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Level 1 Mathematics and Statistics 2021

91028 Investigate relationships between tables, equations and graphs

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 room for any answer, use the extra space provided at the back of this booklet.

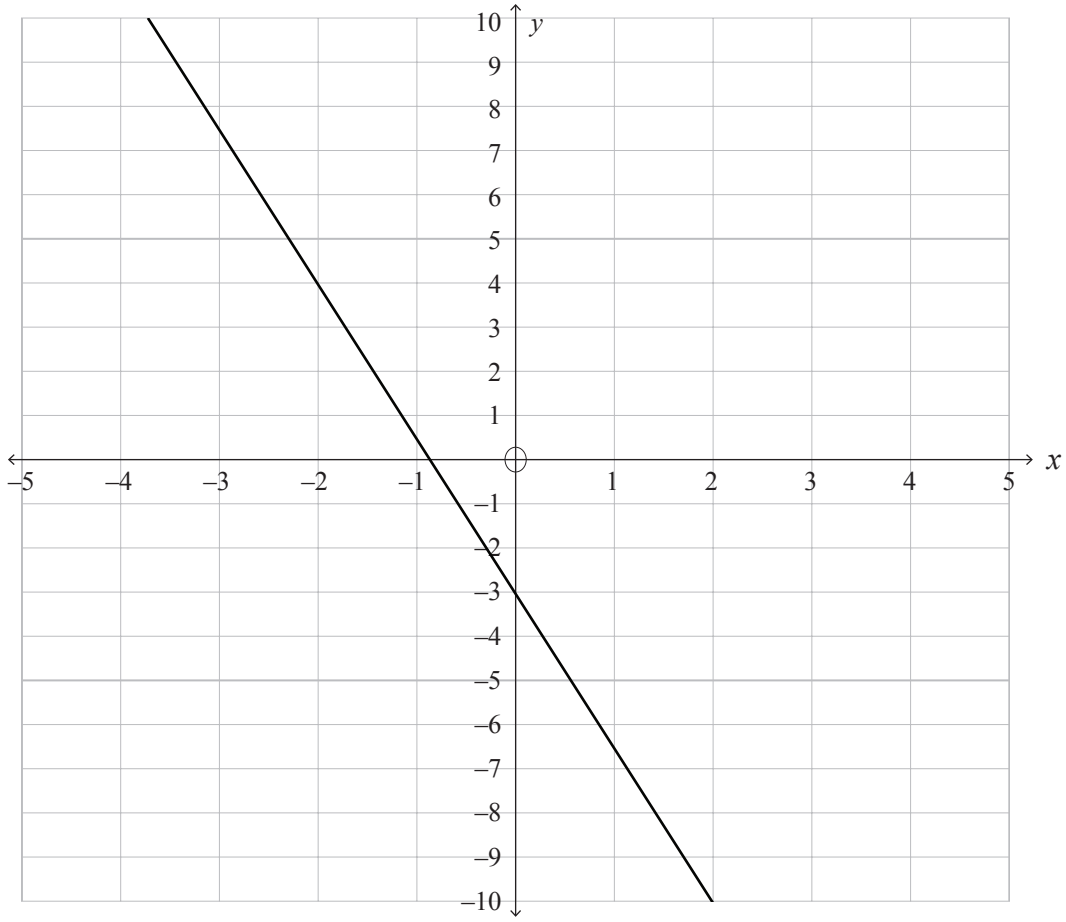
Check that this booklet has pages 2–20 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (▨). This area may be cut off when the booklet is marked.

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

QUESTION ONE

(a) (i) Give the equation of the graph shown below.



Equation: _____

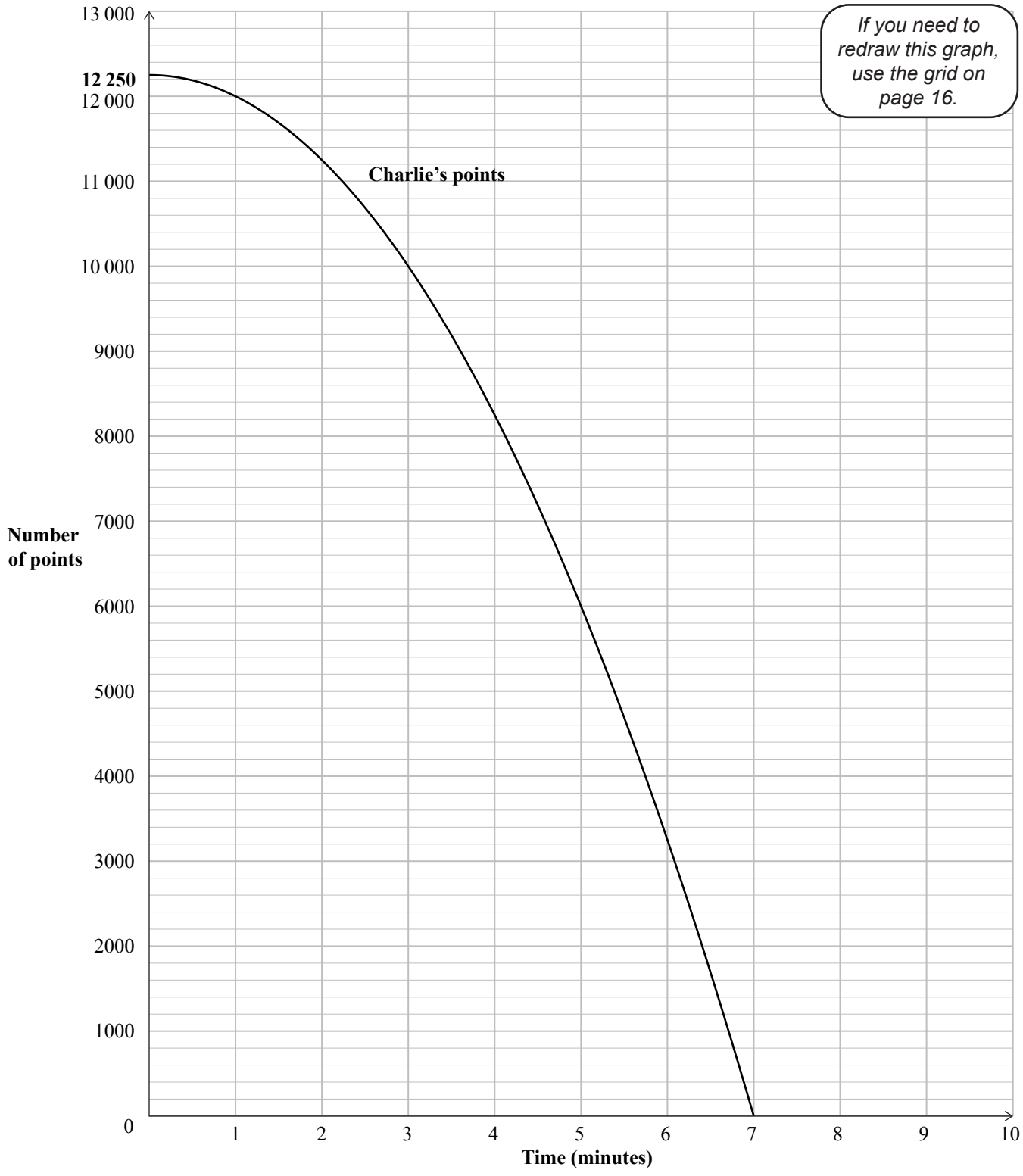
(ii) Find the equation of the new line if the graph shown on page 2 is translated 20 units up and 10 units to the left, simplifying your answer as far as possible.

