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91028



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Level 1 Mathematics and Statistics 2022

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 2–24 in the correct order and that none of these pages is blank.

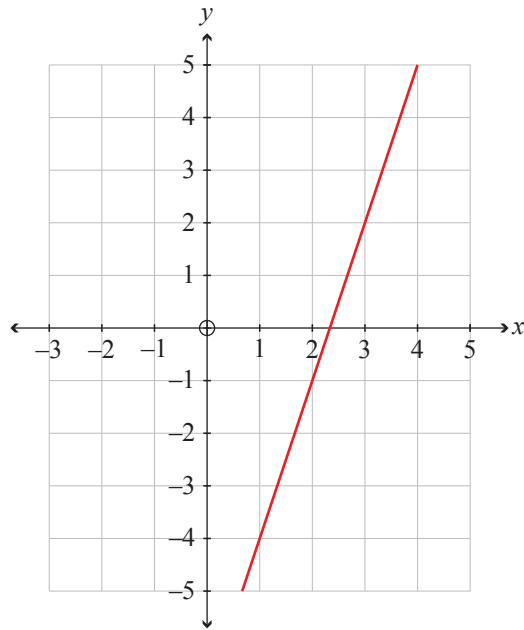
Do not write in any cross-hatched area (✂). This area may be cut off when the booklet is marked.

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

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The examination starts on the following page.**

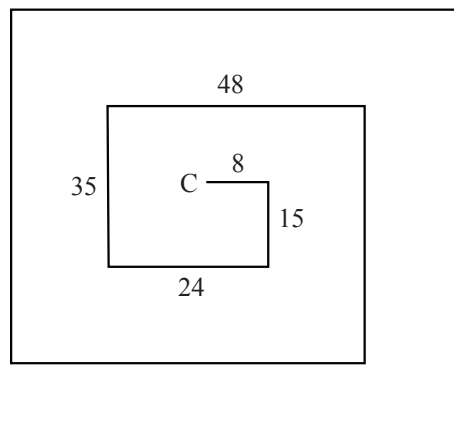
QUESTION ONE

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



Equation is: _____

- (b) The diagram below shows the first 10 sides of a spiral pattern, starting at the central point C. It also gives the lengths, in cm, of the first 5 sides.



*Diagram is
NOT to scale*

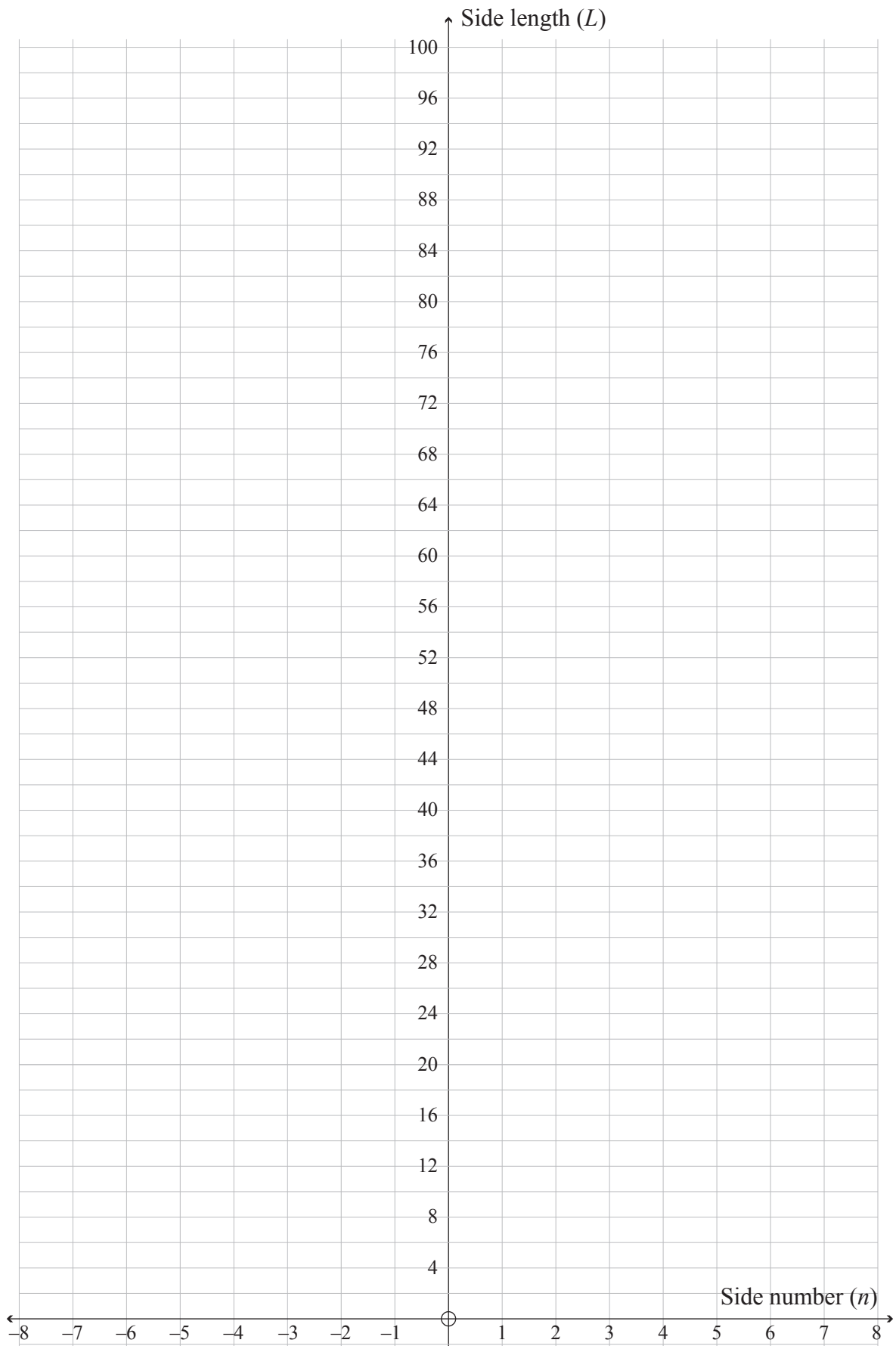
The length of each side is shown in the table below.

