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SUPERVISOR'S USE ONLY

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Level 1 Mathematics and Statistics, 2015

91028 Investigate relationships between tables, equations and graphs

9.30 a.m. Monday 9 November 2015
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Investigate relationships between tables, equations and graphs.	Investigate relationships between tables, equations and graphs, using relational thinking.	Investigate relationships between tables, equations and graphs, using extended abstract thinking.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Show ALL working.

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 2–16 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Not Achieved

TOTAL 7

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QUESTION ONE

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A plant is growing on the surface of a pond. Hank noticed the plant on Day 1. Two days later Hank was worried about the plant and started measuring the area that the plant covered.

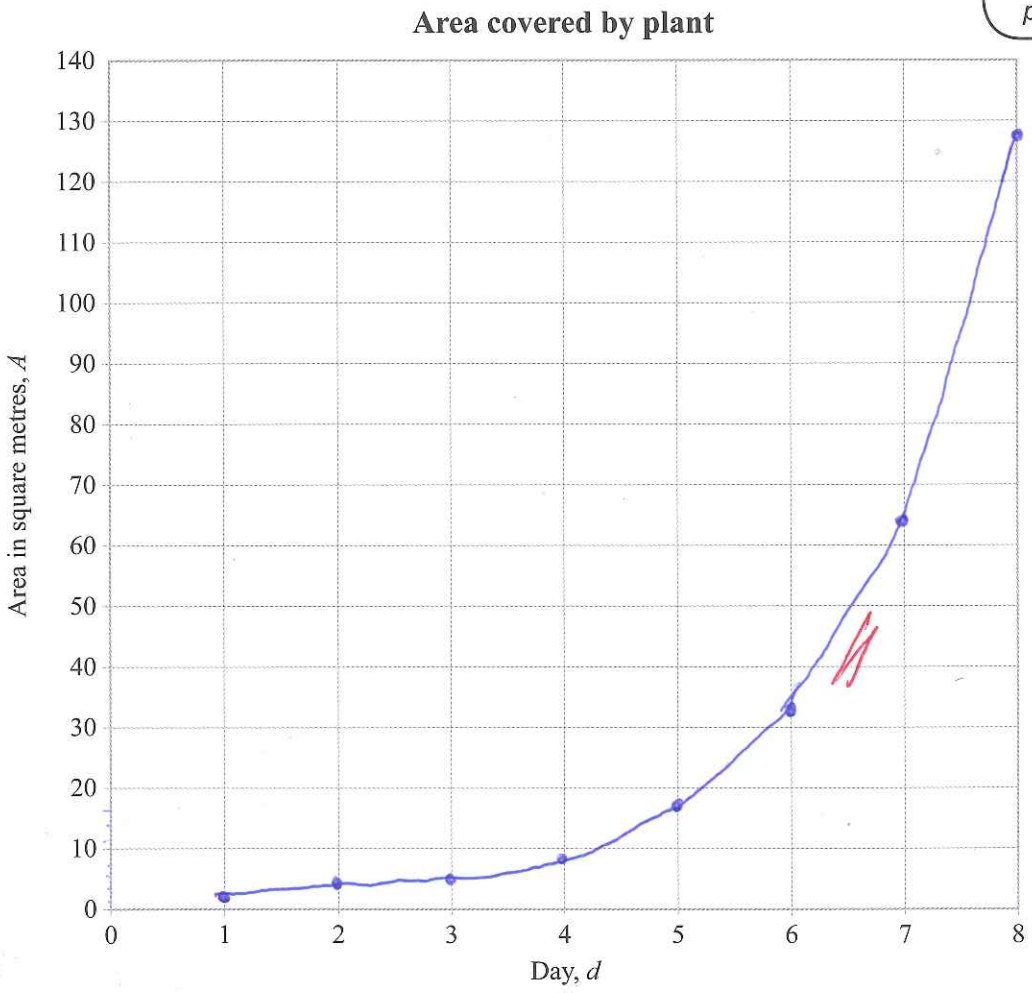
(a) Each day (at 5 pm) Hank measures the area of water (in square metres) covered by the plant. He records his measurements in the table below.

Day, d	Area covered by plant, A
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128

d is the number of days since Hank first noticed the plant.

