

## Advanced Calculus (MAU11202), Homework Assignment 1 Solutions

Straightforward

1. **[3 points]** Find the derivative of the vector-valued function

$$\mathbf{r}(t) = \left( \frac{t^2 - 1}{t^2 + 2}, \sin(t) \ln(t), \cos(\sin(t)) \right).$$

What is  $\mathbf{r}'(1)$  equal to?

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**Solution:**

To differentiate  $\mathbf{r}(t) = (x(t), y(t), z(t))$ , we differentiate the three component functions separately.

Using the Quotient Rule,

$$x'(t) = \frac{2t(t^2 + 2) - 2t(t^2 - 1)}{(t^2 + 2)^2} = \frac{2t^3 + 4t - 2t^3 + 2t}{(t^2 + 2)^2} = \frac{6t}{(t^2 + 2)^2}.$$

Using the Product Rule,

$$y'(t) = \cos t \ln(t) + \sin(t) \cdot \frac{1}{t} = \cos(t) \ln(t) + \frac{\sin(t)}{t}.$$

Using the Chain Rule,  $z'(t) = \cos(t)(-\sin(\sin(t))) = -\cos(t) \sin(\sin(t))$ .

Hence

$$\mathbf{r}'(t) = \left( \frac{6t}{(t^2 + 2)^2}, \cos(t) \ln(t) + \frac{\sin(t)}{t}, -\cos(t) \sin(\sin(t)) \right).$$

Letting  $t = 1$  in this expression, we obtain

$$\begin{aligned} \mathbf{r}'(1) &= \left( \frac{6(1)}{(1^2 + 2)^2}, \cos(1) \ln(1) + \frac{\sin(1)}{1}, -\cos(1) \sin(\sin(1)) \right) \\ &= \left( \frac{2}{3}, \sin(1), -\cos(1) \sin(\sin(1)) \right). \end{aligned}$$

2. **[3 points]** Find the derivative of the vector-valued function

$$\mathbf{r}(t) = (2t^3 - 3t^2 + 5t + 3) \left( \frac{t^2 - 1}{t^2 + 2}, \sin(t) \ln(t), \cos(\sin(t)) \right).$$

What is the domain of this function?

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**Solution:**

Here we use Theorem 1.2.11(c) (Chapter 1 of course notes by Anthony Brown), the solution to Question 1, and the fact that the derivative of  $f(t) = 2t^3 - 3t^2 + 5t + 3$  is  $F'(t) = 6t^2 - 6t + 5$ , to obtain

$$\begin{aligned} \mathbf{r}'(t) &= (2t^3 - 3t^2 + 5t + 3) \left( \frac{6t}{(t^2 + 2)^2}, \cos(t) \ln(t) + \frac{\sin(t)}{t}, \cos(t) \cos(\sin(t)) \right) \\ &\quad + (6t^2 - 6t + 5) \left( \frac{t^2 - 1}{t^2 + 2}, \sin(t) \ln(t), \cos(\sin(t)) \right). \end{aligned}$$

The domain of  $\mathbf{r}$  is  $\mathbb{R} \cap (0, \infty) \cap \mathbb{R} = (0, \infty)$ .

# Calculus Homework Solutions

**Margaret L. Lial, Raymond N.  
Greenwell, Nathan P. Ritchey**



## Calculus Homework Solutions:

## **Calculus Homework Solutions** Book Review: Unveiling the Magic of Language

In a digital era where connections and knowledge reign supreme, the enchanting power of language has been apparent than ever. Its ability to stir emotions, provoke thought, and instigate transformation is really remarkable. This extraordinary book, aptly titled "**Calculus Homework Solutions**," compiled by a highly acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound affect our existence. Throughout this critique, we will delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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