

**MATHEMATICS: SPECIALIST 3 & 4**

**EXTENDED PIECE OF WORK 4**

**PART A**

# HYPERBOLIC FUNCTIONS

In this investigative assignment you will be required to work Part A thoroughly. Part B will be a test. You will need to bring your solutions and working from Part A to use during the test.

Validation Date:

The hyperbolic cosine, sine and tangent functions of real numbers are written as , , and respectively. (Pronounced “cosh, shine, and than”).

The definitions are:

and

**1.** (a) Sketch the graph of

(b) Show that

(c) Evaluate (i)

(ii)

**2.** (a) Use the definitions of and to show:

(i)

(ii)

(iii)

(b) Determine a formula for in terms of .

(c) (i) Write in terms of .

(ii) Investigate integral powers of as a function of .

Hence,

(iii) write an expression for in terms of .

Is this expression true for any real number ?

**3.** (a) Show that (i)

and (ii) .

(b) Hence or otherwise, find the derivatives of

(i) (ii) (iii)

**4.** A formula involving and/or can be obtained from the corresponding formula involving and/or by the following rules:

replace by

and replace by where .

For example, =

thus =

=

(a) Illustrate this rule by determining the corresponding identities for

(i)

(ii)

and comparing these answers to your answers in Questions 2(a) and 2(b).

(b) Investigate at least two other identities (Check your formula sheet) not mentioned in this assignment.