1

SAMPLE PAPER

NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1 Mathematics and Statistics

1.3: Investigate relationships between tables, equations or graphs

Credits: Four

Check that you have completed ALL parts of the box at the top of this page.

You should answer ALL parts of ALL questions in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO YOUR TEACHER AT THE END OF THE ALLOTTED TIME.

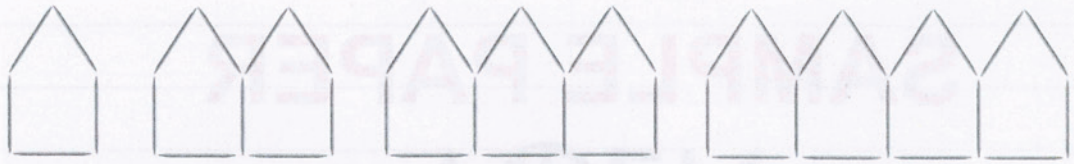
For Assessor's use only	Achievement Criteria		
Achievement	**Achievement with Merit**	**Achievement with Excellence**	
Investigate relationships between tables, equations, or graphs. ✓	Investigate relationships between tables, equations, or graphs, with relational thinking. ✓	Investigate relationships between tables, equations, or graphs, with extended abstract thinking. ✓ ENE	
Overall Level of Performance E	**Low Excellence**		

You are advised to spend 60 minutes answering the questions in this booklet.

Assessor's use only

QUESTION ONE

(a) Sarah starts making a pattern of houses using toothpicks as shown in the diagram below.



Design 1 Design 2 Design 3 Design 4

She begins a table for the number of toothpicks she uses for the number of houses in the pattern.

Design (n)	Number of toothpicks used in the design (T)
1	5
2	9
3	13
4	17
5	21
6	25
7	29
8	33

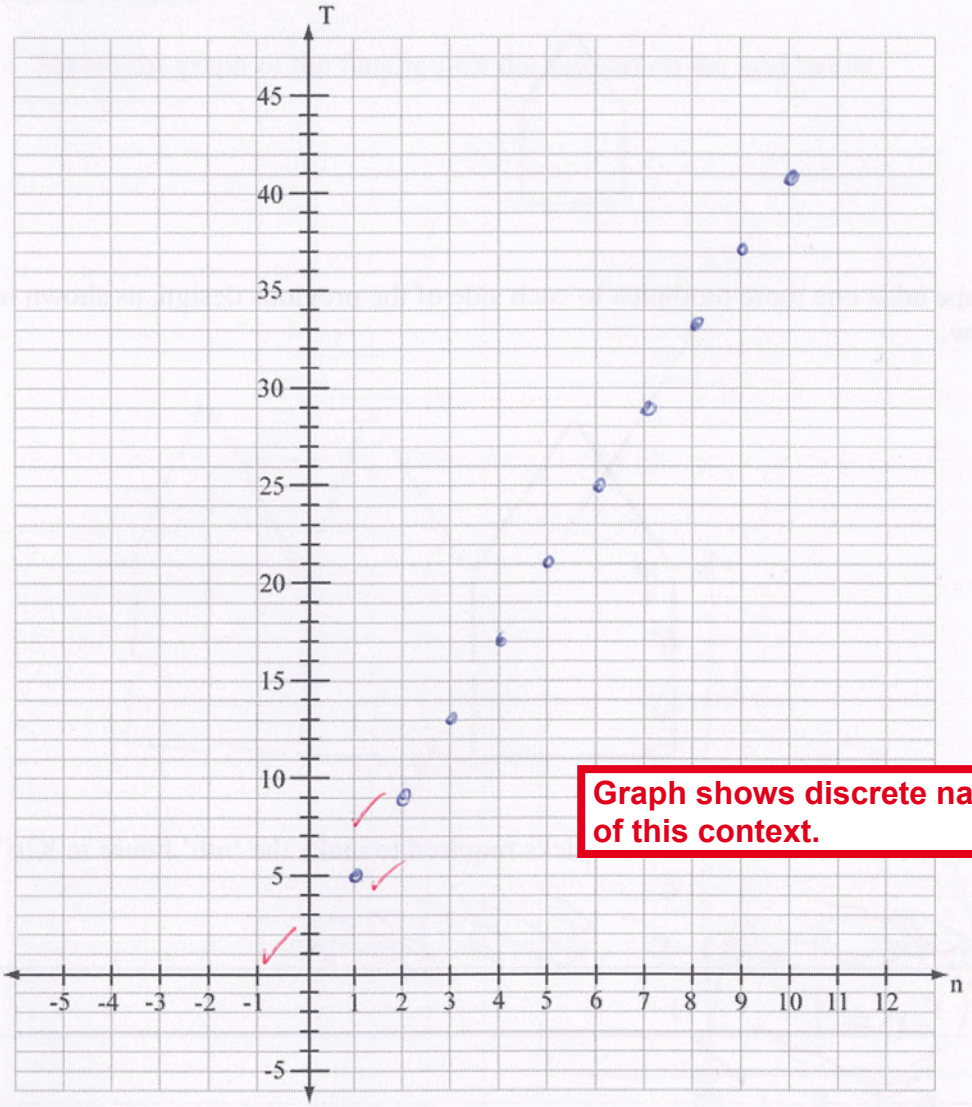
(i) Give the rule for calculating the number of toothpicks T that Sarah will need to make the 'nth' design.