Side number (n)	Side length (L) (cm.)
1	8
2	15
3	24
4	35
5	48
6	
7	
8	

- (i) Find an equation that represents the side length, L , for any given side number, n , in this spiral pattern.

Justify your answer.

- (ii) Using the axes below, draw the graph to show the pattern in (b)(i).
Show the results as far as $n = 8$.



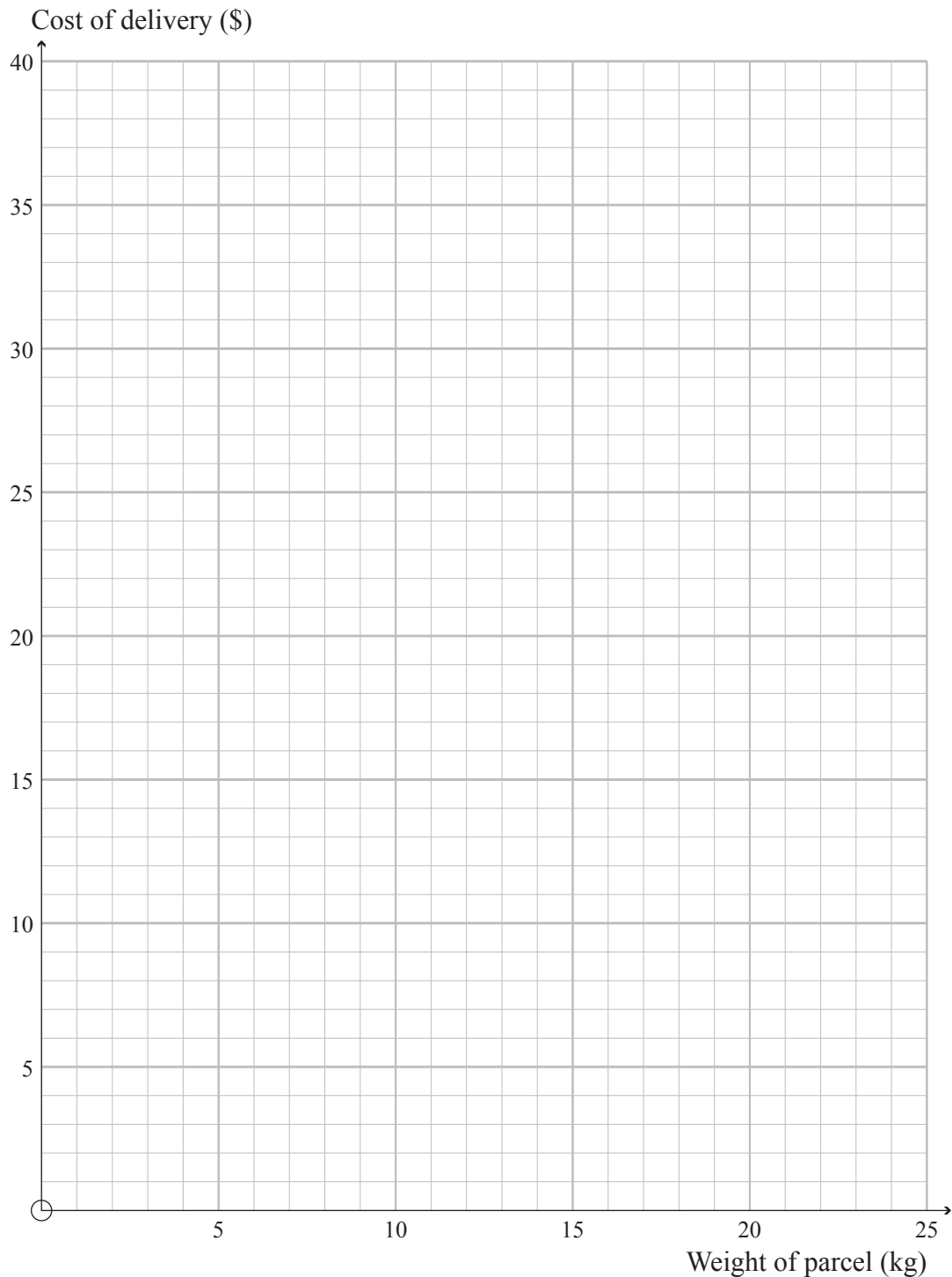
If you need to redraw your graph, use the grid on page 18.