(b) Anne, Ben, and Charlie are playing a computer game that involves fighting monsters. Each game lasts for nine minutes. They all start playing the game at the same time.

In one game:

- Anne starts with 4 000 points. As she plays, she loses 500 points every minute.
- Ben starts with 12 000 points. He loses half his points every minute.
- Charlie starts with 12 250 points. He loses all of his points after seven minutes, with the rate following a quadratic pattern, as shown on the graph below.

If a player loses all of their points before the nine minutes are up, they are removed from the game. The players lose their points continuously.



(i) Complete the table below.

Time (minutes)	Number of points remaining for Anne	Number of points remaining for Ben	Number of points remaining for Charlie
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			

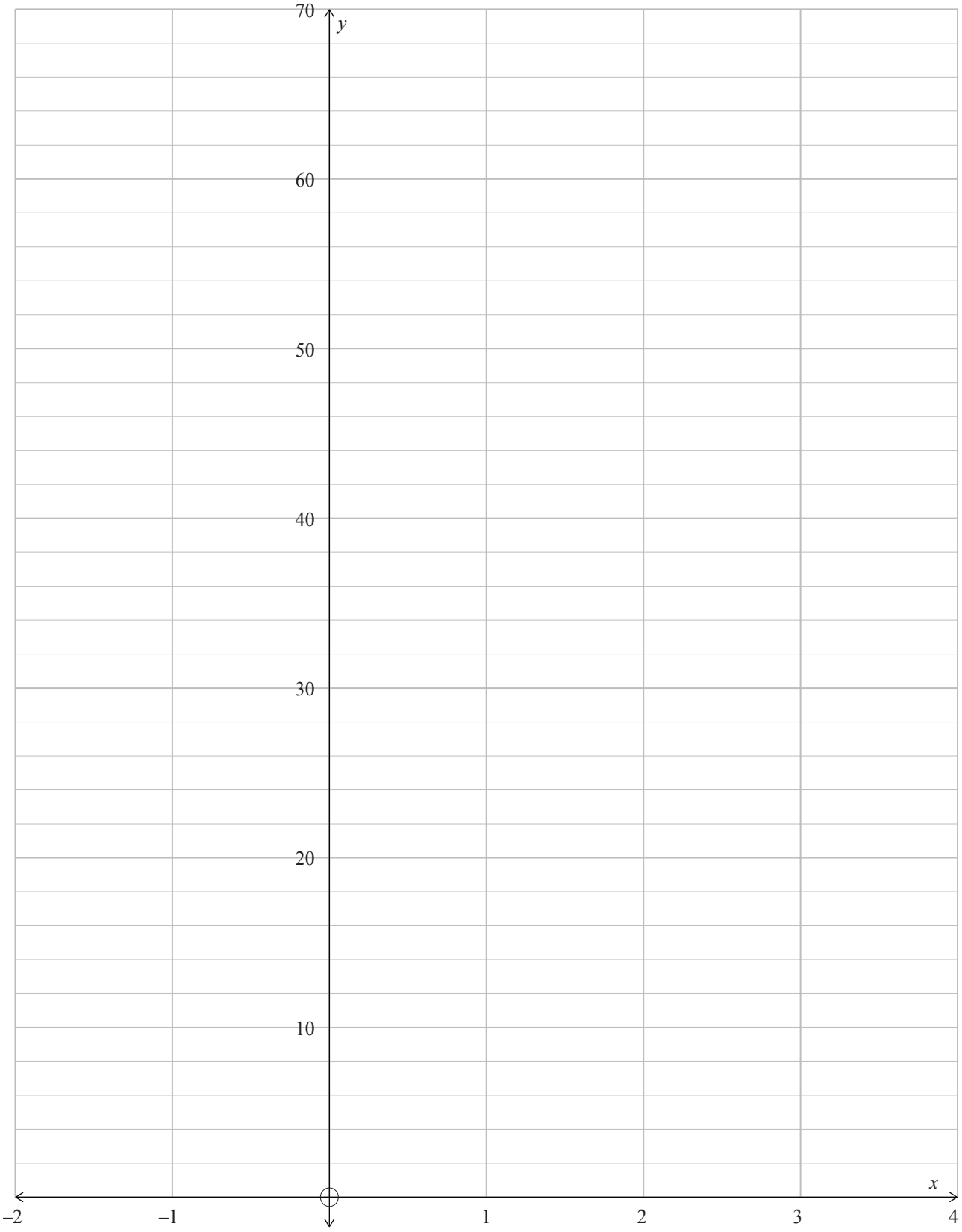
(ii) Using the axes provided on the page opposite, draw the graphs representing the number of points from the games played by Anne and Ben.