$4n+1 = T$

Mathematics and Statistics 1.3

Assessor's use only

(ii) On the grid below, sketch a graph showing the number of toothpicks required for up to the 10th design.



Graph shows discrete nature of this context.

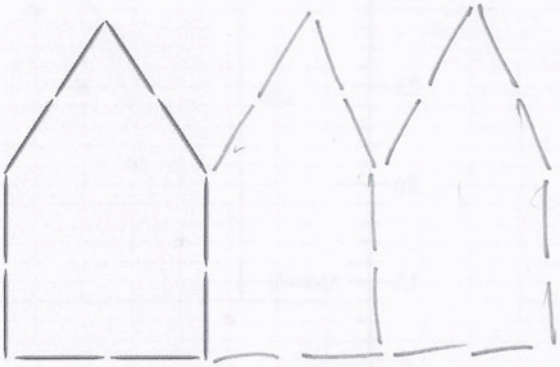
e

(iii) Give the rule for the **total** number of toothpicks that Sarah would need if she was to continue following the pattern and complete '*n*' designs.

Use this rule to find the total number of toothpicks needed to complete the first 12 designs using Sarah's pattern.

(b) Kiri decides to make a different pattern involving separate houses. She begins with the same design as Sarah, as shown in the diagram below.

Each new shape adds one more toothpick to each side of the previous design, as shown in the diagram below.



Student did not realise that these shapes were separate initially but ends up with the correct formula.

(i) Give the rule for the number of toothpicks required to make the '*n*th' house in Kiri's pattern.

$5n = T$ ✓

(ii) Use this rule to find the number of toothpicks needed for the 6th house in the pattern.

$30 = T$ ✓

(iii) Describe how the graph for the number of toothpicks Kiri used for *n* houses relates to Sarah's graph.

Kiri's formula is twice Sarah's. The gradient on Kiri's graph has a gradient of 5

A comparison of the two graphs is required (not just a description of one of them)

Assessor's use only

M

n

E

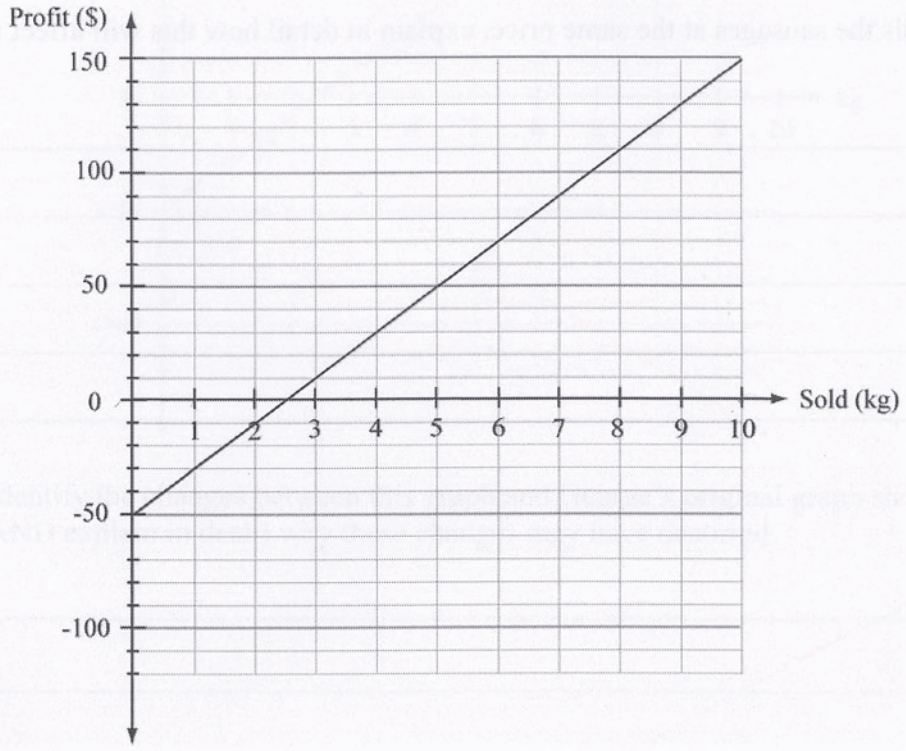
QUESTION TWO

Assessor's use only

(a) George and Gina are running a sausage sizzle to raise funds for their school.

They have bought 10 kg of sausages to sell.

George draws a graph of the profit they hope to make against the number of kilograms of sausages sold.



(i) Give the equation for the profit made in terms of the number of kilograms of sausages sold.

$2x - 50 = y$ ✓

(ii) Find the cost of a 2 kg bag of sausages.

$10 ✓

(iii) How much profit do they hope to make on each of the 2 kg bags of sausages and how is this shown on the graph?

