PHAS1245: Mathematical Methods I - Problem Sheet 2

(Solutions to be handed in at the lecture on Tuesday 16th October 2007)

Staple your answer sheets together and put **your name** and your **tutor's name** on your script (or Dr. Konstantinidis, if you have no tutor in the P&A department).

1. Find the first derivative (d/dx) of $x^2 e^x$. [3]

2. Show that [3]
$$\frac{d}{dx} ln(a^x + a^{-x}) = \frac{(a^x - a^{-x})}{(a^x + a^{-x})} ln\ a\,.$$

3. Find the first derivative of $ln\ (x^a + x^{-a})$. [3]

4. Find the first derivative of x^x. [3]

5. Find the first derivative with respect to r (regarding θ as a constant) of [3]
$$\frac{1}{(r^2 + d^2 - 2rdcos\theta)^{\frac{1}{2}}}\,.$$
(Note that this derivative is a partial derivative - see later in the course.)

6. Find the first derivative of $y = \arcsin x$. [4]

7. A tunnel cross-section is to have the shape of a rectangle surmounted by a semicircular roof. The total cross-sectional area must be A, but the perimeter minimized to save building costs. Find its dimensions. [5]