**The properties of quadrilaterals**

**Extended investigation In-class validation**

**Solutions and marking key**

**Question 1 (a)**

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| Solution  (i) Let (*x, y*) be the coordinates of D  *BC // AD* and *AB //* DC      *Solve simultaneous equations*    (ii) Midpoint of AC is (3.5, 3.5)  Midpoint of BD is (3.5, 3.5)  The diagonals of the parallelogram bisect each other. | |
| Mathematical behaviours | Marks |
| (i)   * Calculates the gradient of BC * Determines the gradient of AD * Determines the gradient of AB * Determines the gradient of CD * Determines two equations linking equal gradients * Solves simultaneous equations   (ii)   * Determines the midpoints * Interprets concurrency of midpoints | 1  1  1  1  2  1  2  1 |

**Question 1(b)**

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| Solution  (i) Check the length of all four sides  *AB*2 = (3-0) 2+ (4-0) 2= 25 *AB* = 5  *BC*2 = (7-3) 2+ (7-4) 2= 25 *BC* = 5  *CD*2 = (4-7) 2+ (3-7) 2= 25 *CD* = 5  *DA*2 = (4-0) 2+ (3-0) 2= 25 *DA* = 5  The four sides are equal.  Therefore ABCD is a rhombus.  (ii) ABCD can also be proved to be a rhombus if the diagonals have the same  midpoint, and bisect each other at right angles. | | |
| Mathematical behaviours | | Marks |
| (i)  (ii) | * Calculates the lengths of the four sides * Justifies conclusion * Identifies diagonals - have same midpoint   - bisect each other  - are perpendicular | 2  1  1  1  1 |

**Question 2**

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| Solution  (a) AB2 = (3 -1)2 + (4 – 2)2 = 8  BC2 = (3 -1)2 + (4 – 6)2 = 8  (b)    (c) Midpoint of AC is (4,1)  BH = 2 (same x value so in a line two units difference in y)  HD = 7-2=5 units  (d) BD is a straight line. Coordinates of D (4, -4) | | |
| Mathematical behaviours | | Marks |
| (a)  (b)  (c)  (d) | Determines lengths of AB and BC  Determines gradients of AB and BC  Applies correct logic to relationship between gradients  Determines correct coordinates for H  Justifies HD is 5 units  Determines correct coordinates for D | 2  2  1  1  1  2 |

**Question 3**

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| Solution  (a)  (b) Z is the midpoint of PR so Z is (5, 4.5)  (c)  Given *QZ : ZS* = 1 : 3 then we have A as the midpoint of QS    To determine the coordinates of A:    ∴A(6, 3)  A is the midpoint of QS.  To determine the coordinates of S:    ∴S(8, 0) | | |
| Mathematical behaviours | | Marks |
| (a)  (b)  (c) | Interprets and represents given features of a kite  Calculates the midpoint of PR (Z)   * Identifies A as the midpoint of QS * Identifies Z as the midpoint QA * Determines coordinates of A * Determines coordinates of S | 2  1  1  1  1  1 |

**Question 4**

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| Solution | |
| Mathematical behaviours | Marks |
| * Determines the midpoint of *JL* * Determines the midpoint of *KM* * Identifies midpoints are concurrent * Concludes giving the *x* and *y* ordinates in terms of *a* and *b* | 1  1  1  1 |