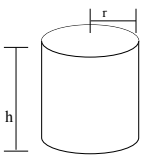
Year 9 Practice Task, Term 2 Investigation 2011

THE BIG CHEESE

Introduction: Monetary costs and environmental impact are important considerations to take into account when packaging food to keep it fresh. The following scenario concerns the packaging of cheese pieces. The amount of packaging material needed will relate to the combined Total Surface Area of all of the pieces.

PART A: Consider a full cylindrical piece of cheese of radius **r** centimetres and height **h** centimetres.



Q1 Show that the original Total Surface Area (TSA) of the cheese piece is equivalent to the following rule:

$$TSA = 2\pi r^2 + 2\pi rh$$

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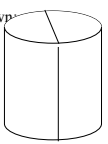
Let TSAo= the original TSA of the piece of cheese for the remainder of this investigation.
Therefore TSAo= $2\pi r^2 + 2\pi rh$

The cheese piece is cut in half as shown



Q2 Show using relevant formulae and diagrams that the TSA of the two pieces combined would be: **TSA=TSAo +4rh**

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The cheese is cut in half a further two times. Fill in the table below:

NUMBER OF PIECES	TSA IN TERMS OF **r** AND **h**	TSA IN TERMS OF TSA**o**, **r** and **h**
2	$2\pi r^2 + 2\pi rh$ +2rh+2rh	TSAo + 4rh
4		
8		

Q3 Why did the table exclude the number of pieces 3,5,6 and 7?

Q4 Give a simple logical explanation using TSAo as to why the general rule for 8 pieces definitely calculates the combined TSA of all of the pieces.

Q5 If **n** represents the number of pieces of cheese then re-write in terms of **TSAo**, **n**, **r** and **h** a general rule for calculating the TSA for pieces of cheese cut in this manner.

PART B: The block is now cut **horizontally** to form the cylindrical blocks as shown.

Q1 Use the strategies from part A - draw a table use similar headings , deduce patterns to determine a general equation in terms of **TSAo, h , r and n** for the TSA of n blocks cut in this manner. Include any relevant diagrams, tables, calculations, etc…. to aid in the communication of your mathematics.

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PART C: The general rules for calculating the TSA of the **n** cylindrical blocks of cheese for Part A and Part B are as follows:

PART A general rule: $TSA=TSAo + 2nrh$

PART B general rule: $TSA=TSAo + (2n-2)\ r$

Question 1
Use these general rules for a cylindrical cheese block of height 10cm and radius 20cm to determine which cut method (Vertical or Horizontal) results in the least TSA of wrapping the following number of smaller blocks of cheese:

n=2
Part A

Part B

n=4
Part A

Part B

n=8
Part A

Part B

Question 3

Why could these results be an important consideration to protect our environment?

Question 4

What business factors may influence the choice of which cut method is preferred?

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Assessment criteria:

Criterion B: investigating patterns

Maximum 8

Students are expected to investigate a problem by applying mathematical problem-solving techniques, to find patterns, and to describe these mathematically as relationships or general rules and justify or prove them.

This criterion examines to what extent the student is able to:

- select and apply appropriate inquiry and mathematical problem-solving techniques
- recognize patterns
- describe patterns as relationships or general rules
- draw conclusions consistent with findings
- justify or prove mathematical relationships and general rules.

Achievement level	Descriptor
0	The student does not reach a standard described by any of the descriptors given below.
1–2	The student **applies**, **with some guidance**, mathematical problem-solving techniques to recognize **simple** patterns.
3–4	The student **selects and applies** mathematical problem-solving techniques to recognize patterns, and **suggests** relationships or general rules.
5–6	The student **selects and applies** mathematical problem-solving techniques to recognize patterns, **describes** them as relationships or general rules, and **draws conclusions** consistent with findings.
7–8	The student **selects and applies** mathematical problem-solving techniques to recognize patterns, **describes** them as relationships or general rules, **draws conclusions** consistent with findings, and **provides justifications**.

Generally use the following as a Guideline

Level	
1	With guidance some of Q1 or 2 for Part A or B
2	With guidance some of Q1 or 2 for Part A and B
3	A rule is suggested for Q5 for Part A or B
4	A rule is suggested for Q5 for Part A and B
5	The rule is found for Q5 for Part A or B and Part C Question 1 is completed for either A or B
6	The rules are found for Q5 for Part A and B and Part C Question 1 is completed
7	Q3 or Q4 is answered for Part A
8	Q3 and Q4 is answered for Part A

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Criterion C: communication in mathematics
Maximum 6

Students are expected to use mathematical language when communicating mathematical ideas, reasoning and findings—both orally and in writing.

- use appropriate mathematical language (notation, symbols, terminology) in both oral and written explanations
- use different forms of mathematical representation (formulae, diagrams, tables, charts, graphs and models)
- move between different forms of representation.

Achievement level	Descriptor
0	The student does not reach a standard described by any of the descriptors given below.
1–2	The student shows **basic** use of mathematical language **and/or** forms of mathematical representation. The lines of reasoning are **difficult to follow**.
3–4	The student shows **sufficient** use of mathematical language **and** forms of mathematical representation. The lines of reasoning are **clear** though not always **logical** or **complete**. The student moves between different forms of representation **with some success**.
5–6	The student shows **good** use of mathematical language **and** forms of mathematical representation. The lines of reasoning are **concise**, **logical** and **complete**. The student moves **effectively** between different forms of representation.

Apply the above descriptors to what the student has completed.

A student cannot, however, receive a

a) Three or four unless they have attempted at least two parts of the task.

b) **Five or six unless they have completed all three parts.**

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Criterion D: reflection in mathematics

Maximum 6

Reflection allows students to reflect upon their methods and findings.

This criterion examines to what extent the student is able to:

- explain whether his or her results make sense in the context of the problem
- explain the importance of his or her findings in connection to real life
- justify the degree of accuracy of his or her results where appropriate
- suggest improvements to the method when necessary.

Achievement level	Descriptor
0	The student does not reach a standard described by any of the descriptors given below.
1–2	The student **attempts** to explain whether his or her results make sense in the context of the problem. The student **attempts to describe** the importance of his or her findings in connection to real life.
3–4	The student **correctly but briefly explains** whether his or her results make sense in the context of the problem and **describes** the importance of his or her findings in connection to real life.
5–6	The student **critically explains** whether his or her results make sense in the context of the problem and provides a **detailed explanation** of the importance of his or her findings in connection to real life.

Generally use the following as a Guideline

Level	
1	An attempt is made at either Part A Q 3 or 4 or Part C Q 2 or 3
2	An attempt is made at either Part A Q 3 or 4 and Part C Q 2 or 3
3	Part A Q 3 or 4 or Part C Q 2 or 3 as per band 3-4
4	Part A Q 3 or 4 and Part C Q 2 or 3 as per band 3-4
5	Part A Q 3 or 4 and Part C Q 2 or 3 as per band 5-6
6	Part A Q 3 and 4 and Part C Q2 and 3 as per band 5-6

Mark allocation:

Total	1-3	4-5	6-7	8-10	11-15	16-17	18-20
IB mark	1	2	3	4	5	6	7