**MATH 209/4 all sections except EC: - Fundamental Mathematics II**
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**Midterm - Sunday, March 2, 2014 (1h30min) 14:00-15:30**
**Only approved calculators are permitted.**

*MARKS*

[7] **1.** (a) Find $\lim_{x\to 3} \dfrac{x^2-7x+12}{x^2-x-6}$.

[8] (b) Give an example of a function $g(x)$ and a function $h(x)$ with the following properties:

(i) $\lim_{x\to 7} g(x) = 0$ (ii) $\lim_{x\to 7} h(x) = 0$ (iii) $\lim_{x\to 7} \dfrac{[g(x)]^2}{h(x)} = 2$

[7] **2.** Let $k(x) = x^3 - 5$. Work out the following in detail: $\lim_{s\to 0} \dfrac{k(x+s)-k(x)}{s}$

[12] **3.** (a) If $f(x) = 4x^{\frac{3}{4}} - x^{-6}$, find $f'(1)$. You don't have to simplify the answer.

(b) If $g(x) = [4x^3+7]\,[3-\ln(x^2)]$, find $g'(2)$. You don't have to simplify the answer.

(c) Find $h'(x)$ if $h(x) = \dfrac{x^2 - \frac{1}{x}}{e^x - x^2}$. You don't have to simplify the answer.

(d) Find the value of $dy$ if $y = \ln(x+1)$, $x = 3$, and the change in $x$ is 0.2.

[6] **4.** A stock grew from \$35 to \$120,000 in 43 years. Assuming continuous compounding, what is the associated annual rate of growth?

[10] **5.** The total profit (in dollars) from the sale of $x$ lawn mowers is $P(x) = 30x - 0.03x^2 - 750$, $0 \le x \le 1{,}000$.

(a) Find the average profit per mower if 50 mowers are produced.

(b) Find the marginal average profit at a production level of 50 mowers, and interpret the results.

(c) Use the results from parts (a) and (b) to estimate the average profit per mower if 51 mowers are produced.

[10] **6.** Find $x'$ for the function $x = x(t)$ defined implicitly by $1 + x\ln t = te^x$ and evaluate $x'$ at $(t,\ x) = (1,\ 0)$.

[10] **7.** A person who is new on an assembly line performs an operation in $T$ minutes after $x$ performances of the operation, as given by

$$T = 6\left(1 + \frac{1}{\sqrt{x}}\right)$$

If $dx/dt = 6$ operations per hour, where $t$ is time in hours, find $dT/dt$ after 36 performances of the operation.