(iii) Find the equation of each of the models for the number of points from the games played by Anne, Ben, and Charlie.

(iv) Compare each player's points over the course of this game, including who will play the game for the longest time.

QUESTION TWO

(a) Using the axes below, sketch the graph of $y = 2^{x+2}$



If you need to redraw this graph, use the grid on page 17.

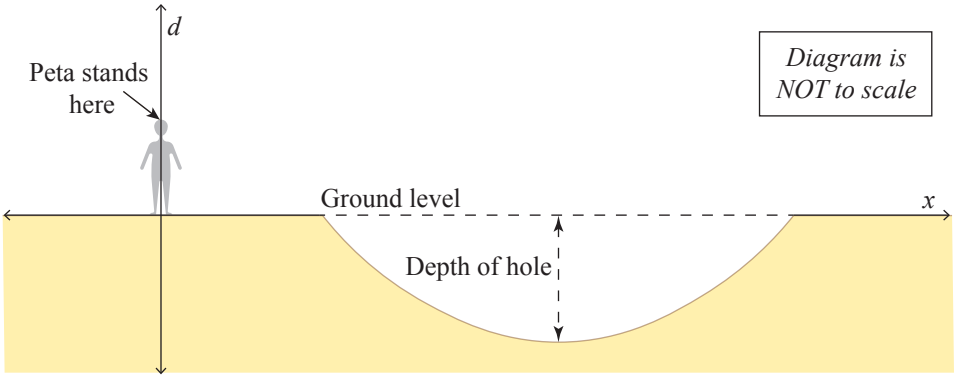
(b) At Hot Water Beach, people dig holes in the sand to reach warm water. The holes fill with water and people lie in the warm water.

Source: https://www.newzealand.com/int/plan/business/cathedral-cove-and-hot-water-beach-express/

(i) Peta's family dug a hole that can be modelled by the equation $d = 0.8(x - 1)(x - 4)$

where d is the depth of the hole in metres below ground level

and x is the horizontal distance measured from where Peta is standing.



How far below ground level is the deepest point of the hole?

(ii) Peta's grandmother thinks the hole is possibly dangerous. Peta's family decide to dig a new hole to try to calm their grandmother. The new hole will still be in the shape of a parabola.

Suggest at least two ways in which the original equation of the hole in (i) could be altered to make a new, safer hole.

Describe how each of the changes would affect the hole's shape.

(iii) Sheila's family dig their hole with a gentle slope downwards so their dog can slide into the warm water. They measure the depth in several places, which are recorded in the table below.

Horizontal distance from Sheila (metres)	**Depth of the hole below ground level (metres)**
0	1
1	0.5
2	0.25
3	0.125

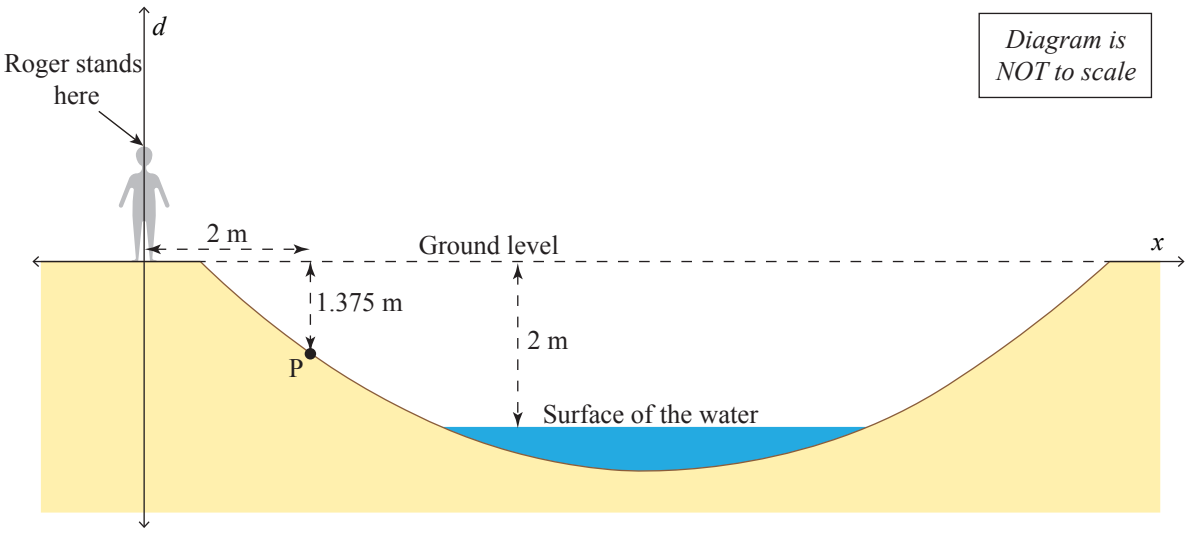
What is the equation of the model that fits the results shown in the table above?

(iv) Roger's family dug a hole that can be modelled by a quadratic equation, as shown in the diagram below.

The hole's greatest depth is 2.5 metres, at a horizontal distance of 5 metres from Roger.

The hole is 1.375 metres deep at a horizontal distance of 2 metres from Roger (point P on the diagram).

