Glasgow Caledonian University

Questions for drop-in

Mars

Question - Differentiation

What is the derivative of $f(x) = \sin(2x) + x^3 - x^{-2}$ (with respect to x)?

Question - Differentiation and logs

Using the 'rules of logarithms' fact that $\log(ab) = \log(a) + \log(b)$ explain why the derivatives of $\log(x)$, $\log(2x)$, $\log(3x)$ and $\log(4x)$, all have the same answer.

This rule is normally called the First Log Law. It would be beneficial to write the other two out for revision.

Question - Composition of functions

Re-write $h(x) = \sin(3x + 2)$ as a *function of a function*, i.e. as $h(x) = f(g(x))$ for some f and g.

Take care here in making sure your presented f and g both contain dummy variable letters in their descriptions. This question is not asking you to do the differentation, but you can if you wish.

Question - The chain rule formula

If function $h(x) = f(g(x))$ then state the formula for $h'(x)$ (the derivative of h with respect to x).

Question - Using the chain rule

Let $h(x) = \log(3x^2 + x + 4)$. First write h as a function of a function. Then find the derivative of h with respect to x. Try and write your answer as a fraction of functions.

Question - Using the chain rule

Let $u(x) = e^{x^2+1}$. First write u as a function of a function. Then find the derivative of u with respect to x. Use your answer to identify the only value of x where the gradient is zero (i.e the only stationary point of the function).

Question - Extending derivatives to classify stationary points (advanced)

The power, P, transmitted through fluid-filled pipes in a hydaulic braking system can be written as

$$P = k\left(V - cV^3\right)$$

where k and c are both constants which depend on system quantities (like pipe length, diameter etc.). The key quantity we consider varying here is V, the fluid velocity.

(i) By calculating $\frac{\mathrm{d}P}{\mathrm{d}V}$ find the stationary points of P, then

(i) by calculating $\frac{\mathrm{d}^2P}{\mathrm{d}V^2}$ find which stationary point is a maximum.

An extended version of this problem appears in HELM Worksheet 12.2: Maxima and Minima as Engineering Example 3 if you wish to read further.

This is again quite hard. The extra constants can make it hard to focus on the key variable, the V in this case is the variable for our differentiation. If you change all the V's into x's you might find it easier to relate to the theory.