Assessor's use only

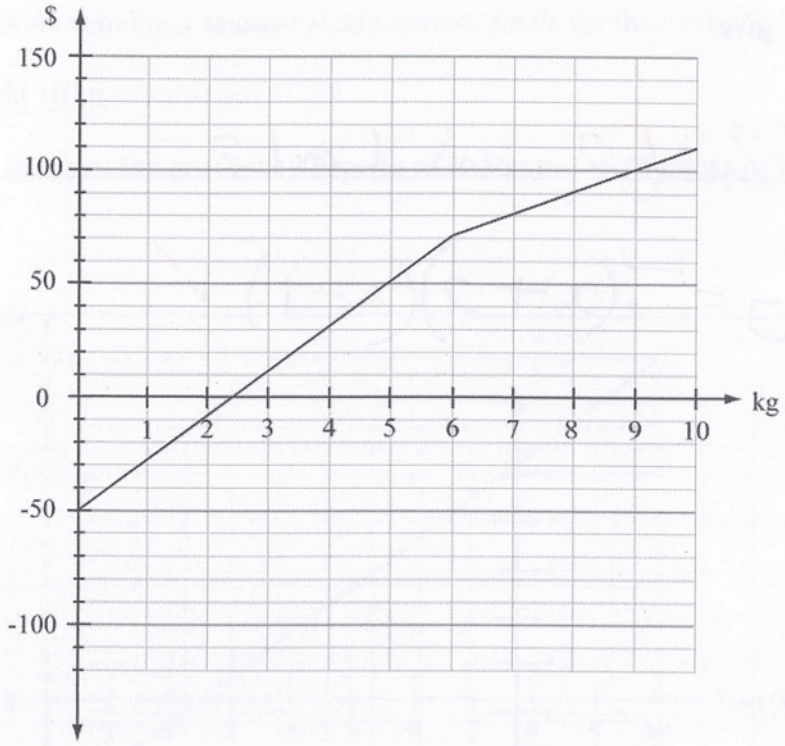
M

(iv) Gina is able to get the same number of sausages at 10% discount.

If she sells the sausages at the same price, explain in detail how this will affect the graph.

(v) George graphs the actual profit they made from their sale of sausages.

Assessor's use only



Identify the changes between this graph and George's original graph shown on page 5, AND explain in detail why these changes may have occurred.

N

QUESTION THREE

Assessor's use only

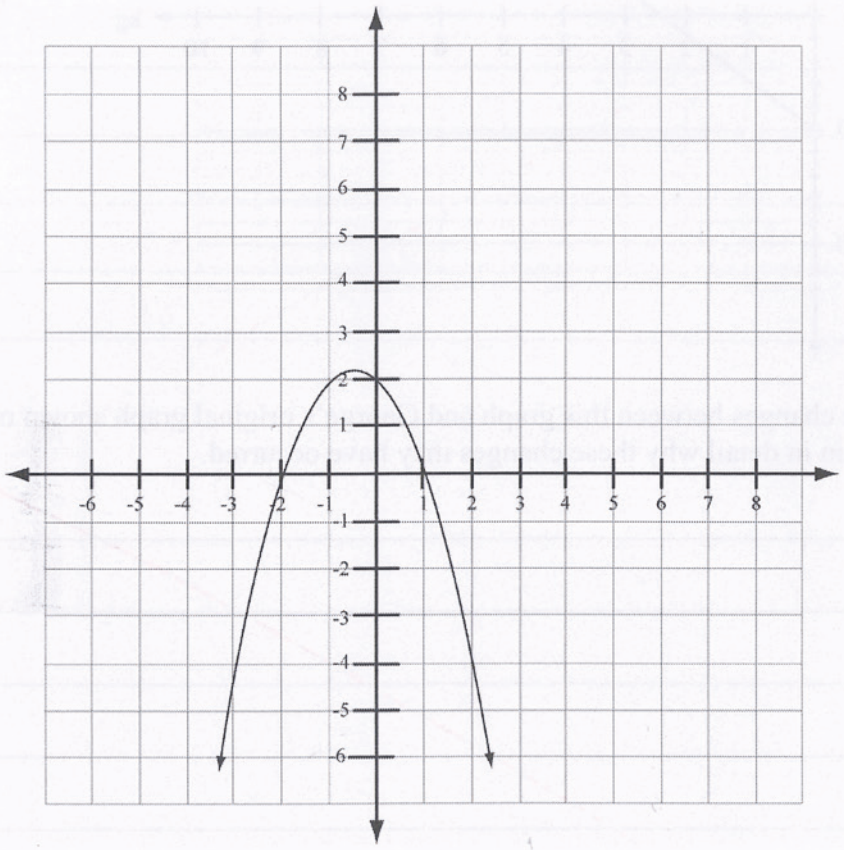
(a) For the graph below give:

(i) the intercepts:

-2 and 1 and 2

(ii) the ~~function~~ equation:

$y = -(x+2)(x-1)$ ✓



a

(iii) The parabola is moved 3 units to the right and 5 units up.

Give the equation of the parabola in simplified form its new position AND give the y intercept.

