**Optimisation**

**Extended investigation Part 1:** **Preparation activity**

**Solutions**

**Problem 1**

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| Solution  A: Square  Length = 2 m, Area = 4 m2  B: Equilateral triangle  Length =  m, Area =  C: Regular hexagon  Length of side = *a* =  m    D: Circle  Radius =  Area =  In order of increasing magnitude the shapes are triangle, quadrilateral, hexagon, circle. The greater the number of sides the greater the area (assuming the circle has infinite number of sides)  A pentagon with a perimeter of 8 m would have an area between 4 and 4.619 m2  Pentagon  *a* = 8 ÷ 5 = 1.6  For the two outer triangles  Area =  Using the cos rule    Non-congruent angle of middle triangle = 36o  Area of middle triangle =  Total area = 4.404 m2 which is in the predicted range |

**Problem 2**

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| Solution  A: Rectangular prism  (b)  (c)  (d)  metres  (e)  metres  (f)  m3    B: Triangular prism  (b)  (c)  (d)  metres  (e)  metres  (f)  m3  C: Cylindrical garden bed  (a)  (b)  (c)  (d) Maximum volume = |

**Problem 2 (cont’d)**

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| D: Hexagonal prism    (a)  (b)        (c)  ALTERNATELY (and more accurately)    (a)    (b)    (c) |

**Problem 2 (cont’d)**

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| |  |  |  |  | | --- | --- | --- | --- | | Shape | Restriction | Dimensions for maximum volume (m) | Maximum volume  (m3) | | Rectangular prism |  |  | 2.31 | | Triangular prism |  |  | 2.31 | | Cylinder |  |  | 14.544 | | Hexagonal prism |  |  | 12.028 |   Comment   * There is no clear indication from these results that a particular shape will produce the maximum volume as two shapes have the same volume. There is not a consistent restriction (variables not controlled) for a conclusion to be valid. * The restrictions appear similar – comparing the cylinder and the hexagonal prism but in one case it was half the width + 4 *h* = 5 and in the other case it was the length of the sides + 4*h* = 5. These are not comparable as they measure different aspects of the shape. * The similarity in the restrictions led to similar formulae for volume and hence similar dimensions for maximum volume for the cylinder and the hexagonal prism; however, the volumes do not appear to be related. * The area of a rectangle of fixed perimeter is maximised when the rectangle is also a square and this principle could explain the congruent length and width in the maximised volume for the rectangular prism. * Another method to locate a maximum value for volume is to plot the volume function (when reduced to one variable) and find the local maximum on the graph. Calculus offers a more accurate and quicker way to locate the maximum value. |