**Narrogin Senior High School**

**Extended investigation**

**The properties of quadrilaterals Part 1: Preparation activities**

**Question 1**

(a) A square has vertices A, B, C and D.

Three sets of coordinates are known, A(0, 0), B(3, -4) and *C*(7, -1).



(i) Determine the coordinates of D. Hint: Consider the gradients of the sides.

(ii) By determining the lengths of AB, BC, CD and DA confirm that ABCD could be a square. Write down the name of the other quadrilateral that has four equal sides but is not a square.

(iii) Determine the midpoints of the diagonals AC and BD. Write down the property illustrated by your result.

(iv) Determine the gradients of AC and of BD. Write down the property illustrated by your result.

(v) Are the properties in (iii) and (iv) sufficient to guarantee ABCD is a square? Explain.

(b) A second square with vertices A, B, C and D has known coordinates A(0, 0),

C(6, -4) and D(5, 1).

(i) The midpoint of AC is located at the midpoint of BD. Use this information to determine the coordinates of point B.

(ii) Confirm that ABCD is a square by determining the lengths of the sides and by showing that one of the angles is a right angle.

(c) Investigate the properties of the quadrilateral ABCD with coordinates A (0, 0),

B ( b, -a), C (a + b, b - a) and D (a, b). Determine the name that best describes the quadrilateral.

**Question 2**

(a) The parallelogram *ABCD* has three known coordinates A(0, 0), B(3, -4) and

C(8, -1).

1. Determine the coordinates of point D by finding the intersection of two lines.

(ii) Describe the properties of the parallelogram by determining

* the lengths of the sides of the parallelogram
* the gradients of a pair of adjacent sides of the parallelogram
* the lengths of the diagonals
* the midpoints of the diagonals
* the gradients of the diagonals

(b) Given a different parallelogram ABCD with known coordinates

A(0, 0), B(a, b) and C(c, d).

(i) Determine the coordinates of point D.

(ii) Write expressions for

* the gradients of the sides of the parallelogram
* the lengths of the sides of the parallelogram
* the gradients of the diagonals

**Question 3**

Investigate the properties of kites, rhombuses, rectangles and trapeziums.

Consider the following questions.

* Which sides are equal?
* Which sides are parallel?
* Which internal angles are right angles?
* Do the diagonals bisect each other?
* Do the diagonals meet at right angles?

For each of these quadrilaterals, consider what information would be needed to determine any unknown coordinates(s) of the vertices or the points of intersection of the diagonals.