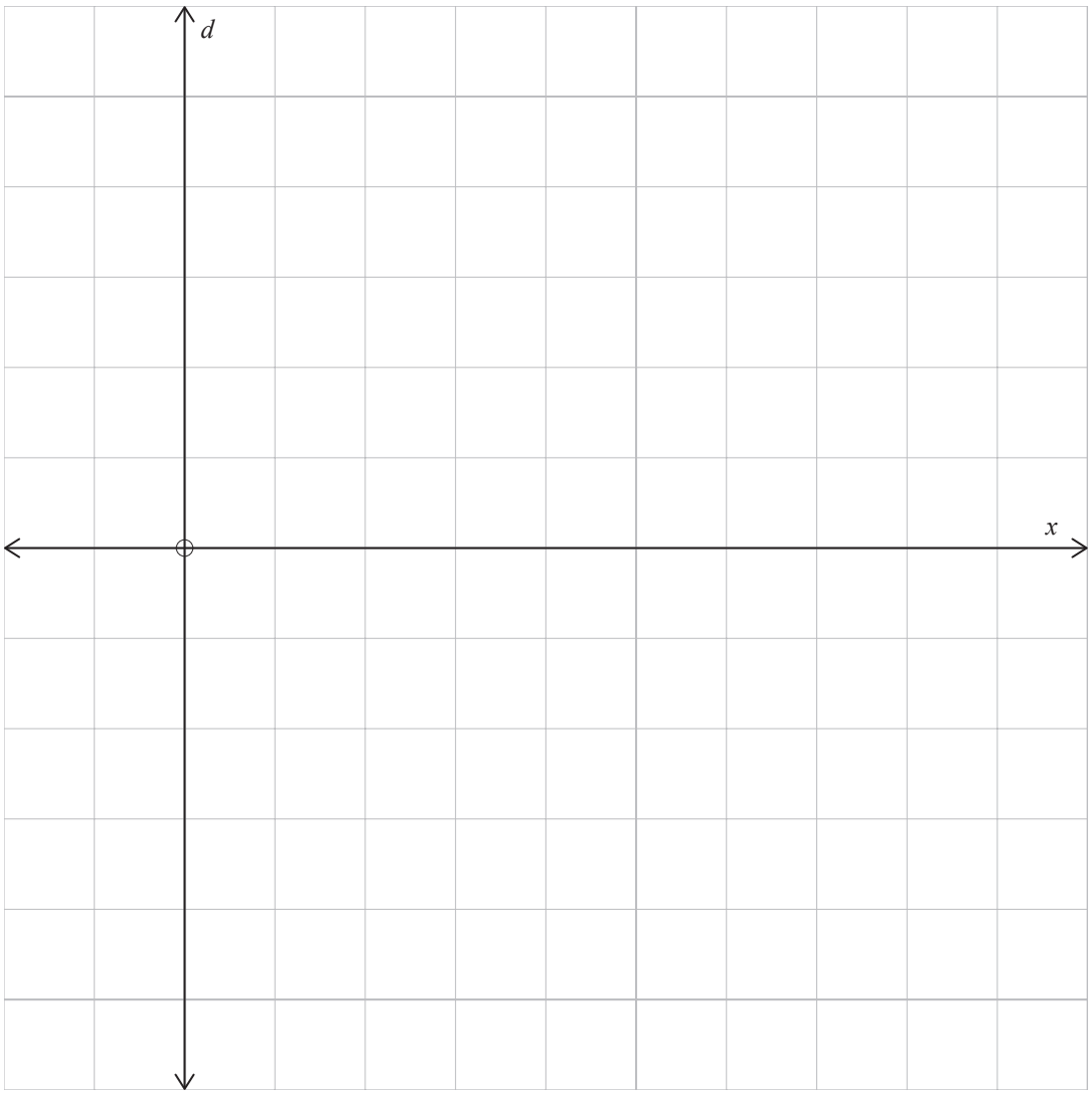
Warm water flows into the hole. The surface of the water is 2 metres below ground level.



Using equations **OR** graphs, find how wide Roger's hole is at the **surface of the water**.

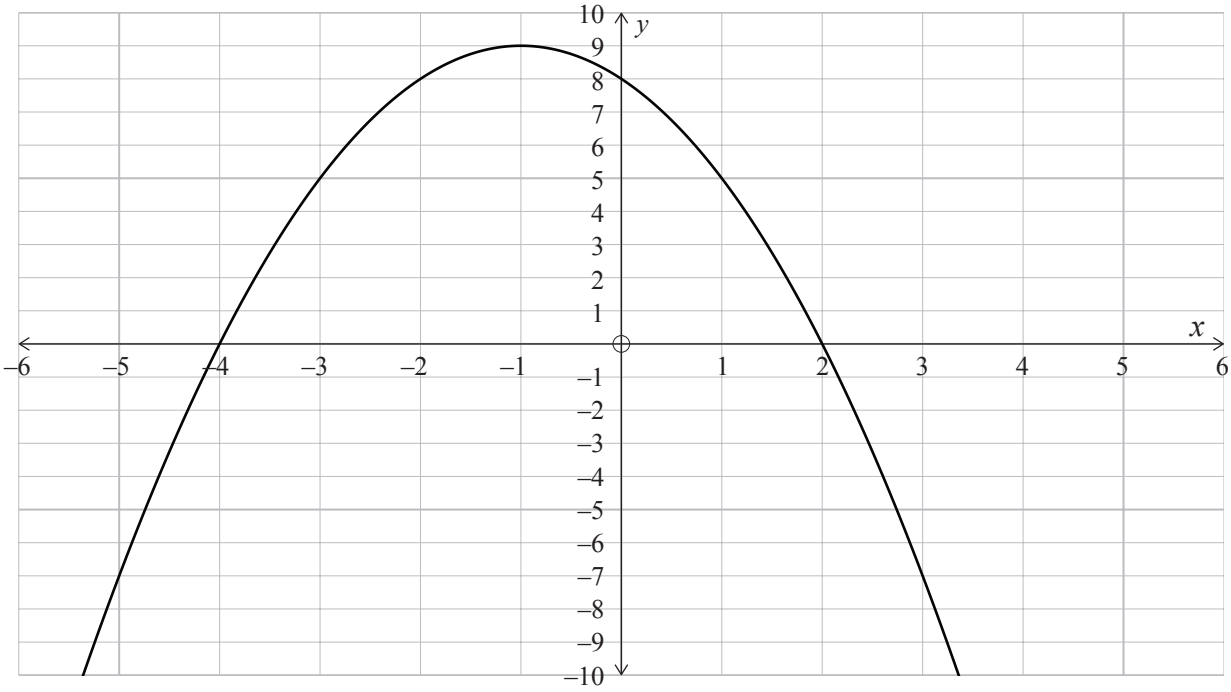
Justify your answer with full and clear working.