$y = -(x-3+2)(x-3-1)+5$

$= -(x-1)(x-4)+5$ ✓

y-intercept $= -(-1)(-4)+5$

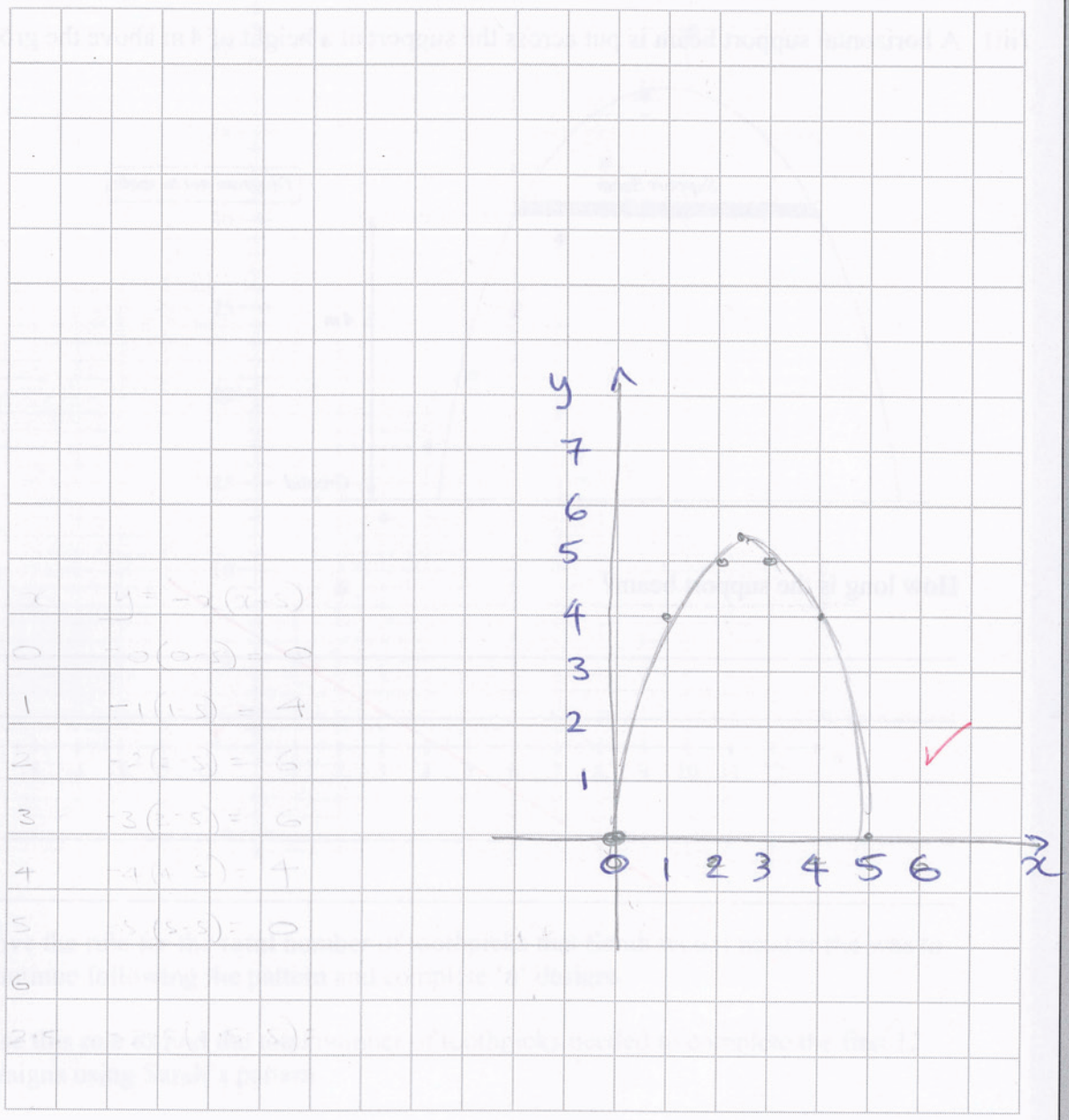
$= 1$ ✓

e

(b) A support for a children's bungy jump is modelled by the function $y = -x(x-5)$ where y is the height of the support in metres above the ground and x is the distance from the left hand side of the support.

Assessor's use only

(i) Sketch the graph of the function for the support on the grid below.

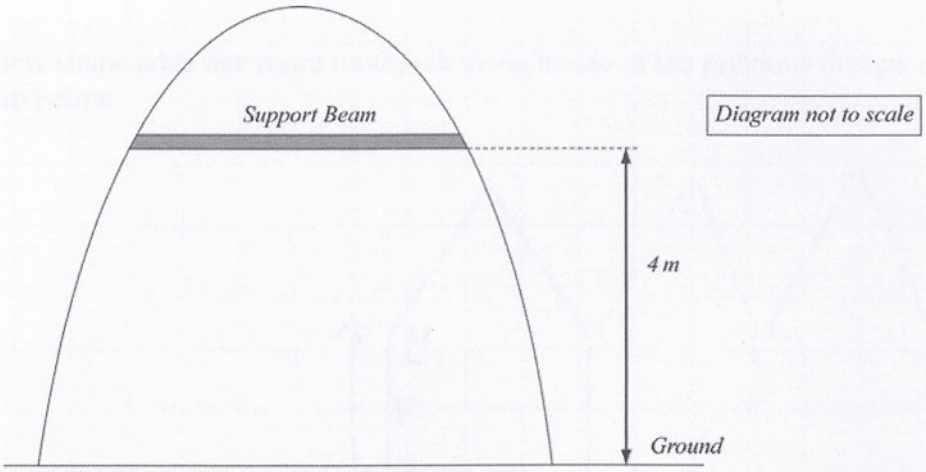


M

(ii) What is the maximum height of the support?

6.25 m ✓

(iii) A horizontal support beam is put across the support at a height of 4 m above the ground.



How long is the support beam?

Assessor's use only

a

E

1

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Overall Level of Performance E **High Excellence**		

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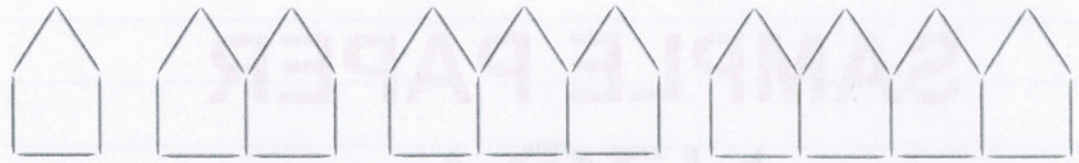
Assessor's use only

QUESTION ONE

(a) Sarah starts making a pattern of houses using toothpicks as shown in the diagram below.