- (c) A courier company, *Parcels to You*, decides on the cost of delivery, according to the weight of the parcel.

If a parcel weighs less than 6 kg, then the cost of the delivery will be \$8.

If a parcel weighs 6 kg or more, then the charge will be at a rate of \$1.50 per kg, plus an extra fixed cost of \$1 for each parcel up to a weight of 25 kg.

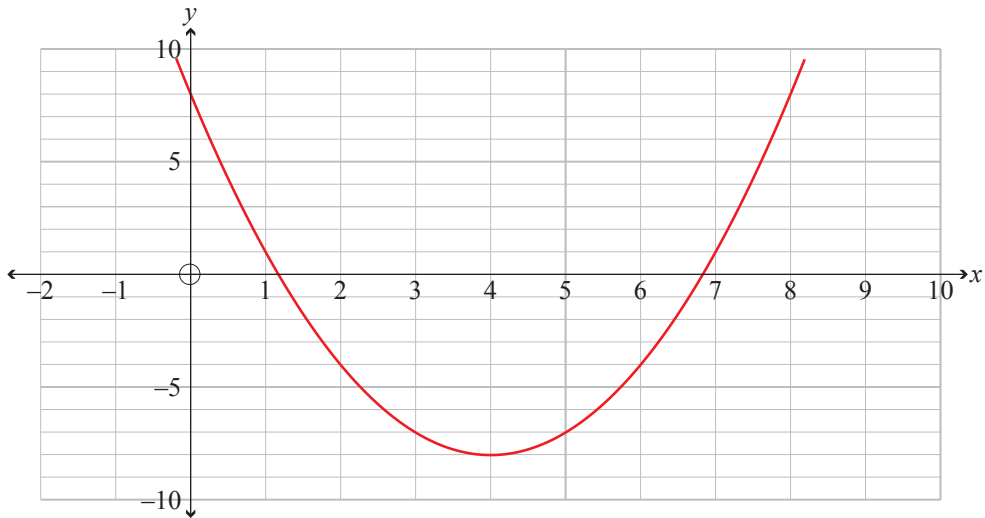
- (i) On the grid below, plot an accurate graph showing the cost of delivery for the weights of parcels delivered by *Parcels to You*.



If you need to redraw your graph,
use the grid on page 19.

QUESTION TWO

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



Equation is: _____

- (ii) Describe, in words, how the position and shape of the graph of $y = 4(x + 8)^2 + 16$ compares to the graph above.

Give at least TWO supporting statements.

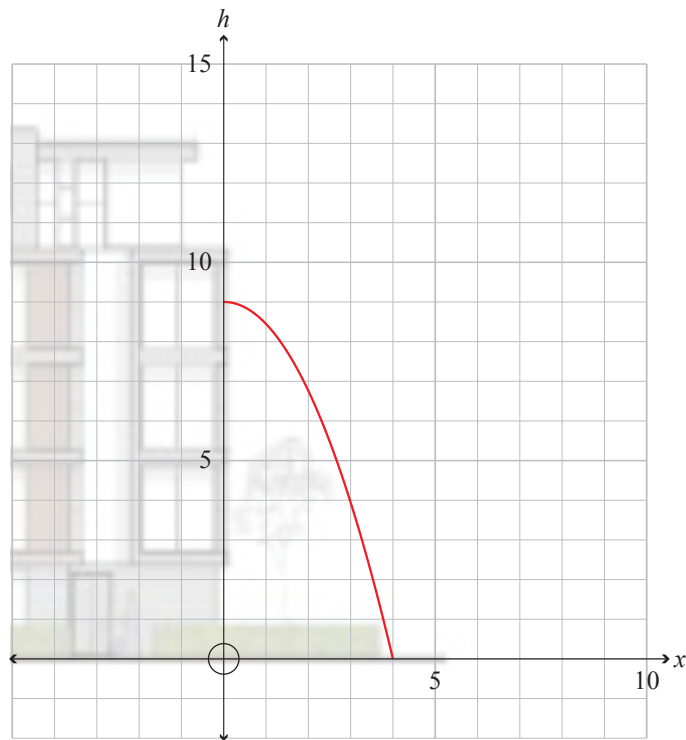
- (b) Hemi threw a ball out of a window from his third-floor apartment.

