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| Name: | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | | | Date: *\_\_\_\_\_\_* | |
| pact jpg1 | **Subject: METHODS MAT**  **Investigation 2, 2015**  **Topic: Applications of Differentiation** | | | | 34  = % | |
| **Weighting:** | *5% of the year.* | | | | |  |
| **Equipment:** | *Curriculum Council, Formula sheets, Calculators* | | | | | |
| **Important Information:**  *Although the take-home component is not worth any marks, it is essential in preparation for the in-class component. Knowledge and skills gained will be extended in the in-class validation component. This in-class validation will be completed under test conditions on the day in which this take-home component is due. The take-home component may be used when completing the in-class component. Contact will be made to parent(s) if the take-home component is not available for submission (at the start of the lesson).*  ***Answers should be rounded appropriately****. All working should be shown in the space provided. Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks.*  *No pen, pencils, highlights etc. may be used during reading time. This time is to be used to read through the assessment and check that you understand what is being asked of you. You may speak with the teacher/supervisor during this time (by putting up your hand and waiting patiently for them to approach you) but you may only ask clarification questions and not how to solve the problems. After reading time has ended, you may not ask any more questions.* | | | | | | |
| **Take home component weighting:** | | *0% of the year* | **In-class component weighting:** | *5% of the year.* | | |

**Part A**

When travelling by air, some destinations specify luggage limitations in linear measurements rather than weight. This is defined as

*linear measurement* = *width + height + length.*

For one airline the maximum linear measurement is 158 cm for any one piece of luggage. All the shapes considered in Part A have the maximum linear measurement and are to be investigated for their maximum volume.

**Question 1 (12 marks)**

Luggage item is the shape of a rectangular prism

*The length (l) of this item is twice the width (w) of the item.*

(a) State the rule to calculate the volume (*V*) of the item. (1)

(b) Show how you can determine that for the height (*h*),  (2)

(c) Write the rule to calculate the volume in terms of *w* only. (1)

(d) Determine  (2)

(e) For what value of *w* is the volume a maximum? (Use calculus) (2)

(f) Determine the maximum volume. (2)

(g) When the volume is a maximum, (2)

(i) what is the length?

(ii) what is the height?

**Question 2 (7 marks)**

Luggage item is the shape of a triangular prism

*The length (l) of this item is twice the width (w) of the item.*

(a) Given , the rule to calculate the volume (*V*) of the item,

determine  . (2)

(b) Use the expression for , identified in part (a) to determine the value of *w* for which the volume is a maximum. (2)

(c) Calculate the maximum volume. (1)

(d) When the volume is a maximum, (2)

(i) what is the length?

(ii) what is the height?

**Question 3 (9 marks)**

Luggage item is the shape of a cylinder

(a) Show that the volume of the cylinder is given by the rule  (3)

(b) Use calculus techniques to show that a maximum volume occurs when the radius *(r*)

is  cm (3)

(c) Determine (3)

(i) the maximum volume of the cylinder

(ii) the length of the cylinder when the volume is at a maximum.

**Part B (6 marks)**

(a) Enter your results for the items of luggage in the table below. (1)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Shape | Maximum volume  (cm3) | Dimensions for maximum volume  (cm) | | |
|  |  | length | width | height |
| Rectangular prism |  |  |  |  |
| Triangular prism |  |  |  |  |
| Cylinder |  |  |  |  |

(b) Rank the items of luggage in order of increasing volume. Comment on your listing. (1)

(c) What aspects of the dimensions of luggage items appear to produce shapes with maximum volumes? (2)

(d) One passenger had an item of luggage that satisfied the rule for maximum linear dimensions but its volume exceeded all of those listed in the table. Suggest a possible shape and the dimensions for this item of luggage. Show that its volume is greater than those listed. (2)