University of Nottingham
School of Mathematical Sciences

MM1MTE (Spring 2019): Coursework Feedback

- **Question 1**:

  Many good solutions for this question, despite the fact that it was not an easy one. Quite a few students noticed that the expression for the speed can be simplified considerably, and

  $$\frac{du}{dt} = \frac{2}{2u^2 + 1}\,.$$

  Some marks were lost for not making it clear how the chain rule is applied, for not underlining vectors and, in general, for poor explanations. A common mistake was to ignore the dependence of 'u' on 't', and saying that $\mathbf{v} = d\mathbf{r}/du$. Of course, this approach cannot lead to the correct solution. In a few instances the velocity was calculated correctly, but the students missed the fact that the acceleration required another application of the chain rule. A two-dimensional version of a similar type of question was worked out in detail in one of the problem classes.

- **Question 2**:

  Overall, everyone who attempted this question got the correct partial derivatives (which were relatively easy to calculate). The value $m = 2$ was also guessed by many, but the arguments for the justification of that step were missing in many instances. Please see the marking scheme on Moodle, which shows how the marks were distributed.

- **Question 3**:

  This is where many students lost a substantial amount of marks. This was meant to be a straightforward application of the formula given in the notes. The purpose of the question was to provide you with further opportunities for calculating partial derivatives, one of key concepts in this particular module. Unfortunately, a large number of students chose to disregard the information in the notes and provided incorrect solutions (from various "textbooks"). The starting point for those "solutions" was the formula

  $$dR = \frac{\partial R}{\partial R_1} dR_1 + \frac{\partial R}{\partial R_2} dR_2 + \frac{\partial R}{\partial R_3} dR_3\,, \qquad (1)$$

  instead of

  $$\Delta R = \frac{\partial R}{\partial R_1} \Delta R_1 + \frac{\partial R}{\partial R_2} \Delta R_2 + \frac{\partial R}{\partial R_3} \Delta R_3\,. \qquad (2)$$

  There are many differences between these two formulae. For example, equation (1) is exact, while equation (2) is just an approximation of the Taylor expansion formula. In this latter case, if $R = f(R_1, R_2, R_3)$ then the left hand side is (by definition)

  $$\Delta R = f(R_1 + \Delta R_1, R_2 + \Delta R_2, R_3 + \Delta R_3) - f(R_1, R_2, R_3)\,;$$

ΔR and ΔR_1, ΔR_2, ΔR_3 represent finite changes in the corresponding variables. By contrast, dR, dR_1, dR_2, dR_3 in (1) are differentials (infinitesimal quantities). In problems involving small changes/errors we use equation (2).

If you choose to use your own approach to solve this type of question, then you are expected to provide full explanations. The formula in the notes does not require any justification, as long as you know how to apply it (it only requires evaluating the so-called pre-factors and plugging in the percentanges for the relative changes in the independent variables).

- **Question 4**:

  A standard question which did not present any problems for most students. A few marks were lost in some isolated cases for sloppy notation (i.e., vectors were not underlined, etc).

- **Question 5**:

  A relatively large number of students did not attempt this question. The purpose of the question was to help you become familiar with the properties of the triple scalar product (discussed in section 4.5 of the chapter on vectors). Many of those who provided solutions for the first part used the determinant formula for the triple scalar product, which makes the solution a bit more cumbersome than it should be. The second part of the question required identifying particular points on the two lines as well as their direction vectors. This went very well in many cases.

Detailed solutions together with the marking scheme are posted on Moodle. You should study them carefully and compare them with your work.