Q1

[Maximum mark: 4]

Solve the equation $\log_2(x^2 - 2x + 1) = 1 + \log_2(x - 1)$.

Q2

[Maximum mark: 6]

Consider the complex number $z = \frac{w_1}{w_2}$ where $w_1 = \sqrt{2} + \sqrt{6}\mathrm{i}$ and $w_2 = 3 + \sqrt{3}\mathrm{i}$.

(a) Express w_1 and w_2 in modulus-argument form and write down

(i) the modulus of z;

(ii) the argument of z. [4]

(b) Find the smallest positive integer value of n such that z^n is a real number. [2]

Q3

[Maximum mark: 5]

Solve the equation $15^{4y} = 81^{y+2}$ for y. Express your answer in terms of $\ln 3$ and $\ln 5$.

Q4

[Maximum mark: 4]

Peter needs to decide the order in which to schedule 14 examinations for his school. Two of these exams are Mathematics (1 SL and 1 HL).

Find the number of ways Peter can schedule the 14 exams given that the two Mathematics subjects must not be consecutive.

Q5

[Maximum mark: 5]

(a) Write down the quadratic expression $3x^2 + 5x - 2$ as the product of two linear factors. [1]

(b) Hence or otherwise, find the coefficient of x^9 in the expansion of $(3x^2 + 5x - 2)^5$. [4]