If you need to redraw this graph, use the grid on page 14.

(i) Show how the area of the pond covered by the plant changes with time.



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(ii) The plant followed the same pattern of growth from the time when it was first noticed.

What area of the pond was covered by the plant when it was first noticed?

Explain your answer.

1 square metre. each day the plant would times its growth by 2, for example on day 5 the area was 16 and on day 6 the area was 32 and 16 × 2 = 36

(iii) Give the equation that describes the area of the plant covering the pond after d days.

(iv) If no intervention takes place, on which day will Hank first measure the area of the plant to be more than 500 square metres?

day 10. because day 8 = 128
128 × 2 = 256. day 9 = 256
256 × 2 = 512. day 10 = 512.

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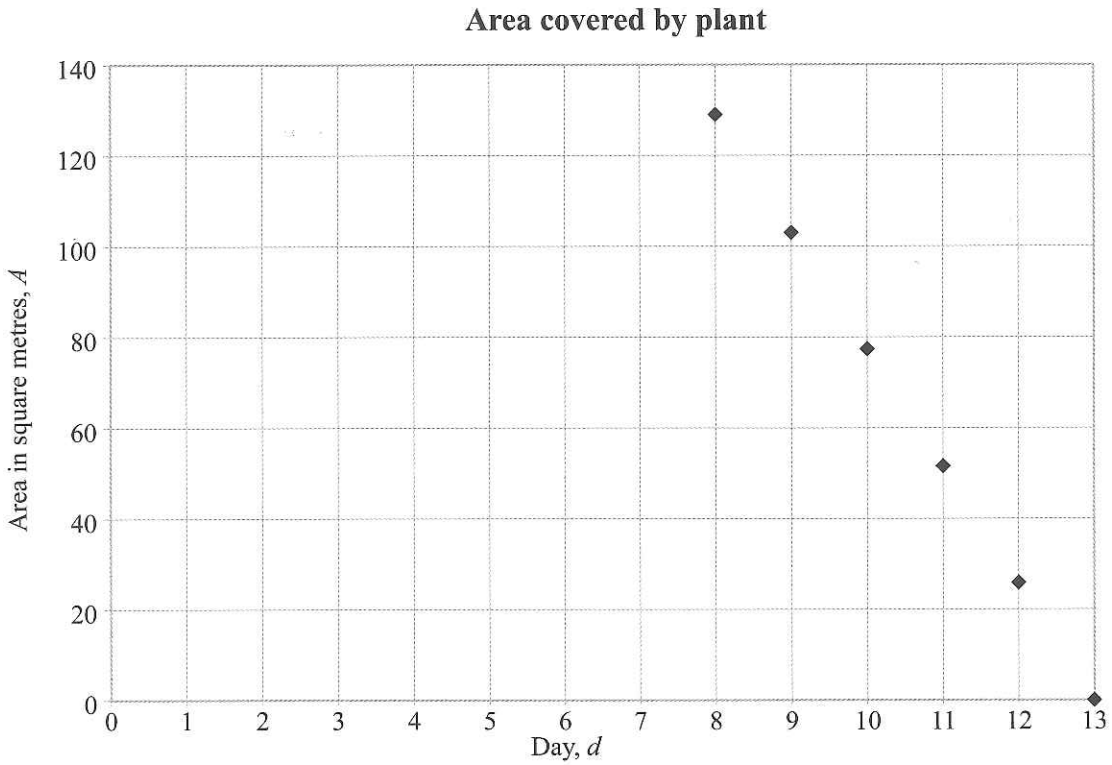
(b) Hank and some friends start removing the plant on Day 9.

The graph of the area covered by the plant from **Day 8** (when it covers 128 square metres), below, shows what Hank hopes will happen to the area of pond covered by the plant.



(i) What is the equation for the area covered by the plant as shown in this graph?

(ii) What is unrealistic about this graph?

Write at least TWO comments with justification.

