Massachusetts Institute of Technology

Mathematical Methods for Materials Scientists and Engineers

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W. Craig Carter

Department of Materials Science and Engineering
Massachusetts Institute of Technology
77 Massachusetts Ave.
Cambridge, MA 02139

Problem Set 1: Due 13 Sept. 2010, box by 13–5018, stapled

The assigments should be a combination of your hand-worked solutions and other printed material—they should stapled be placed in the mailbox outside Prof. Carter's door.

Attach your signed copy of `http://web.mit.edu/academicintegrity/violations/examples.html` to the homework.

Individual (Handworked) Exercise I1-1

Find the derivative df/dx

$$f(x) = \frac{1}{(1/2 + \sin^x(x))}$$

Individual Exercise I1-2

1. Define a variable $x = 1 + y$ and display the results of expanding x^2, x^4.
2. Define a variable, z, where
$$z = \exp\left(\int_0^{x^2} \frac{s}{1+s^2}\, ds\right)$$
assuming that y is a real number. Display z in several different ways (i.e., factor it, etc.).
3. Find the derivative
$$\frac{d}{dy}(1+x)^z$$
4. Plot the above derivative for $-3 < y < 0$. Comment.

Individual Exercise I1-3

1. Define a function in mathematica that takes two arguments $f(x, n)$ and returns a list $(x^0, x^1, x^2, \ldots, x^n)$. Use this function to create a list of powers of 2 up to 2^{12}, (i.e., $(1, 2, \ldots, 2^{12})$
2. Divide every member of the list, $(1, 2, \ldots, 2^{12})$, by 2. Subtract this list from $f(2, 12)$
3. Use your function to create a list $(1, YourName, YourName^2, \ldots, YourName^{100})$

Individual Exercise I1-4

1. Find the indefinite integral
$$\frac{2\sqrt{\alpha}}{\pi} \int e^{-\alpha x^2}\, dx$$
2. Plot (in the same graph) the resulting expression for $-5 < x < 5$ for several equally spaced values of α where $0 \leq \alpha \leq 1$