You may choose to use the graph paper on the next page.


d
x

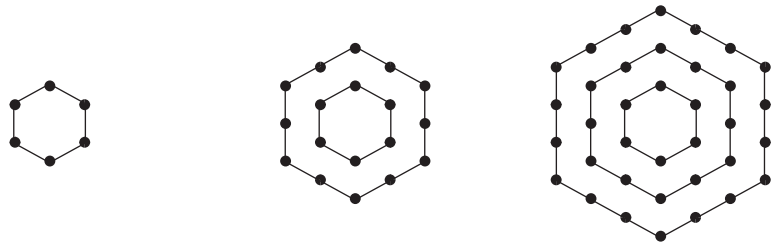
QUESTION THREE

(a) Give the equation of the graph shown below.



Equation: _____

(b) Zak was drawing some patterns in his book, drawing dots and then connecting them to form hexagons.



Pattern 1 **Pattern 2** **Pattern 3**

(i) Complete the table below to give the total number of dots used in each pattern.

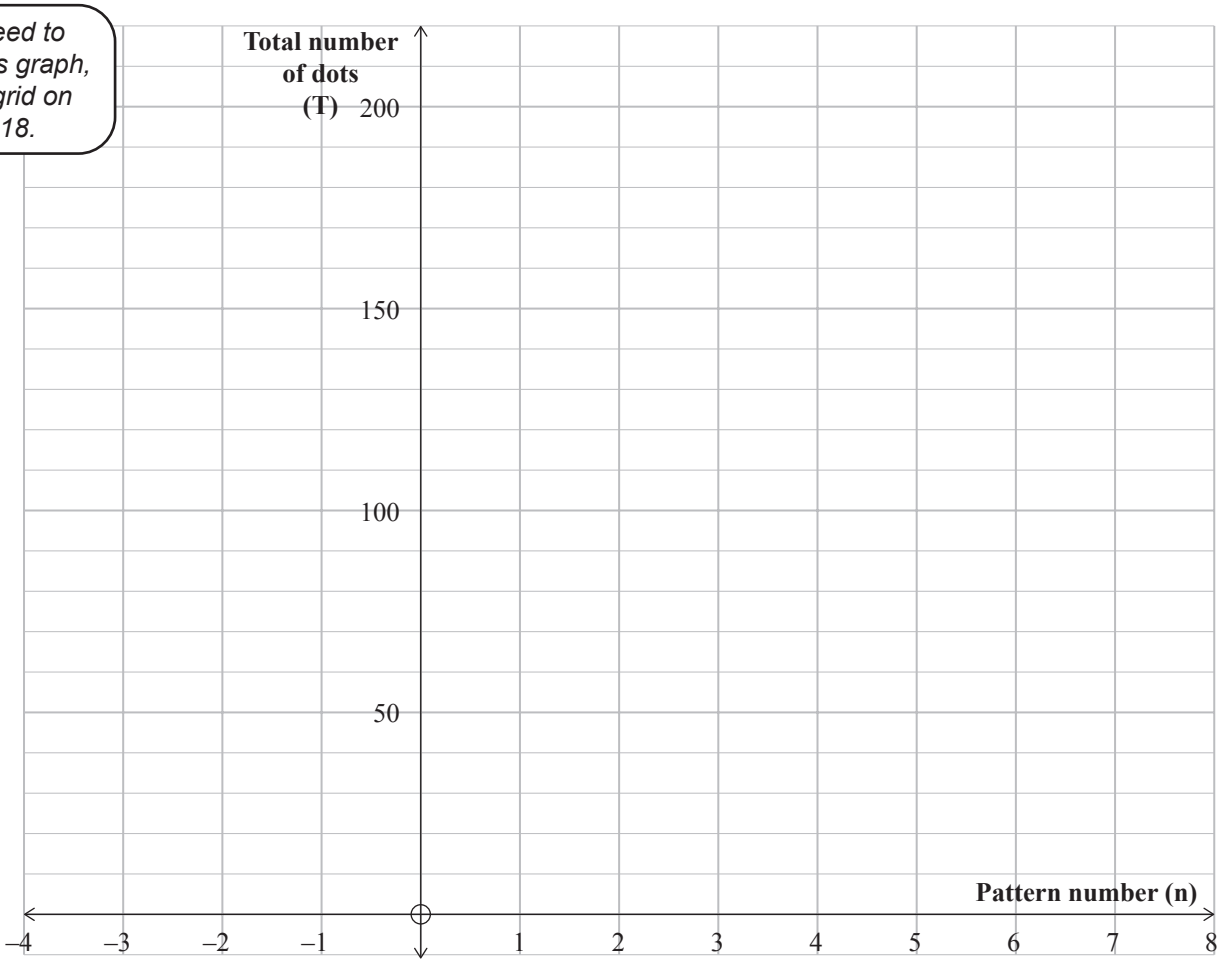
Pattern number (n)	Total number of dots (T)
1	6
2	18
3	36
4	
5	

(ii) Find an equation that represents the total number of dots in any given pattern.