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M5

QUESTION TWO

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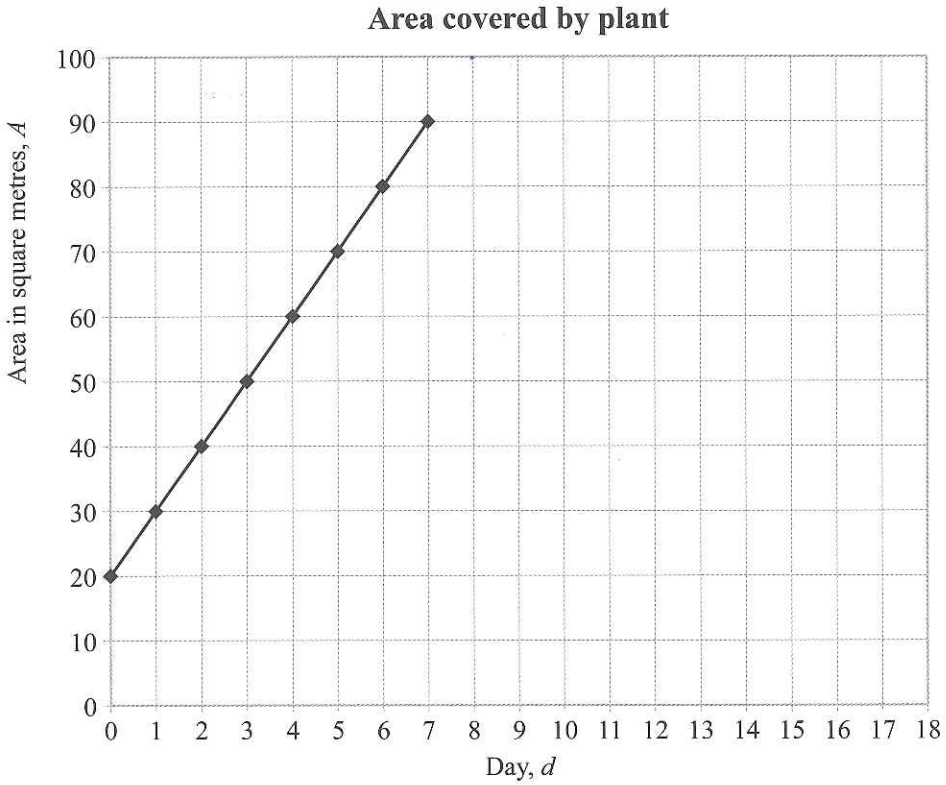
The next year, when the plant begins to grow back, Hank tries to stop it from spreading across the pond so quickly. As soon as he notices the plant, he begins removing it. The graph of the area of pond covered by the plant in this year is shown below:



(a) How much more area is the plant covering each day?

same more area

m

(b) What day will it be when the plant covers 200 square metres if the conditions remain the same?

Show your working.

day 16.
day 8 = 100 square metres
8 × 2 = 16.
day 16 = 200 square metres.

n

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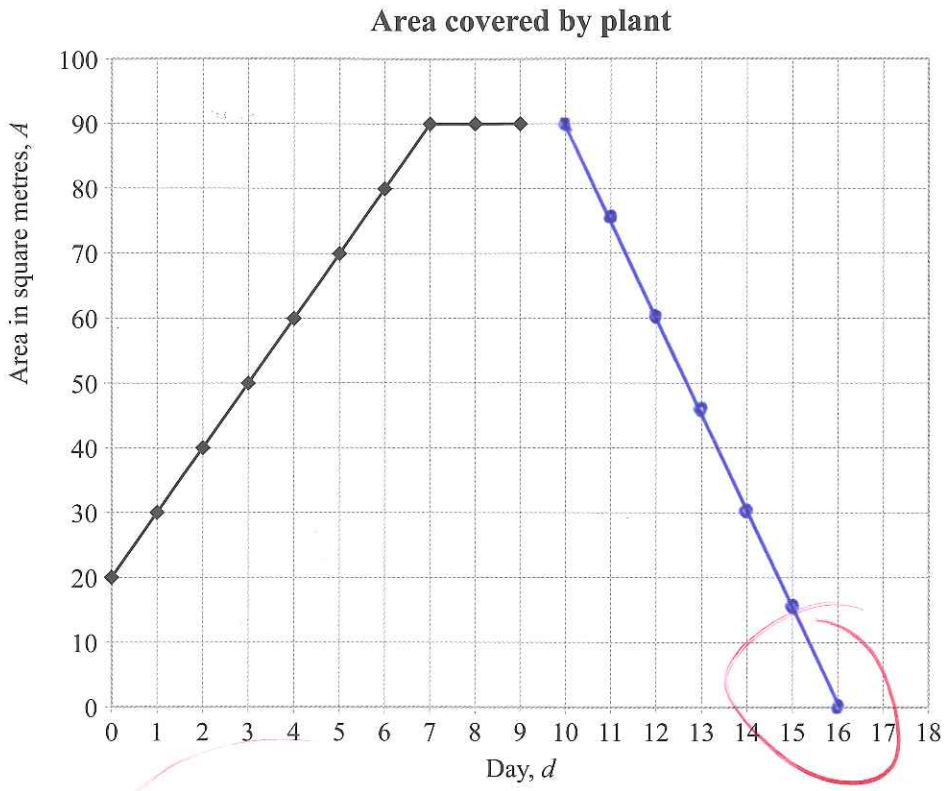
After 7 days removing some of the plant by himself, Hank decides to get help.

(c) One friend helps on Day 8 and Day 9.

The area covered by the plant stays the same for Day 8 and Day 9.



If you need to redraw this graph, use the grid on page 14.

(i) What is the equation of this new section of the graph on Day 8 and Day 9?

$A = 225 - 15d$

(ii) What does this section of the graph mean?

it means that the plant hasn't ~~not~~ ~~growing~~ growth.

(d) Two more friends come to help. Now the area covered by the plant decreases by 15 square metres each day until the plant is completely removed.

(i) Draw a graph on the grid above to show the area of pond covered by the plant from Day 10.

(ii) On what day will there be no plant left?

day 16

(e) The equation of the line for Day 9 onwards is $A = 225 - 15d$.

If Hank's 2 friends had come on Day 8, what would the equation of this line have been? Explain your reasoning.

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(f) Hank had a dream that he and his friends made the area of the pond covered by the plant follow the parabola given below:

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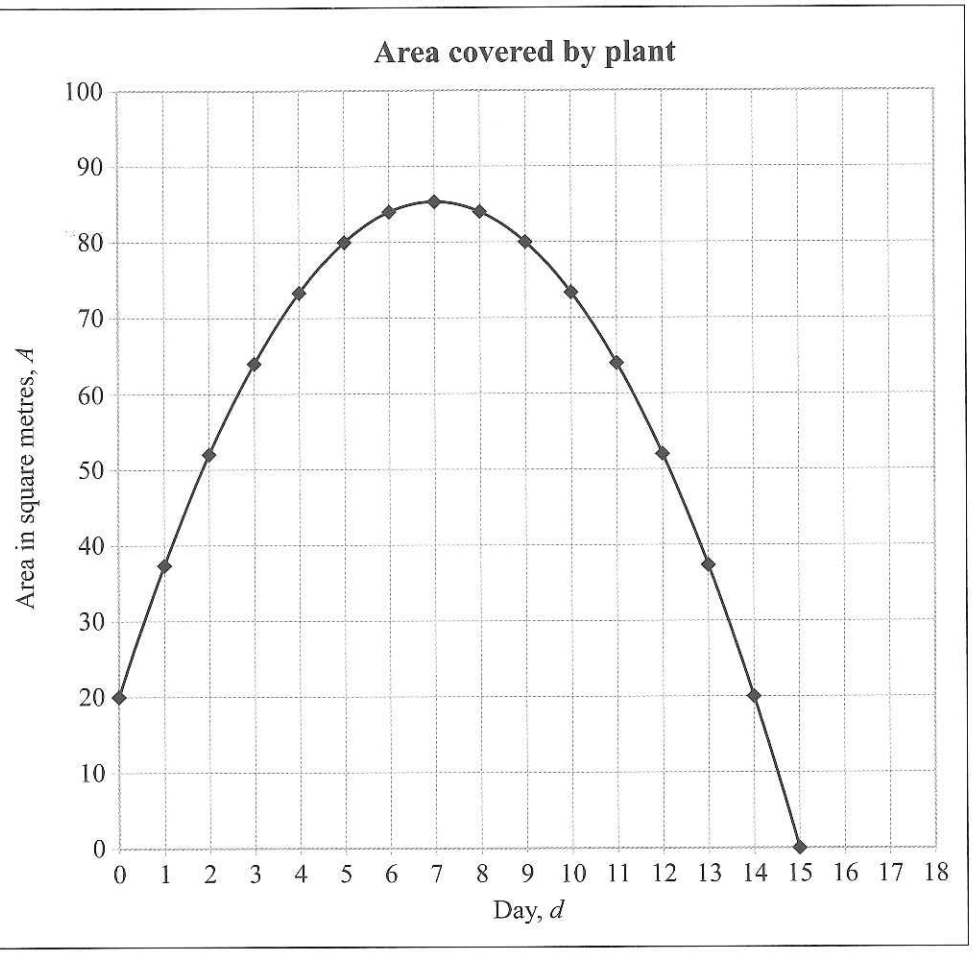
Day	Hank's dream
0	20.00
1	37.33
2	52.00
3	64.00
4	73.33
5	80.00
6	84.00
7	85.33
8	84.00
9	80.00
10	73.33
11	64.00
12	52.00
13	37.33
14	20.00
15	0.00



What is the equation of this graph? h

h

N2

QUESTION THREE

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(a) Jodie sets her friends a mathematical problem. She says:

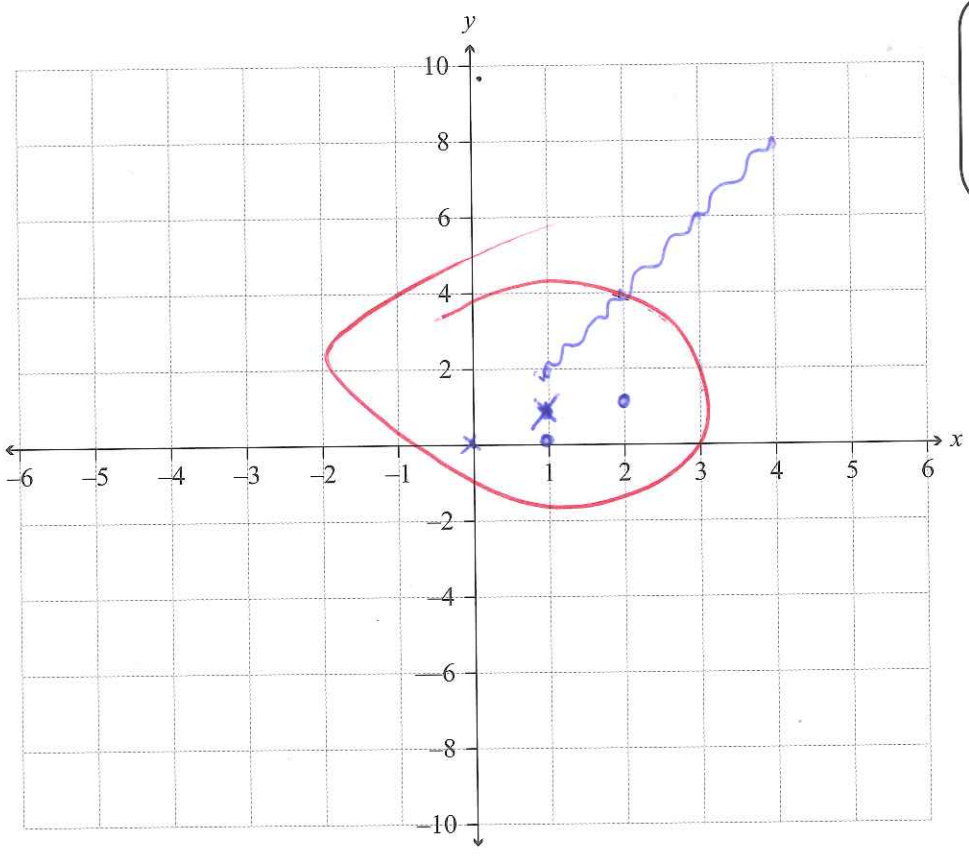
I think of an integer
*When I add 1 to my number, I get **A***
*But if I take 4 off my number, I get **B***
*When **A** is multiplied by **B**, I get an answer of 6.*
What's my number?

Her friends start by writing a table:

x: Jodie's number	$A = x + 1$	$B = x - 4$	$y = AB$
0	1	–4	–4
1	2	–3	–6
2	3	–2	-8
3	4	-1	-10
4	5	0	-12
5	6	1	14
6	7	2	-16

(i) Draw the graph of y against x.

Use the set of axes below.



If you need to redraw this graph, use the grid on page 15

(ii) What is the equation of the graph that matches the table above, in terms of x?

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$y =$

(iii) Explain how Jodie's number can be found from the graph if the answer is 6.

(iv) Suppose Jodie had said *"A multiplied by B gives me –10"*.

What does your graph tell you about the solutions to this new problem?

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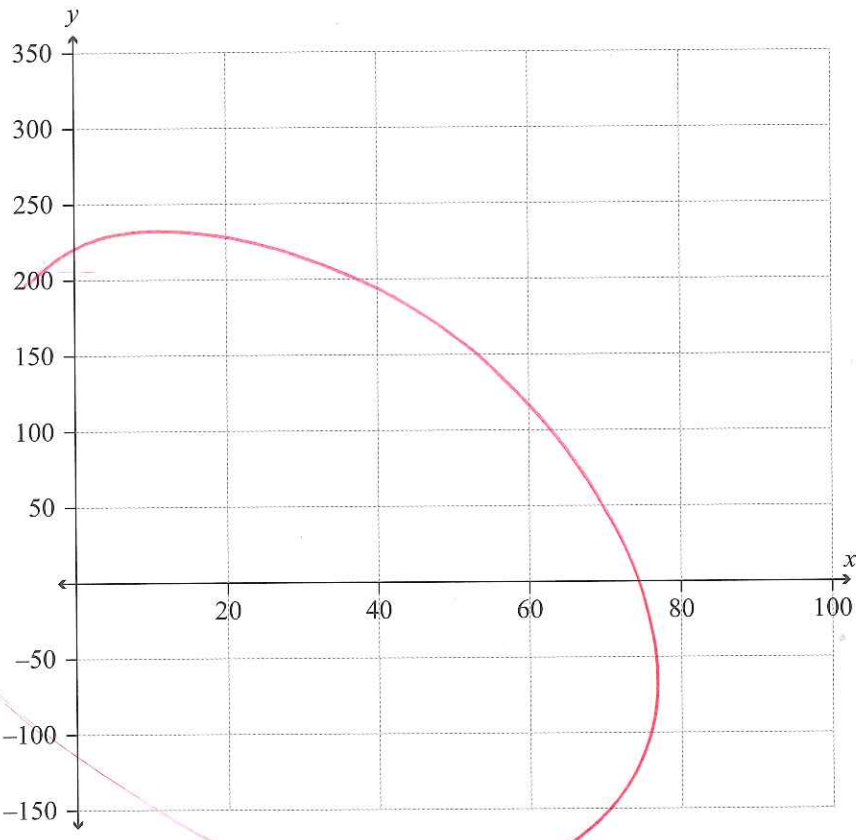
(b) Tom thinks of a puzzle to challenge Jodie.

He starts by saying:

I think of a two-digit number.
I multiply it by 4 and take away 100 ...

(i) What equation would you use to describe this relationship?

(ii) Draw the graph of this relationship on the axes below.



If you need to redraw this graph, use the grid on page 15

(iii) Tom's whole puzzle is:

Guess my 2-digit number:
If I multiply it by 4 and take away 100 ...
I get the same as when I add 47 to it and then multiply the result by 1.12

Explain how the solution to Tom's question can be found, and give the solution as accurately as possible.

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No

Annotated Exemplar Template

Not Achieved exemplar for 91028 2015		Total score	07
Q	**Grade score**	**Annotation**	
1	M5	a(i) Correctly drawn graph for u. a(ii) Correct answer and recognition of doubling (or halving) for r. a(iii) No attempt. a(iv) Correct answer. b(i) and (ii) No attempt made.	
2	N2	a) Attempt crossed out. b) Incorrect answer. c) (i) Equation incorrect. ("Borrowed" from next page.) (ii) "Not grown" not acceptable. Needs to refer to area. d) (i) Graph incorrectly intercepts axis at 16 instead of 15 but u attained for (ii) because consistent with graph e) and f) no attempt made. N2 gained from c(ii).	
3	N0	If the candidate had correct values in table page 10 could have gained N1.	