Design 1 Design 2 Design 3 Design 4

She begins a table for the number of toothpicks she uses for the number of houses in the pattern.

Design (n)	Number of toothpicks used in the design (T)
1	5
2	9
3	13
4	17
5	21
6	25
nth	4n + 1

Totals. 1st difference. 2nd difference.

5
9
14 4
13
27 17 4
44
21 4
65
90 25 4

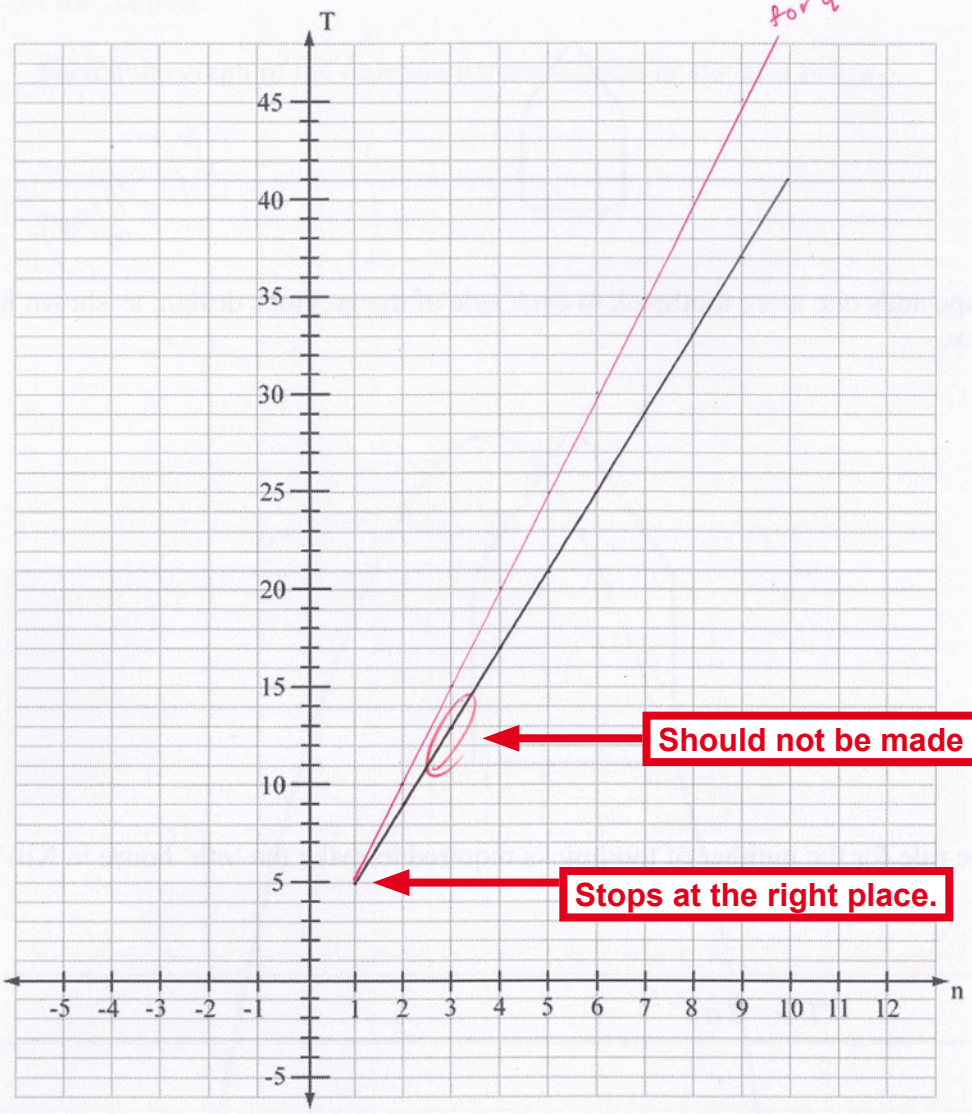
(i) Give the rule for calculating the number of toothpicks T that Sarah will need to make the 'nth' design.

$T = 4n + 1$

a

Assessor's use only

(ii) On the grid below, sketch a graph showing the number of toothpicks required for up to the 10th design.



Should not be made continuous.

Stops at the right place.

m

Students need to take notice of words in bold.

(iii) Give the rule for the **total** number of toothpicks that Sarah would need if she was to continue following the pattern and complete '*n*' designs.

Use this rule to find the total number of toothpicks needed to complete the first 12 designs using Sarah's pattern.

Finite difference used to find the formula for the totals.

$T_T = 2n^2 + 3n$ ✓

$T_T = 2(12)^2 + 3 \times 12$

$= 288 + 36$ ✓

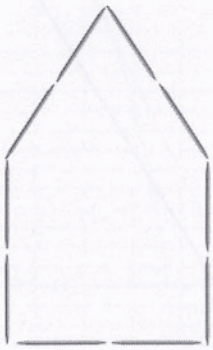
$= 324$ tooth picks needed.

e

Assessor's use only

(b) Kiri decides to make a different pattern involving separate houses. She begins with the same design as Sarah, as shown in the diagram below.

