Phys 208 – Homework (HW12) – SP13  (Due Wednesday, February 27, 2013)

Read the following:  Ch 4-Sect 12  Differentiation of integrals; Leibniz’ Rule
Ch 5- Sect 4  Change of variables in integrals; Jacobians


Answers:  4.12.8  \( \frac{dx}{du} = e^{x^2} \)  4.12.11  \( 3x^2 - 2x^3 + 3x - 6 \)

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Phys 208 – Homework (HW13) – SP13  (Due Friday, March 1, 2013)

Read the following:  Ch 6 -- Sect. 4  Differentiation of Vectors

Problems: Ch 5 – 5.4.14, 5.4.19, 5.6.25, 5.6.27

Answers:  5.6.25  \( \pi / 2 \)

HW13.1  Verify the integral in problem 4.12.15, namely that \( \int_0^\infty e^{-ax} \sin kx \, dx = \frac{k}{a^2 + k^2} \).  Carry out the integral \( \int_0^\infty e^{-ax} e^{ikx} \, dx \) to determine both of the integrals \( \int_0^\infty e^{-ax} \sin kx \, dx \) and \( \int_0^\infty e^{-ax} \cos kx \, dx \).

HW13.2  Find the general form for the integral \( I_n = \int_0^\infty \frac{dx}{(y^2 + x^2)^{n+1}} \) for \( n = 1, 2, 3, \ldots \), given that \( I_0 = \int_0^\infty \frac{dx}{y^2 + x^2} = \frac{\pi}{2y} \).  Hint: set \( a = y^2 \) and take derivatives with respect to \( a \) to generate the desired integral.  Answer:  \( I_n = \frac{\pi (2n-1)!!}{n! 2^{n+1} y^{2n+1}} \).

HW 13.3 (4.12.16)  In the kinetic theory of gases one has to evaluates integrals of the form

\[
I_m = \int_0^\infty t^m e^{-at^2} \, dt.
\]

Given that \( \int_0^\infty e^{-at^2} \, dt = \frac{1}{2} \sqrt{\frac{\pi}{a}} \), evaluate \( I_m \) for \( m = 1, 2, 3, \ldots \)

Answer:  \( I_m = \frac{(2m-1)!!}{2^{m+1} a^m} \sqrt{\frac{\pi}{a}} \).