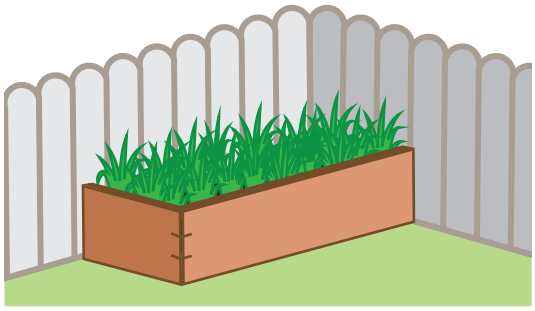
Justify your answer.

(iii) Use the axes below to draw the graph that best represents the relationship between 'Pattern number' and 'Total number of dots'.

If you need to redraw this graph, use the grid on page 18.

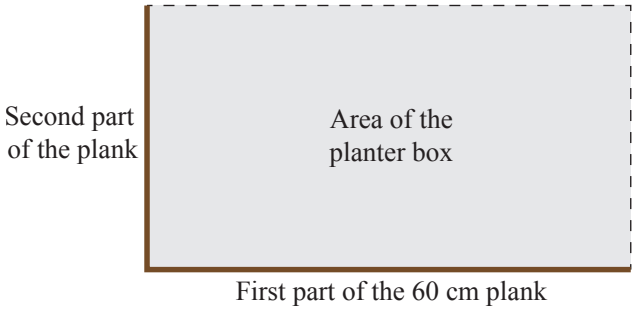


(c) Lizzy has brought home a 60 cm-long plank of wood.



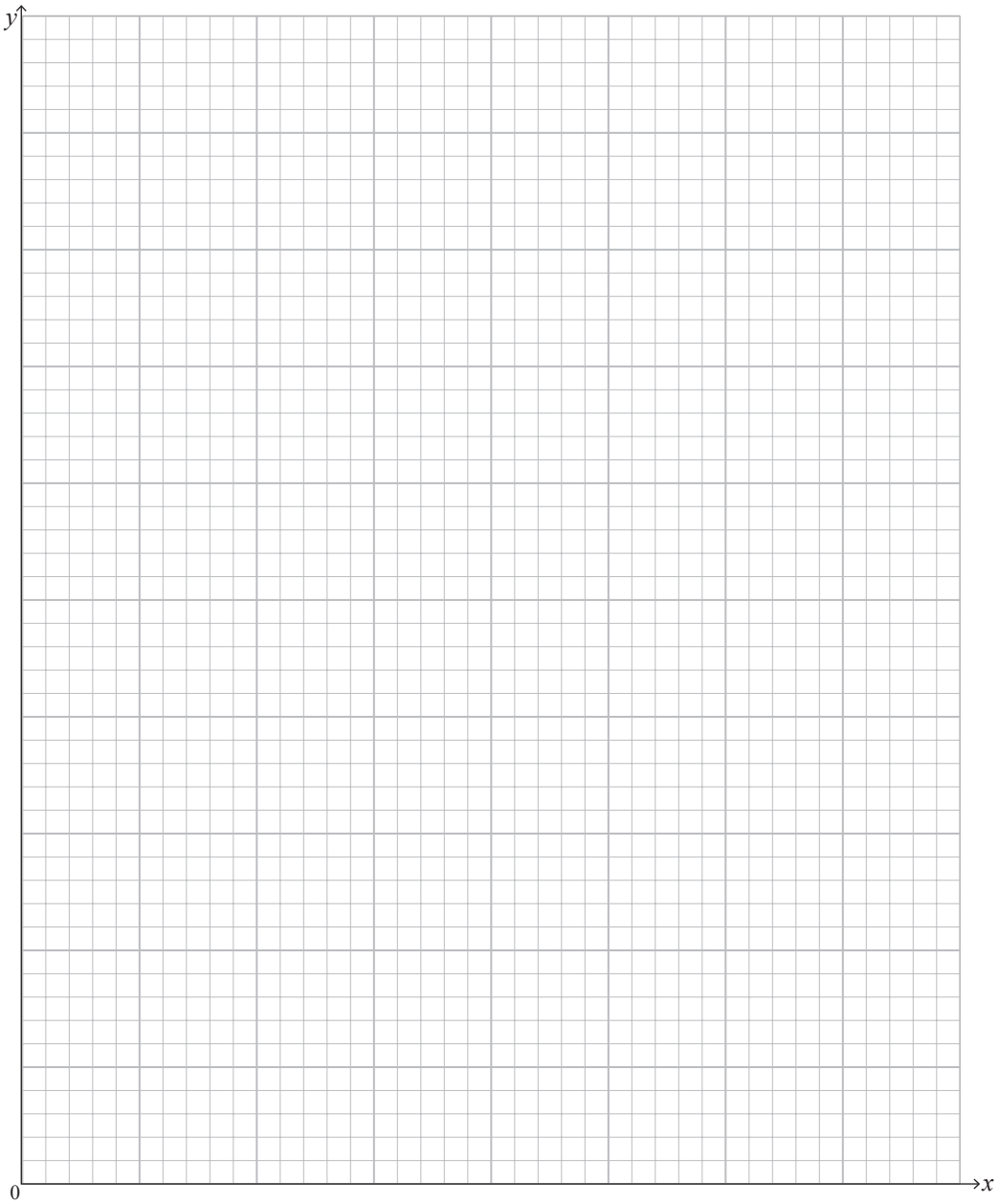
She plans to cut this plank into two parts to make a small rectangular planter box in the corner of her garden, up against the existing fence (so she needs to make only two sides).

The required set-up is shown below.