Each new shape adds one more toothpick to each side of the previous design, as shown in the diagram below.



(i) Give the rule for the number of toothpicks required to make the '*n*th' house in Kiri's pattern.

$T = 5n$

These two questions go together to give one grade.

M

(ii) Use this rule to find the number of toothpicks needed for the 6th house in the pattern.

$T = 5 \times 6$

$= 30$ ~~th~~ tooth picks.

(iii) Describe how the graph for the number of toothpicks Kiri used for *n* houses relates to Sarah's graph.

This question is looking for a comparison of the two graphs.

~~every 5 toothpicks Kiri can~~

It would require 5 times more than the number of the house.

N

E

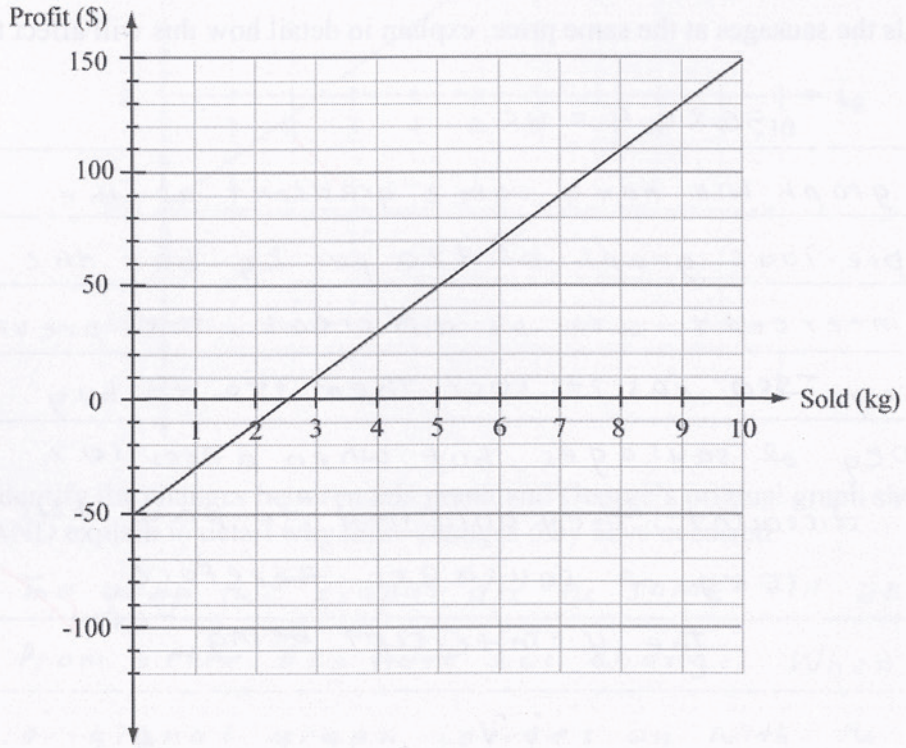
QUESTION TWO

Assessor's use only

(a) George and Gina are running a sausage sizzle to raise funds for their school.

They have bought 10 kg of sausages to sell.

George draws a graph of the profit they hope to make against the number of kilograms of sausages sold.



(i) Give the equation for the profit made in terms of the number of kilograms of sausages sold.

$P = 20s - 50$ ✓

(ii) Find the cost of a 2 kg bag of sausages.

~~$P = 20 \times 2 - 50$~~

~~$= 40 - 50$~~

$50 \div 10 \times 2$

$= \$10.00$ ✓

Uses the y intercept to see that 10kg costs $50.

The parts (i), (ii), and (iii) form one scaffolded question: the grade is on the next page.

(iii) How much profit do they hope to make on each of the 2 kg bags of sausages and how is this shown on the graph?

$40, ~~by the~~ on the graph every 2 kg goes up 40, and as the gradient is 20, meaning every 1 kg, $20 profit, they hope, so as 2 kg is double 1 kg; 20 × 2 = 40

(iv) Gina is able to get the same number of sausages at 10% discount.

If she sells the sausages at the same price, explain in detail how this will affect the graph.

50 × 0.9 = 45 .

The graph will have same gradient as the ~~go~~ previous graph of $20 per kg but the y-intercept will be different, the previous being -$50, as it cost them $50 to buy 10kg of sausages, but when after 10% discount, they only had to pay $45 for 10 kg of sausages therefore the y-intercept being -45.

