value to partition the number line into intervals.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)	
Student demonstrates an attempt of using $f'(x)$ to determine the behavior of the graph of f (increasing/decreasing).	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)	
Student demonstrates the understanding of using a test value to determine if the function is increasing or decreasing.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)	

Question 2(c) (3 points)

****NOTE**** Students do not need to show work when identifying the $x-$coordinates where a relative extremum occurs, as long as the answers agree with their work shown in part (c). However, they are required to show the calculation of relative max/min value (i.e. $y-$coordinates of relative max/min points).

Criteria	Ratings		
Student demonstrates the understanding of identifying a critical point as a relative maximum when the sign of $f'(x)$ changing from positive to negative (i.e.the function first increasing and then decreasing).	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates the understanding of identifying a critical point as a relative minimum when the sign of $f'(x)$ changing from negative to positive (i.e.the function first decreasing and then increasing).	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates the understanding of calculating relative maximum/minimum value by evaluating the function at $x = a$ where a is the $x-$ coordinate of the relative maximum/minimum point	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)

Question 2(d) (2 points)

Criteria	Ratings		
Student demonstrates the understanding of calculating the value of the function where at the lower bound ($x = -2$) by finding $f(-2)$.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates the understanding of calculating the value of the function where at the upper bound ($x = 7$) by finding $f(7)$.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)

Question 2(e) (2 points)

****NOTE**** Students do not need to show work as long as their answers agree with the results found in parts c-d.

Criteria	Ratings		
Student demonstrates the understanding of identifying the **absolute maximum** by using the results found in parts c-d. That is, comparing the value of the function at the lower bound, the value of the function at the upper bound, the relative max, and the relative min.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates the understanding of identifying the **absolute minimum** by using the results found in parts c-d. That is, comparing the value of the function at the lower bound, the value of the function at the upper bound, the relative max, and the relative min.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)

Question 3(a) (4 points)

Criteria	Ratings			
Student demonstrates the understanding of using a **General Power Rule:** $h(x) = [g(x)]^n$**,** $h'(x) = n[g(x)]^{n-1} \cdot g'(x)$.	Meet Expectations (2 pts)	Approaching Expectations (1.5 pts.)	Questionable (1 pt.)	Not Assessable (0 point)
Student demonstrates the understanding of using a **Constant Multiple Rule:** $\frac{d}{dx}(kf(x)) = kf'(x)$.	Meet Expectations (2 pts)	Approaching Expectations (1.5 pts.)	Questionable (1 pt.)	Not Assessable (0 point)

Question 3(b) (3 points)

Criteria	Ratings			
Student demonstrates an attempt to use chain rule.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)	
Student multiply $\frac{dp}{dt}$ to the expression of $\frac{dD}{dp}$ from part (a)	Meet Expectations (2 pts)	Approaching Expectations (1.5 pts.)	Questionable (1 pt.)	Not Assessable (0 point)

Question 3(c) (3 points)

Criteria	Ratings			
Student demonstrates an attempt to use the result from the part (b) and/or part (a) to answer the question.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)	
Student calculate the rate of change by substituting the given values of p, t and $\frac{dp}{dt}$ into the result from the previous parts.	Meet Expectations (2 pts)	Approaching Expectations (1.5 pts.)	Questionable (1 pt.)	Not Assessable (0 point)

Question 4(a) (4 points)

Criteria	Ratings			
Student demonstrates an attempt of using the product rule: $h'(x) = f'(x)g(x) + g'(x)f(x)$ where $h(x) = f(x)g(x)$.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)	
Student demonstrates the understanding of finding $f'(x)g(x)$ in the product rule .	Meet Expectations (1.5 pts.)	Approaching Expectations (1 pt.)	Questionable (0.5 pt.)	Not Assessable (0 point)
Student demonstrates the understanding of finding $g'(x)f(x)$ in the product rule .	Meet Expectations (1.5 pts.)	Approaching Expectations (1 pt.)	Questionable (0.5 pt.)	Not Assessable (0 point)

Question 4(b) (2 points)

Criteria	Ratings		
Student demonstrates an attempt to find the slope from $f'(x)$ found in the previous part.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates the understanding of finding the slope by calculating $f'(1)$.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)

Question 5 (8 points)

Criteria	Ratings		
Student solves for x (or y) from the constraint equation (See Notes 1-2 below).	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student rewrites the objective function in terms of one variable (See Notes 3-4 below).	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student finds the first derivative of the objective function (See Notes 5-6 below).	Meet Expectations / Approaching Expectations (1 pt)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates an attempt of finding critical values by either solving $V'(y) = 0$ or solving $V'(x) = 0$.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student demonstrates the understanding of either solving the equation $V'(y) = 0$ or solving the equation $V'(x) = 0$	Meet Expectations / Approaching Expectations (1 pt)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student solves for x (or y) from the constraint equation (See Notes 7-8 below).	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student finds the maximum volume by evaluating the objective function (the volume function).	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)
Student includes the appropriate units in their answers.	Meet Expectations / Approaching Expectations (1 pts)	Questionable (0.5 pt.)	Unacceptable or No work (0 pt.)

Notes:

1. For the first approach, finding the formula of y in terms of x.
2. For the second approach, finding the formula of x in terms of y.
3. For the first approach, rewriting the objective function in terms of x.
4. For the second approach, rewriting the objective function in terms of y.
5. For the first approach, finding the first derivative of the objective function with respect to x.
6. For the second approach, finding the first derivative of the objective function with respect to y.
7. For the first approach, solving for y from the constraint equation.
8. For the second approach, solving for x from the constraint equation.