

## 2012 Calculus Challenge Exam - Comments

1. (a) Many students did well on this part.  
(b) Common errors were:
  - Using a calculator to guess the limit
  - Attempting to substitute  $x = 2$  into the limit.(c) Many students used L'Hospital's rule to find this limit, instead of multiplying the numerator and denominator by  $\sqrt{x-2} + 2$ .
2. (a) Overall this part was well done, but some students confused  $\cos x^2$  with  $\cos^2 x$ .  
(b) Many students had difficulty with this question. Rather than taking logs of both sides and differentiating implicitly, many students incorrectly treated  $y$  as either a power function or an exponential function.  
(c) Many students found this question difficult also and had trouble applying the chain rule in this context.
3. (a) Overall this was well done, though some students gave a definition that did not contain the number  $a$ , while others left out the limit.  
(b) There were problems with notation in this question but otherwise this was well done.  
(c) Most students found the tangent line correctly.
4. (a) This was generally well done. Some students had difficulty finding an antiderivative for  $2 \cos x$  (common incorrect answers were  $\cos^2 x$  and  $\sin 2x$ ). Some students had trouble finding the constant term from the initial condition, or else left out the constant term completely.  
(b) Common errors were
  - Confusing  $\frac{d^2y}{dx^2}$  with  $\left(\frac{dy}{dx}\right)^2$ .
  - Failing to realize that a horizontal line at  $x = 0$  corresponds to a zero of the derivative.

5. This question was done reasonably well.
  - (a) Many students gave a left-endpoint approximation. Some students omitted the factor  $\Delta x$  from the sum. There were also many arithmetic errors.
  - (b) Most students found the integral correctly.
6.
  - (a) This question was later omitted from the exam because the Intermediate Value Theorem is excluded from the Calculus 12 curriculum.
  - (b) This question was later omitted from the exam because the Intermediate Value Theorem is excluded from the Calculus 12 curriculum.
  - (c) Overall this question was done poorly. Many students did not demonstrate a good understanding of the definition of continuity, and there were several answers given that made no mention of a limit.
7.
  - (a) Overall this question was done well. Some students used the wrong formula. Others did not give a recursive formula and simply wrote  $x = x - \frac{f(x)}{f'(x)}$  instead of  $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$ .
  - (b) There were no common errors for this part.
8. Overall this question was done well. However, some students displayed serious gaps in their understanding of the graphs of functions. Among the more serious errors were:
  - Some students thought that the graph would have a horizontal asymptote as long as they drew a dotted line, regardless of whether or not values of the function converge to it as  $x \rightarrow \infty$  or  $x \rightarrow -\infty$ .
  - Some students sketched a curve that was not a function.
9. Overall this question was well done. Some students omitted units from their answers.
10. This question was done reasonably well. Some students had difficulty with applying the chain rule and/or the quotient rule when differentiating implicitly in the the first step.
11. Some students had difficulty recalling Newton's Law of Cooling. Those that could recall did well overall, but some omitted the final step of finding the time difference.
12. Overall this question was well done. Some students had difficulty applying the chain rule when differentiating the volume and surface area with respect to time.
13. Many students had difficulty finding a function to represent the number of apples produced in the orchard. A common error was to neglect checking that the critical point corresponds to a maximum value of the function.

14. Overall this was well done. A common error was to omit the constant term when finding the general antiderivative.