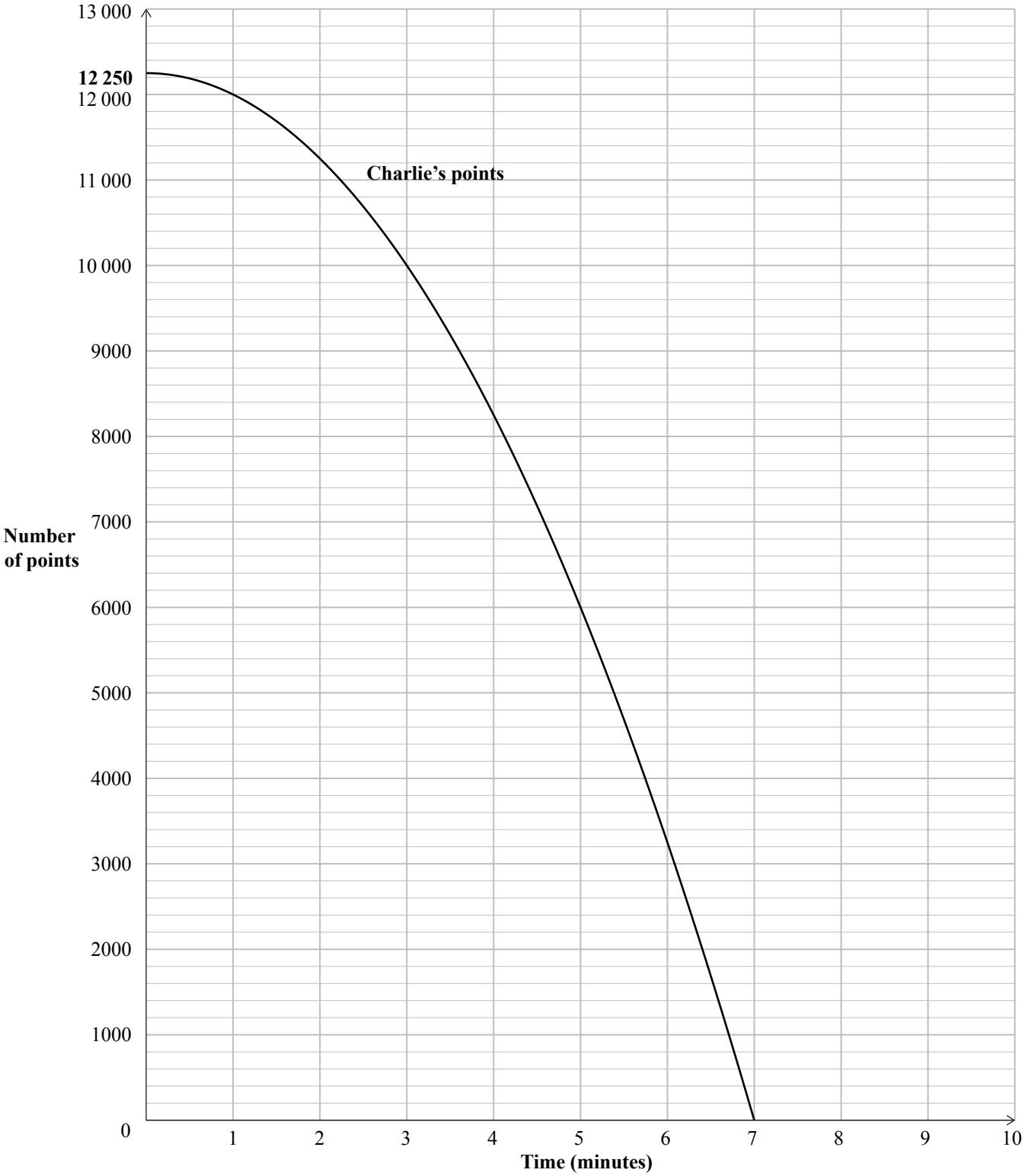
Use tables, equations, **and** graphs to investigate the relationship between the lengths of the two parts and the area of the planter box.

Provide at least THREE comments that follow from your investigation.