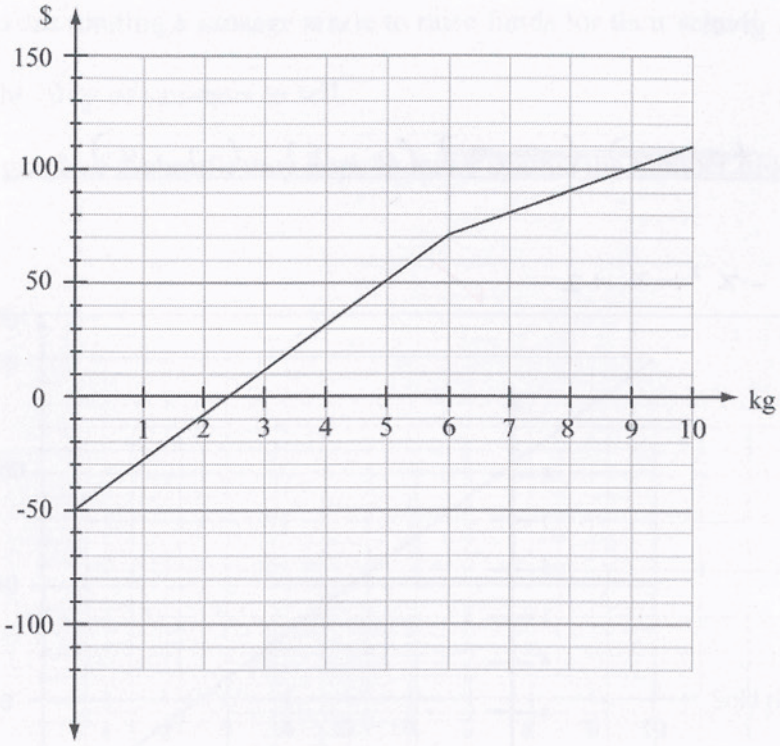
Assessor's use only

M

e

Assessor's use only

(v) George graphs the actual profit they made from their sale of sausages.



Identify the changes between this graph and George's original graph shown on page 5, AND explain in detail why these changes may have occurred.

The ~~grap~~ two graphs are the same till 6kgs but from after 6kg ~~have~~ has changes. When the original graph carries on with the gradient of 20, ~~the~~ this graph now ~~cha~~has the gradient of 10. Which means after the sale of 6kg of sausages, sausages ~~didn't could have been not as~~ been sold so they didn't sell, so they could have lowered the price in half, therefore increasing the demand as ~~other~~ it is cheaper now, and therefor achieving to sell all the 10kg of sausages.

E

QUESTION THREE

Assessor's use only

(a) For the graph below give:

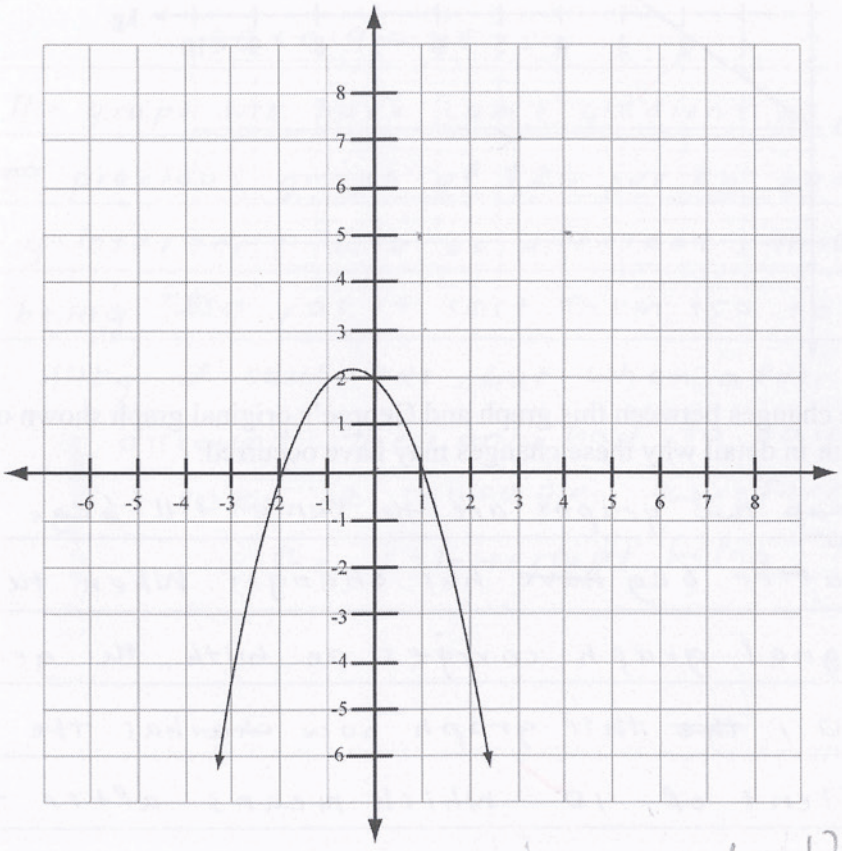
(i) the intercepts:

(-2, 0), ~~(1, 0) (0, 2)~~ (0, 2), (1, 0) ✓

(ii) the function:

$y = -x^2 - x + 2$ ✓

m



$y = a(x-b)(x-d)$

(iii) The parabola is moved 3 units to the right and 5 units up.

Give the equation of the parabola in simplified form its new position AND give the y intercept.

