

# Abronnhill High School

*Prelim Examination 2011 / 2012*  
*(Assessing Unit 3)*

## **MATHEMATICS**

### **Advanced Higher Grade**

**Time allowed - 1 hour**

---

Read Carefully

1. Full credit will be given only where the solution contains appropriate working.
2. **Calculators may be used in this paper.**
3. Answers obtained by readings from scale drawings will not receive any credit.
4. **This examination paper contains questions graded at all levels.**

**All questions should be attempted**

1. A is the 3 x 3 matrix  $A = \begin{pmatrix} x-2 & -1 & 2 \\ 1 & x-1 & 3 \\ 2 & 1 & x \end{pmatrix}$

(a) Show that the determinant,  $\det(A) = x^3 - 3x^2 - 4x + 6$  (3)

(b) Find the integer value of  $x$  such that matrix A has no inverse (3)

2. (a) Use the Euclidean algorithm to determine the greatest common divisor of 407 and 592 (3)

(b) Hence find the integers  $x$  and  $y$  such that  $d = 407x + 592y$  (2)

3. Prove by induction that  $\sum_{r=1}^n (19r - 18) = \frac{n}{2}(19n - 17)$  where  $n$  is a positive integer. (5)

4. Find the first five non-zero terms of the Maclaurin series for  $\ln(1+x)$ . (5)

5. (a) Use the vector product to calculate the area of a triangle with vertices P(2, -1, 0), Q(1, 1, -1) and R(3, 4, 2). (4)

(b) Find the equation of the plane passing through triangle PQR. (3)

(c) Determine the point of intersection of the line

$$\frac{x-1}{2} = \frac{y+1}{1} = \frac{z-1}{3}$$

with this plane. (4)

6. A recurrence relation is defined by the formula:

$$x_{n+1} = \frac{14 - 5x_n}{x_n}$$

Find algebraically the fixed points of the recurrence relation (3)

7. Find the general solution of the differential equation

$$4 \frac{d^2 y}{dx^2} + 4 \frac{dy}{dx} + y = 3x + 4.$$

Find the particular solution corresponding to the initial conditions  $\frac{dy}{dx} = -3$

and  $\frac{d^2 y}{dx^2} = 4$  when  $x = 0$ .

(10)