MATH6103 Differential & Integral Calculus
MATH6500 Elementary Mathematics for Engineers

Problem Sheet 3

Deadline: **Monday 24 October, 5:00**.
Hand in to **the drop box** in the undergraduate common room (maths department, room 502).

Hand in the questions marked with an asterisk (*).

One mark will be deducted if you do not **staple your work**.

1) Differentiate the following functions:

* a) $a(x) = x^2 - \frac{1}{x^2}$
  b) $b(x) = 4\sqrt{x}$
  c) $c(x) = x^8 + \cos x$
* d) $d(x) = 359x^{17}$
  e) $e(x) = \sin^2 x$ [Hint: chain rule]
* f) $f(x) = \sin(x^2)$ [Hint: chain rule]
* g) $g(x) = xe^x$ [Hint: product rule]
  h) $h(x) = (x+2)\sin x$ [Hint: product rule]

2) Differentiate the following functions:

* a) $i(x) = \cos(4 + 3x^2)$
  b) $j(x) = x^2 \sin x$
  c) $k(x) = \sin(e^x)$
* d) $l(x) = \cos(\sin x)$
  e) $m(x) = 2^x$
  f) $n(x) = e^x \sin x \cos x$
* g) $o(x) = \sqrt{\sin x + \cos x}$
  h) $p(x) = \left(x^{10} - x^2 \sin x\right)^2$

3) Find the x co-ordinates of the turning points of the following:

  a) $q(x) = e^{x^3 - 27x}$
* b) $s(x) = x^3 - 108x$
* c) $r(x) = x^3 + 3x^2 + 2x - 8$
* d) $t(x) = \sin x + \cos x$, $-\frac{\pi}{2} < x < \frac{\pi}{2}$

Challenge 1: Differentiate x^x

Challenge 2: Use the product and chain rules to show that:

$$\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$$

$\left[\text{Hint: Use } \frac{f(x)}{g(x)} = f(x)(g(x))^{-1}\right]$