$y = -x^2 + 5x + 1$ ✓

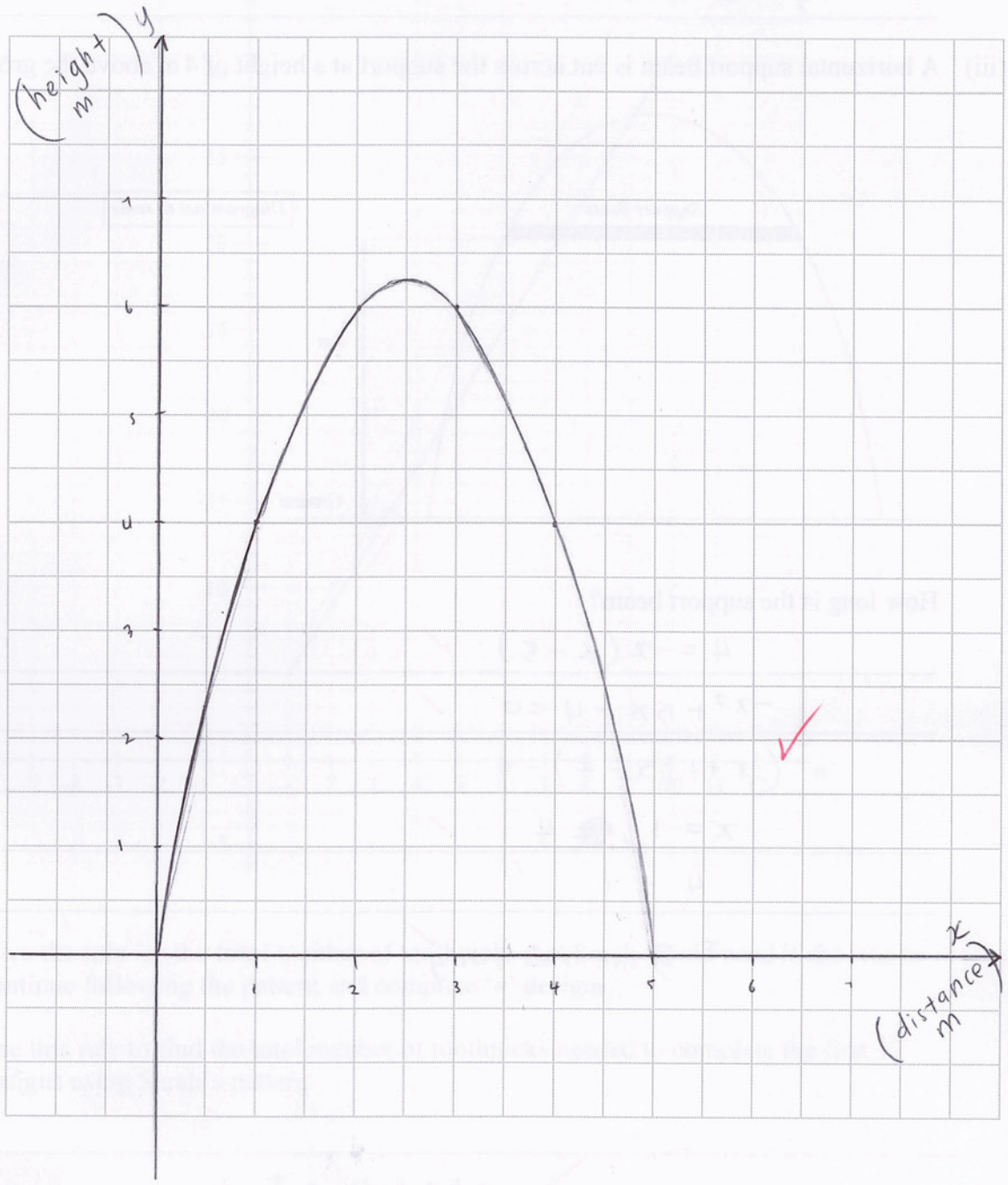
m

Question asked for the new y intercept as well.

(b) A support for a children's bungy jump is modelled by the function $y = -x(x-5)$ where y is the height of the support in metres above the ground and x is the distance from the left hand side of the support.

Assessor's use only

(i) Sketch the graph of the function for the support on the grid below.



m

(ii) What is the maximum height of the support?

$y = -2.5(2.5 - 5)$

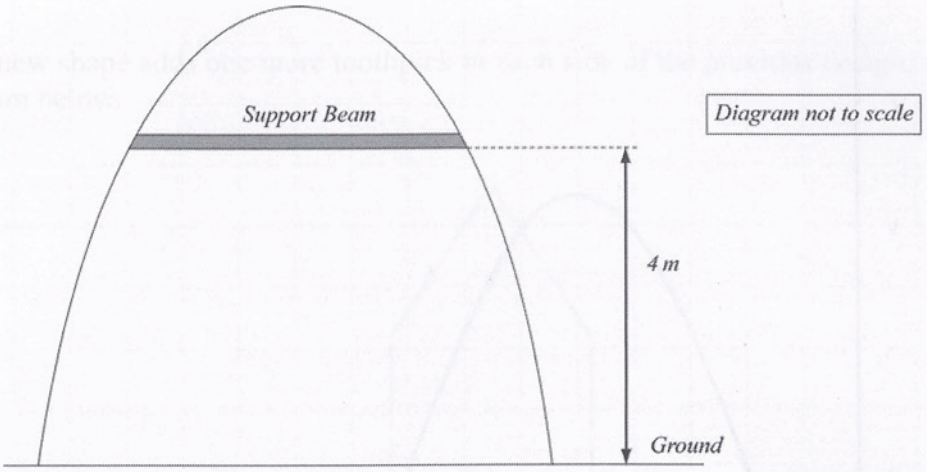
$y = -2.5(-2.5)$

$y = 6.25$ m.

Assessor's use only

a

(iii) A horizontal support beam is put across the support at a height of 4 m above the ground.



How long is the support beam?

$4 = -x(x - 5)$ ✓

$-x^2 + 5x - 4 = 0$ ✓

$(-x + 1)(x - 4) = 0$

$x = 1, 4$ ✓

$4 - 1$

$= 3$ metres long. ✓

e

An algebraic solution was expected rather than merely reading off the graph.

E