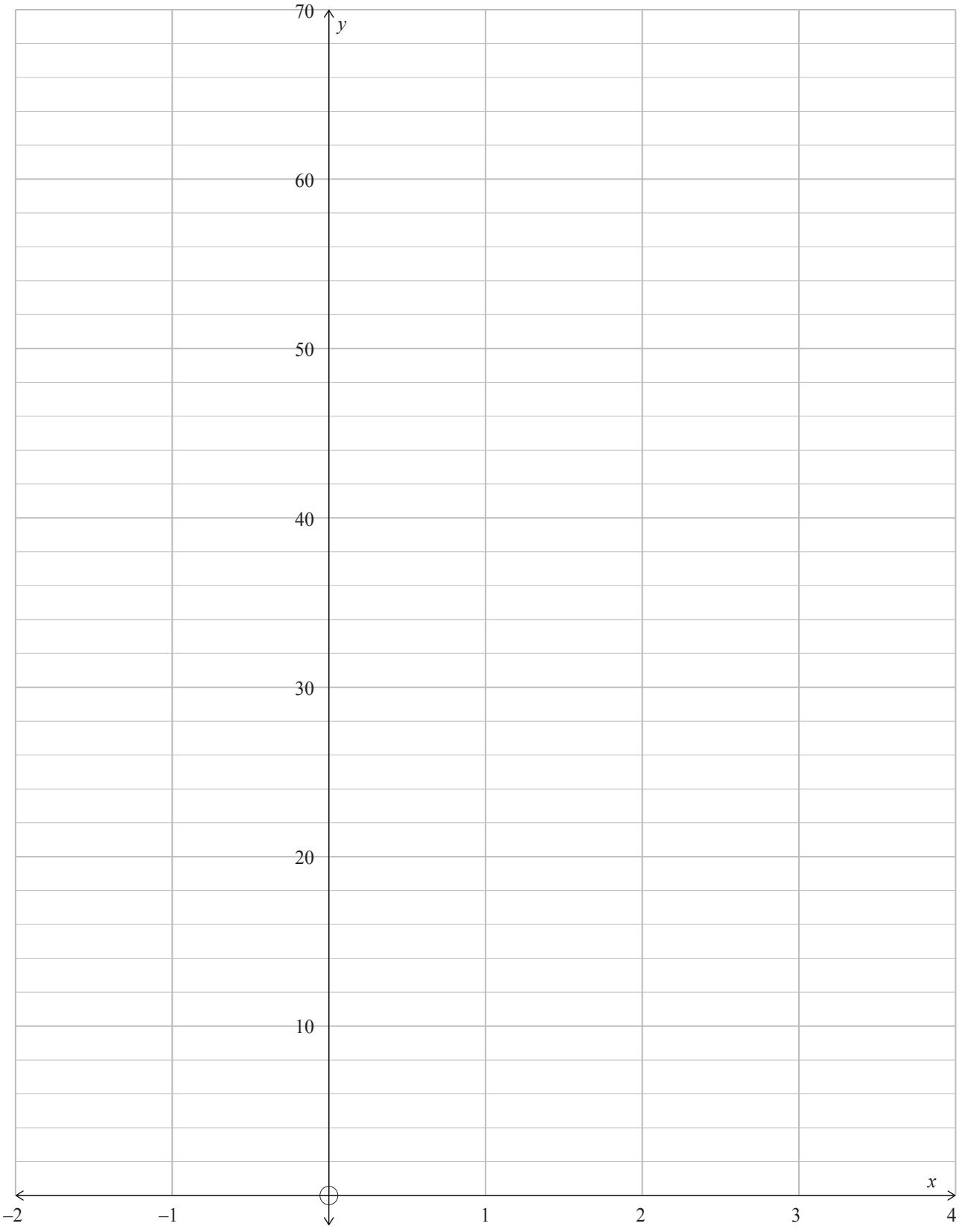

y
0
x

SPARE GRIDS

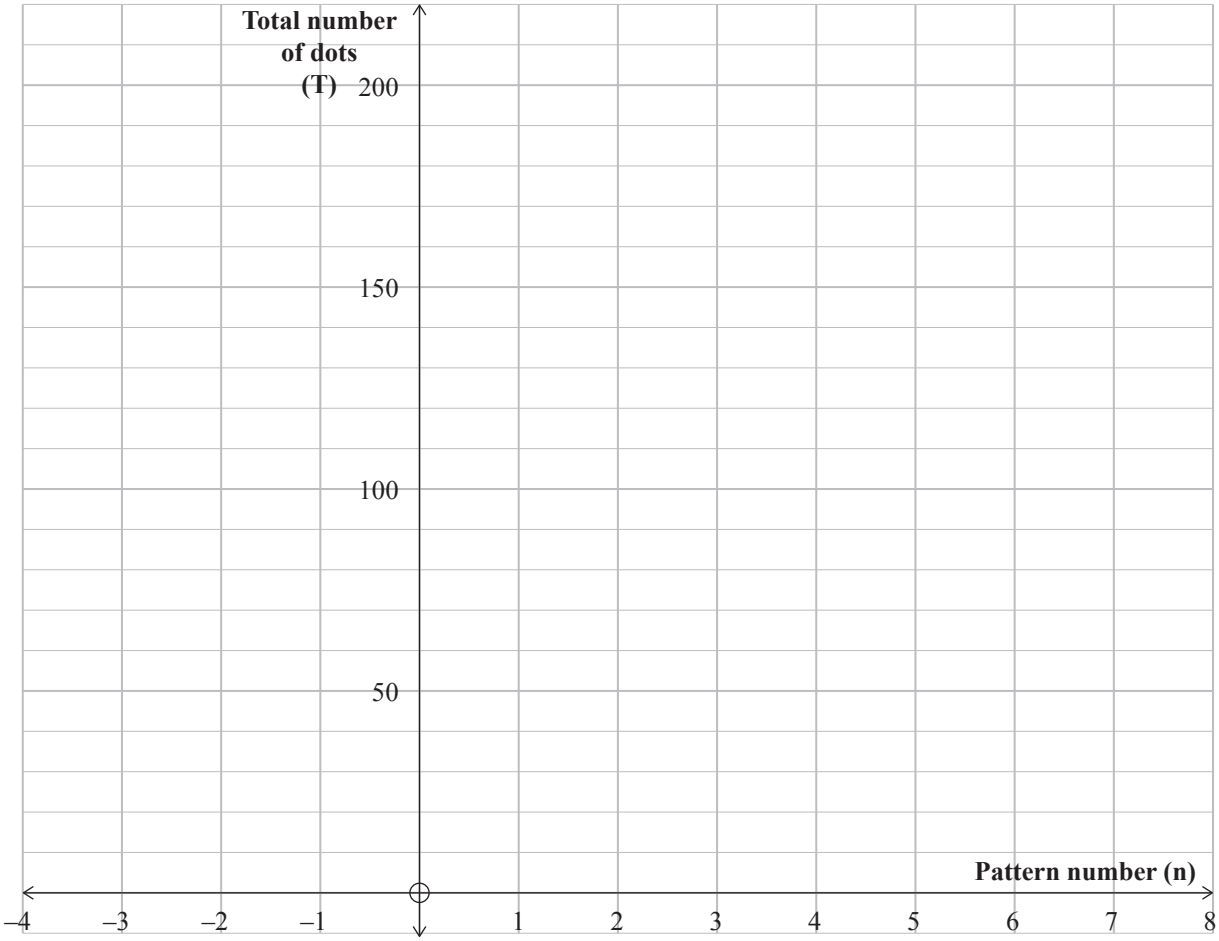
If you need to redo Question One (b), use the grid below. You should make it clear which answer you want marked.



If you need to redo Question Two (a), use the grid below. You should make it clear which answer you want marked.



If you need to redo Question Three (b)(iii), use the grid below. You should make it clear which answer you want marked.



Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER