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NZQA
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SUPERVISOR'S USE ONLY

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.

High Achievement

TOTAL 14

ASSESSOR'S USE ONLY

QUESTION ONE

ASSESSOR'S USE ONLY

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.

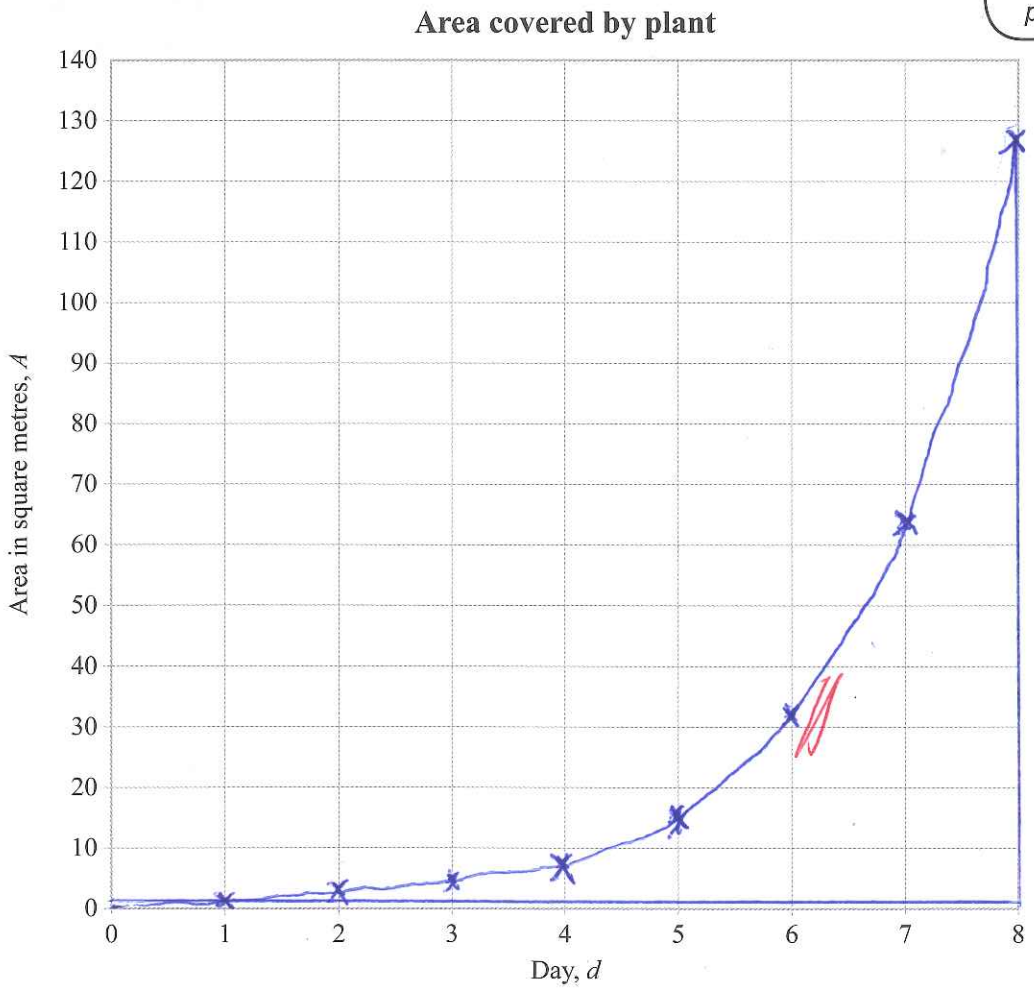
Day, d	Area covered by plant, A
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128

9 256
10 512

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.



ASSESSOR'S USE ONLY

(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. 1

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

$q = 2.8d^2 - 12.5d + 12$ 1

(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?

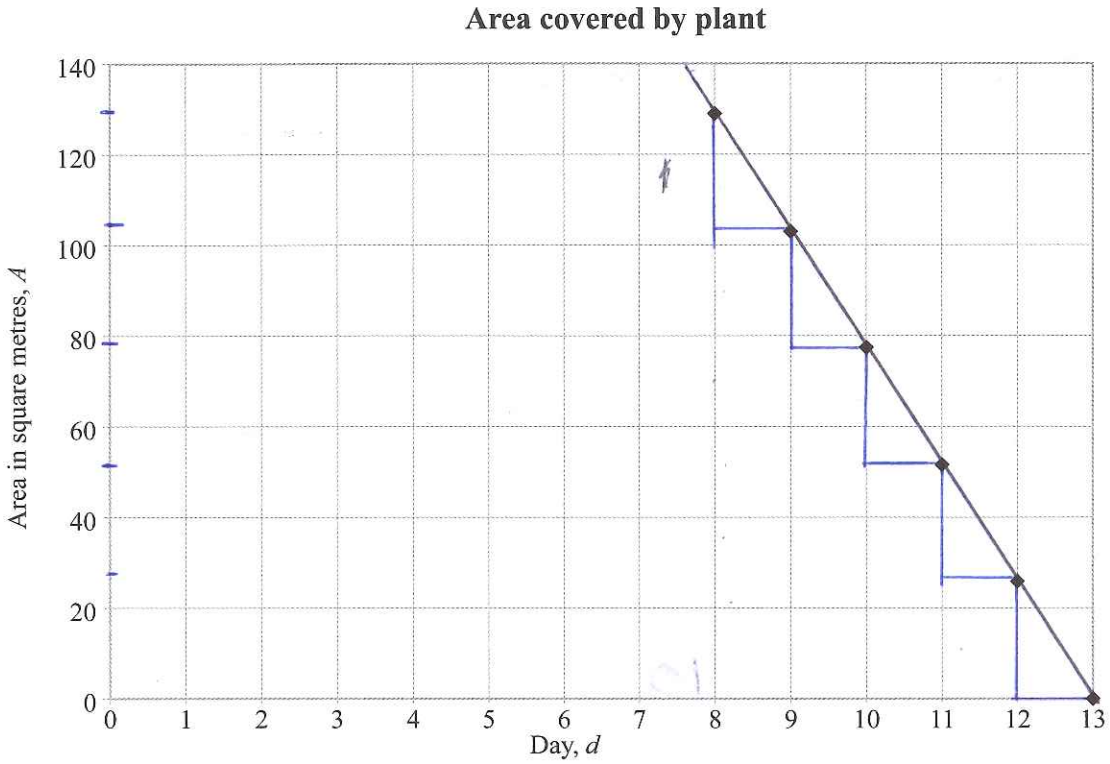
day 10 1

 -25.6 332.8.

ASSESSOR'S USE ONLY

(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?

$a = -25.6d + 332.8$

8
9
10
11
12
13

128
102.4
76.8
51.2
25.6
0

(ii) What is unrealistic about this graph?

Write at least TWO comments with justification.

ASSESSOR'S USE ONLY

That it will go down by the same ~~amount~~ everyday as the plant may not die off by the same amount.

That it is a straight line which is linking to the first option as ~~the~~ for the first 7 days it was an ~~curved~~ exponential graph not a straight lined graph

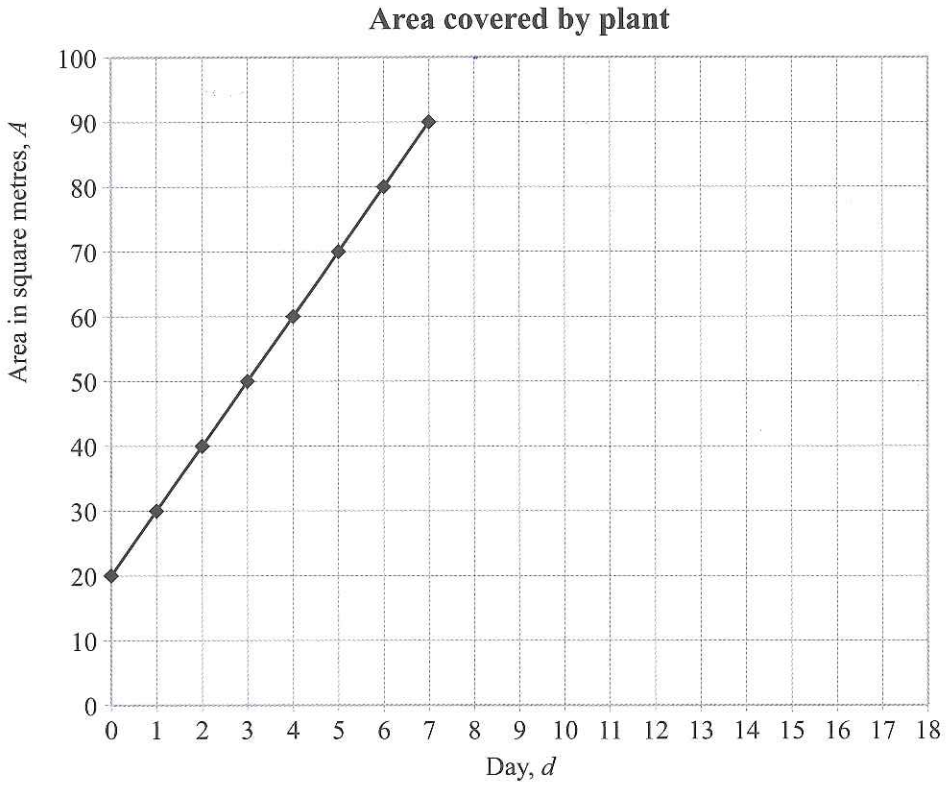
M

M5

QUESTION TWO

ASSESSOR'S USE ONLY

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 = 10d + 20~~

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

10 square metres //

4

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

Show your working.

18 days.

$a = 10 \times 18 + 20$

equation for graph - $a = 10d + 20$ //

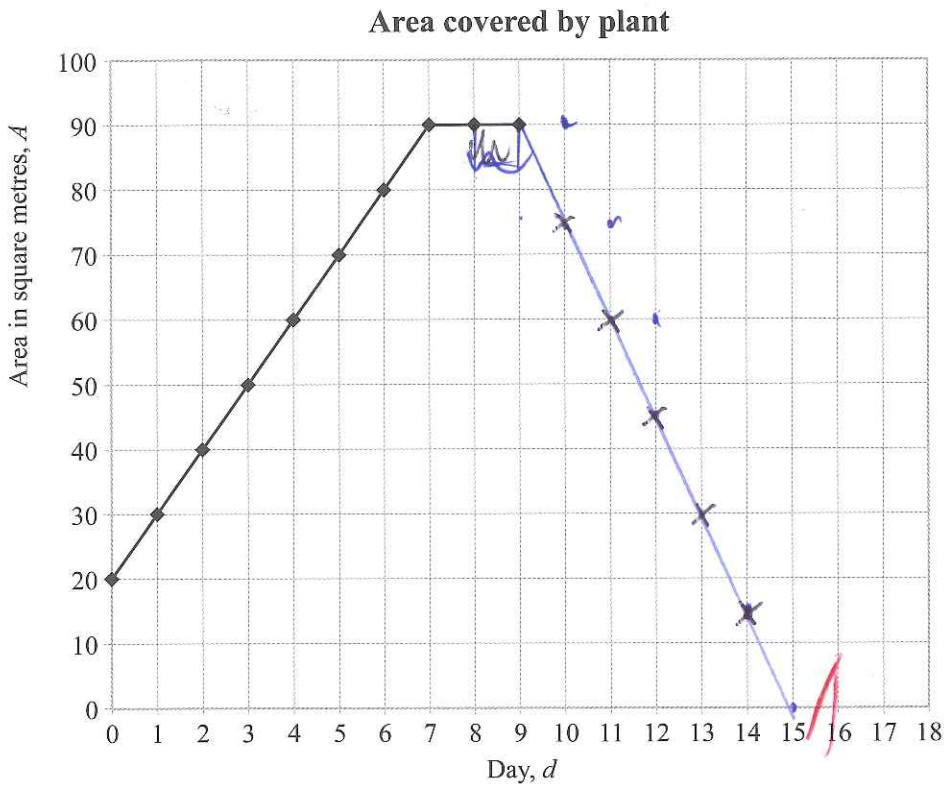
r

ASSESSOR'S USE ONLY

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?

$a = 0d$ ✓

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

It means that no growth has occured. ✓

(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?

15 days. ✓

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

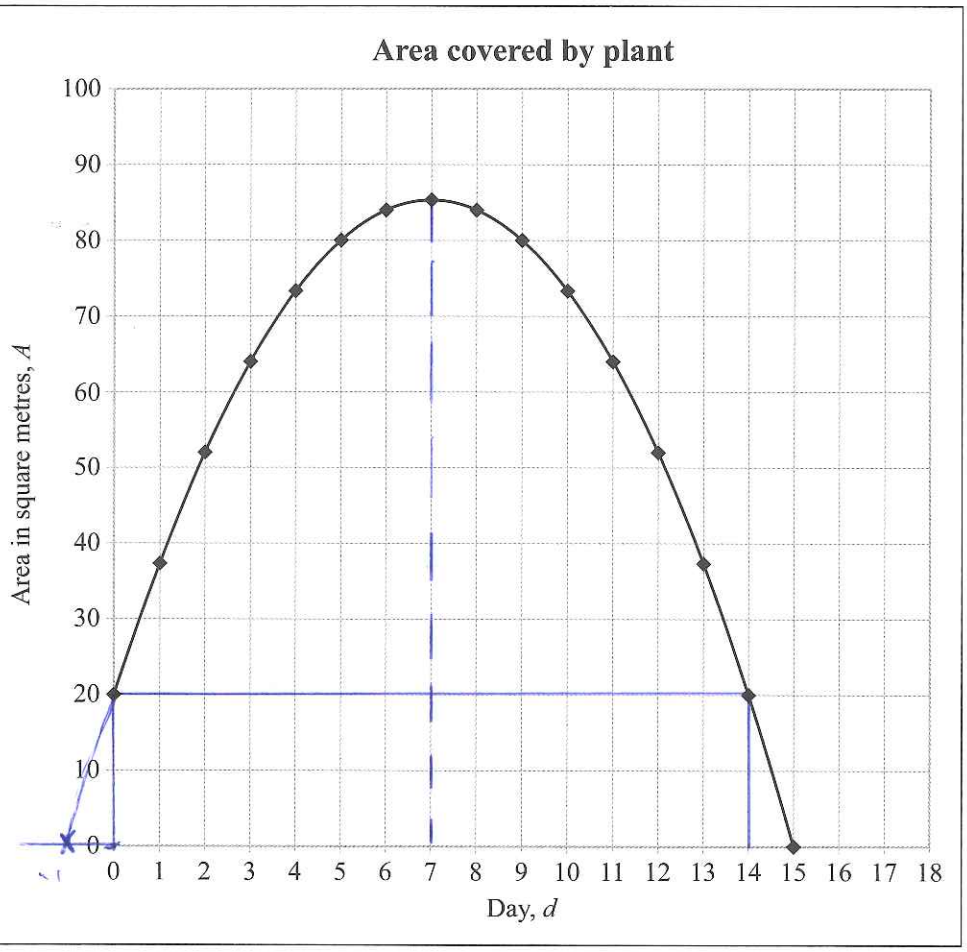
ASSESSOR'S USE ONLY

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

(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:

ASSESSOR'S USE ONLY

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?

$y = A(x + 1)(x - 15)$

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MS

QUESTION THREE

ASSESSOR'S USE ONLY

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

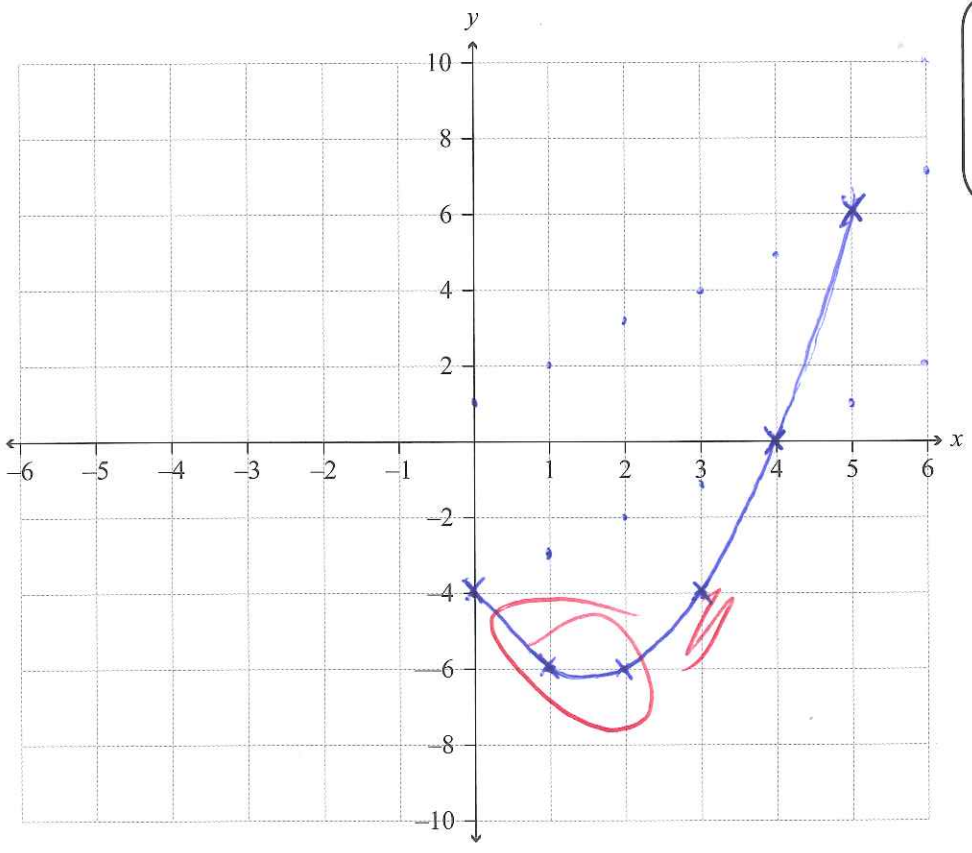
I think of an integer
*When I add 1 to my number, I get **A***
*But if I take 4 off my number, I get **B***
*When **A** is multiplied by **B**, I get an answer of 6.*
What's my number?

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	-6
3	4	-1	-4
4	5	0	0
5	6	1	6
6	7	2	14

(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?

$y =$ .....

(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?

ASSESSOR'S USE ONLY

ASSESSOR'S USE ONLY

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

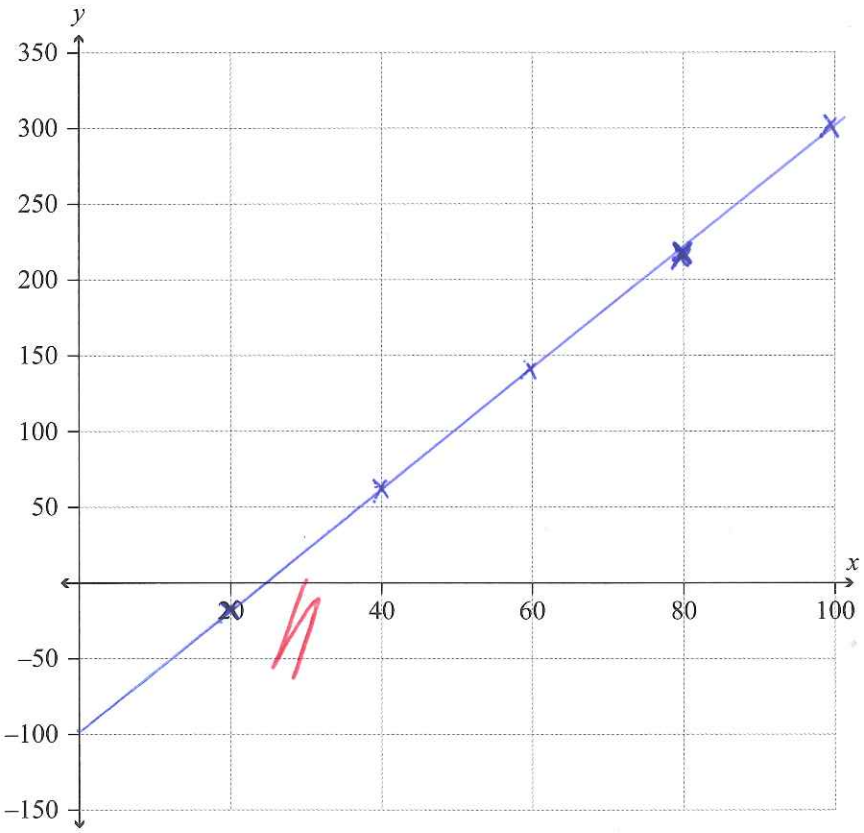
He starts by saying:

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?

$y = 4x - 100$

(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.

$(x \times 4) - 100 = ?$

$4x - 100$ 1

ASSESSOR'S USE ONLY

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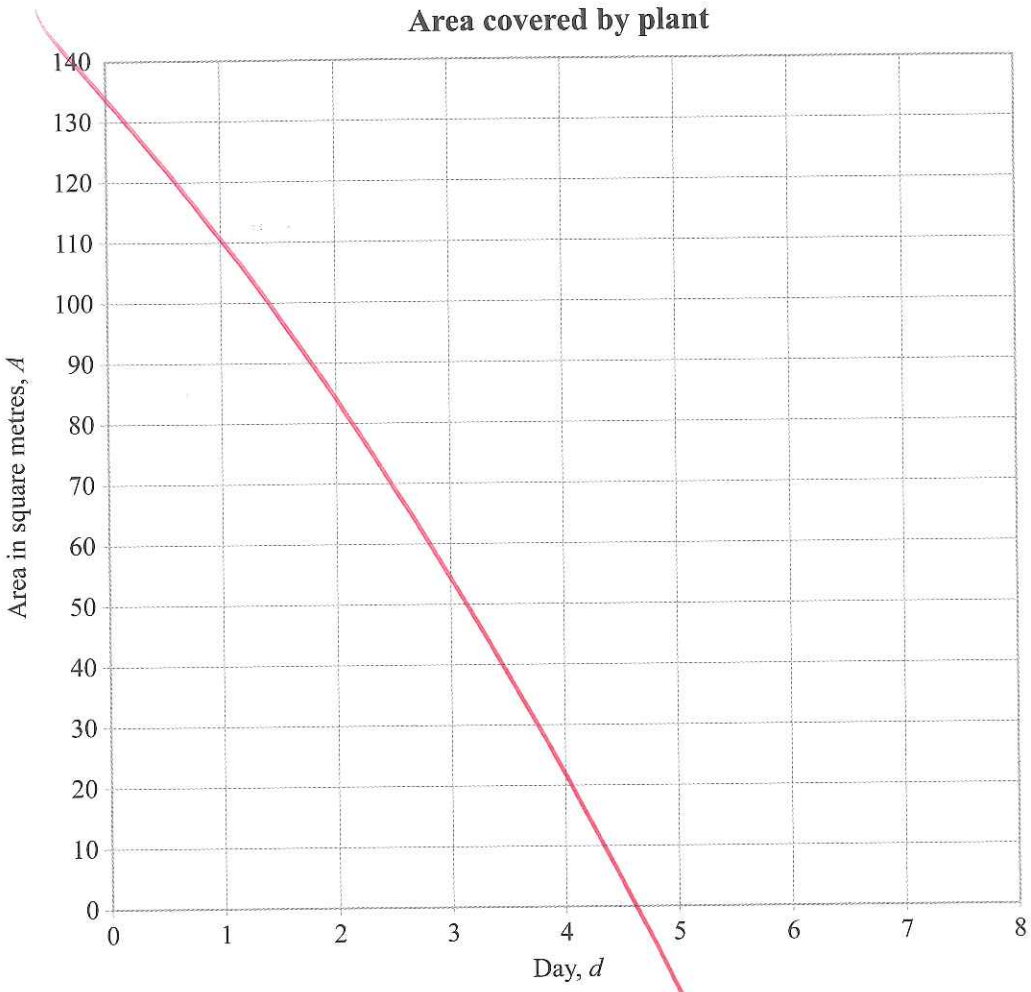
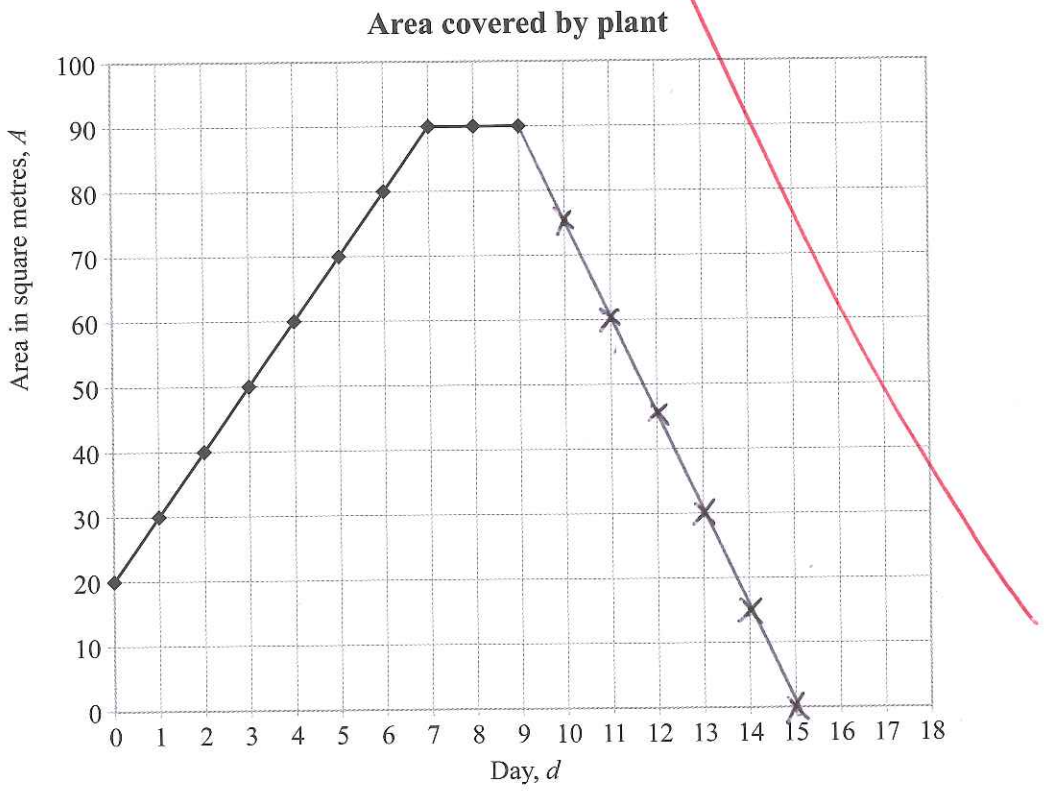
A4

