University of Nottingham
School of Mathematical Sciences

Feedback for Coursework Assignment 1

The coursework was marked out of 100. Generally, the standard of the answers was very good, so well done!

- **Question 1** was answered very well by most students, although very few checked to see if adding up the partial fractions leads to the original function. A small minority "checked" the results by considering one or two particular values for x (this is no check...).

- **Question 2**: almost everyone got the derivative of $f(x)$ for the first part. However, there were many unnecessary lengthy calculations using all sorts of intermediate notations. This indicates that many of you have not given enough attention to the actual presentation of the submitted work. Also, many of those who attempted to check the relationship between the derivatives did so by first calculating the second derivative, which turned out to be a big mess. The question is a lot simpler if one differentiates the result proved for the first-order derivative. Very few noticed this.

  Action: See the solution and compare your attempt with it.

  The second half of the question required you to apply the formal definition of the derivative for two particular functions. Many did this very well, but some simply disregarded the question and calculated the (trivial) derivatives using the quotient rule. There were some solutions which contained insufficient justification of known results; this attracted some lost marks. Also, a common error was writing things like

  $$\lim_{h \to 0} \frac{1}{\cos^2 x},$$

  or using a similar limit sign in front of an expression independent of h. Please remember, once the limit has been taken, the limit sign should no longer appear in your expressions.

  Action: See *Chapter 2* and the two solved examples on how to calculate derivatives from first principles.

- **Question 3**: the first part was done impressively well; many got the correct result for the derivative. The problem was with solving the trig equation for finding the stationary points. Some used a complicated formula for $\tan 3x$ to show that it all boils down to solving $\tan 3x = \tan x$, but this equation was solved by guessing rather than noticing that $3x = x + k\pi$, for some $k \in \mathbb{Z}$. Since the solutions of interest were supposed to be in $[0, \pi]$, the only good choices are $k = 0, 1, 2$. The choice $k = 1$ must be discarded since neither $\tan x$ nor $\tan 3x$ are defined for $x = \pi/2$.

  Action: Use the recommended texts (and your school books) to revise standard facts about trigonometry (especially solving equations like $\sin x = \sin a$, $\cos x = \cos a$ and $\tan x = \tan a$, where $a \in \mathbb{R}$ is given).

The second half of the question was done poorly by many students ($\simeq 35\%$ in my guess). There was significant confusion about what to do, despite several examples being available on Moodle. The parity of a function (even or odd) is a global feature that involves all x-values in the domain of that function. Just picking up a random number, x_0 (say), and showing that $f(-x_0) = f(x_0)$ (or $f(-x_0) = -f(x_0)$) does not prove anything about the parity of $f(x)$. The definitions for even and odd functions are stated in $Chapter\ 1$ (slide 12), where it is mentioned that they must hold 'for all x'.

Action: Read your notes carefully by paying close attention to details. Study the examples posted on Moodle.

- **Question 4**: this is the chemistry-related example. A large number of students considered the actual numerical value for the Bohr radius and made life hard for themselves by doing all the calculations with some very awkward-looking functions. With those cumbersome coefficients even solving a simple quadratic becomes a major challenge. The solution to this question required you to notice that the expression of the given function simplifies considerably by setting $x = r/a_0$. This was actually hinted at in the last part of the question which asked for a plot of $a_0^{3/2} R_{3s}$ as a function of r/a_0. There were less than 10 students who actually used this substitution.

Action: Read the statements of the questions carefully in order to make sure you understand what you are asked to do. If some piece of information is not given to you (e.g., a_0 in this question) it means that you do not need it. Read the solution posted on Moodle and compare it to your attempt.