Maths for Actuarial Science Coursework 1

This is an assessed coursework, and will count towards your final grade. Solutions should be handed in to the **mathematics general office** (CM326) by **noon on Thursday 17th November**. Late submissions will be penalised.

1. The first, second, third, and rth terms of a series are

$$3, \quad -1, \quad -4 \quad \text{and} \quad \left(A + Br + \frac{C}{2^r}\right)$$

   respectively, where A, B, and C are constants. Determine these constants and prove that the sum of the first n terms of the series is

$$8 - n^2 - 2^{-n+3}.$$

2. An ellipse has foci at $(2, \pm 1)$ and major axis of length 6. Find the Cartesian equation for the curve.

3. Find in terms of π all solutions to the equation

$$2 \cos^2 2\theta - \sin 2\theta = 1$$

   in the range $0 \le \theta \le 2\pi$.

4. Find the first and second derivatives (with respect to x) of

   (a) $\tan^2(2x^2 + 3)$ (b) $x = 4t^2 - 6t + 1$ and $y = t^3 - 2t^2$

5. Evaluate the following integrals:

   (a) $\displaystyle\int \frac{3 + x^3}{(1 + x)^2(1 - x)}\, dx$ (b) $\displaystyle\int x^2 \sin(4x)\, dx.$

6. Express $\sin(2 \tan^{-1} x)$ in terms of x only.