ASSESSOR'S USE ONLY

If you need to redraw your graph from Question One (a)(i), draw it on the grid below. Make sure it is clear which graph you want marked.

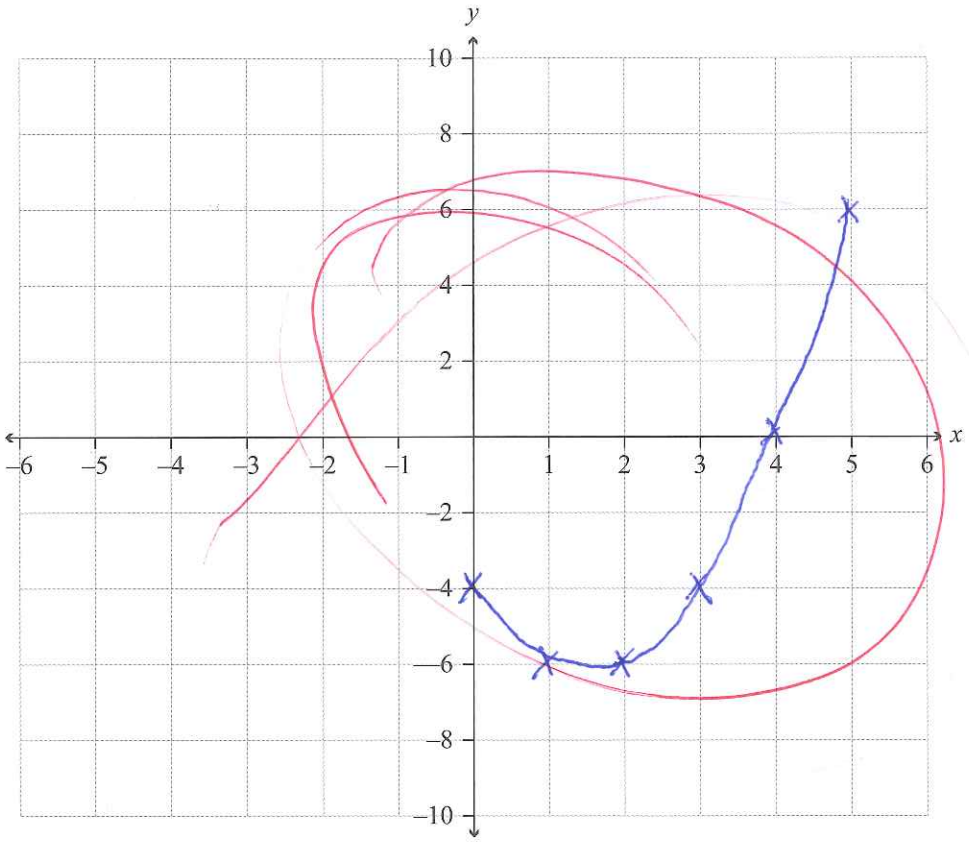


If you need to redraw your graph from Question Two (c), draw it on the grid below. Make sure it is clear which graph you want marked.

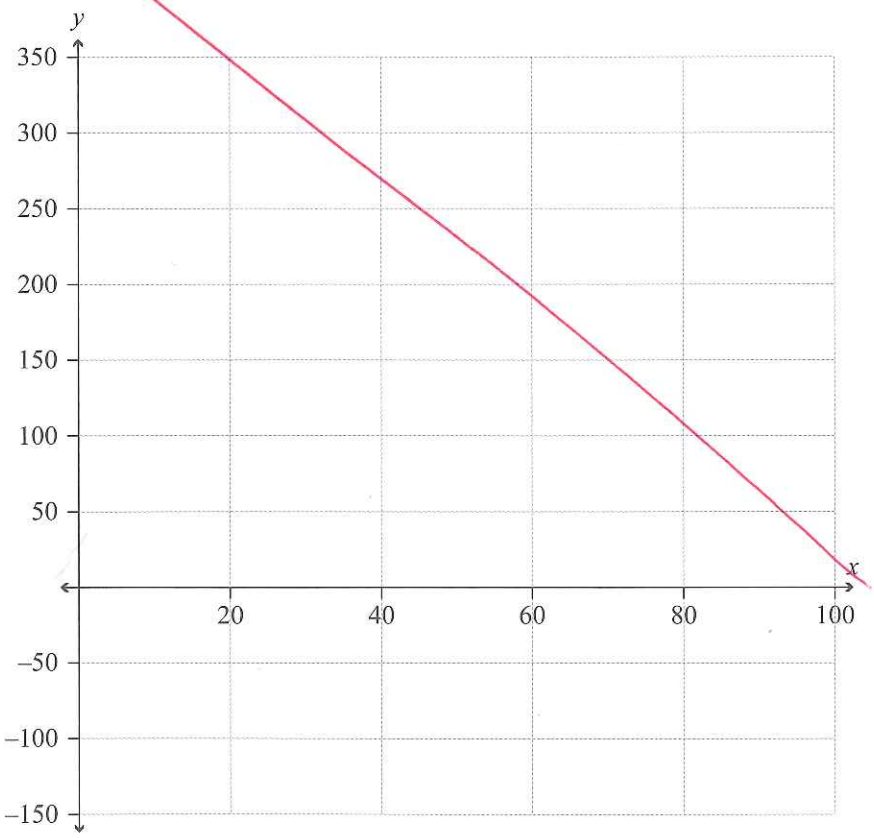


ASSESSOR'S USE ONLY

If you need to redraw your graph from Question Three (a)(i), draw it on the grid below. Make sure it is clear which graph you want marked.



If you need to redraw your graph from Question Three (b)(ii), draw it on the grid below. Make sure it is clear which graph you want marked.



Annotated Exemplar Template

Achieved exemplar for 91028 2015		Total score	14
Q	**Grade score**	**Annotation**	
1	M5	a(i) Graph correct. Discrete points or continuous OK. a(ii) Correct answer for u but no explanation. a(iii) Candidate has probably used graphics calculator but chosen incorrect model. a(iii) Correct. b(i) Correct equation for r. b(ii) Some understanding that linear model probably inappropriate but with no explanation as to why.	
2	M5	a) Correct. b) Correct equation and indication of working. c) Equation incorrect and reason incorrect. d) Correct. e) No attempt. f) Intercepts correct but no scale factor so u.	
3	A4	a(i) Graph OK for u but should be discrete points. a(ii), (iii) and (iv). No attempt. b(i) and (ii). Correct. b(iii).Candidate has been unable to interpret question.	