The vertical height of the window above the ground is 9 metres.

The ball travelled, from this maximum height, downwards in a parabola path that can be modelled by the equation $h = -px^2 + q$,

where h is the height of the ball, in metres, above the ground and x is the horizontal distance, in metres, from the base of Hemi's apartment block.

- (i) Write down the value of q .



- (ii) If the ball landed 4 metres away from the base of the apartment building, what is the value of p ? Justify your answer.

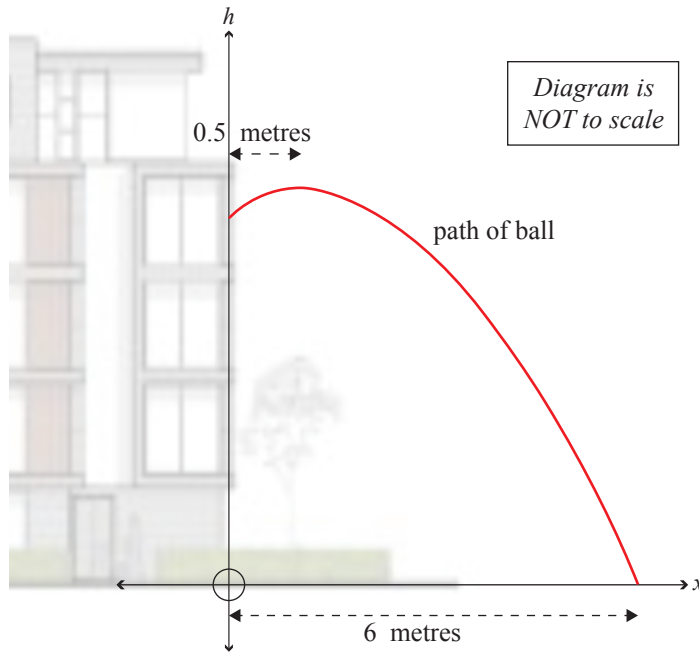
- (iii) Hemi then threw a second ball upwards, from the same window 9 metres above the ground, also in a parabola path.

The ball reached its maximum height when it was a horizontal distance of 0.5 metres from the base of the apartment block.

The ball landed on the ground at a distance of 6 metres away from the base of the building.

- Find the equation that models the path of the ball until it landed on the ground.
- Use your equation to find the maximum height of the ball above the ground.

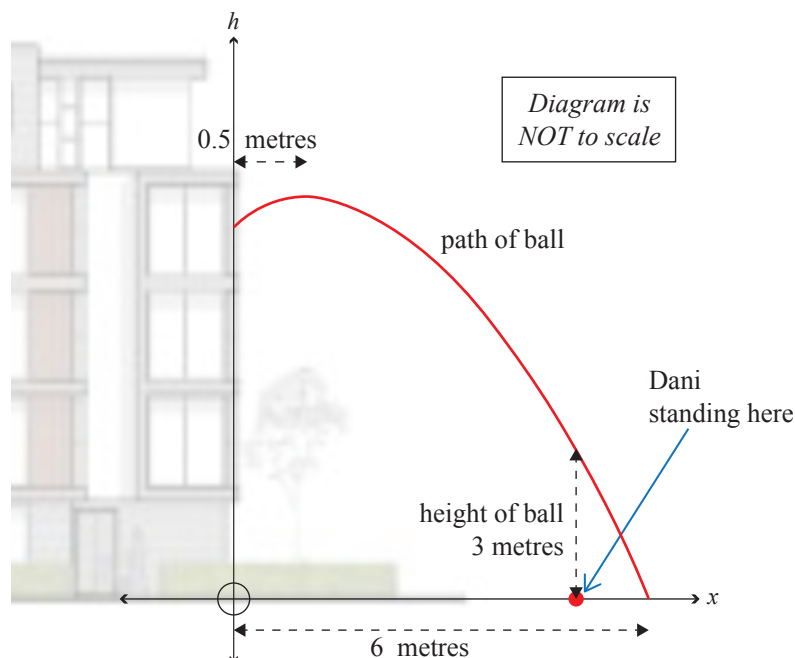
Justify your answer with full and clear working.

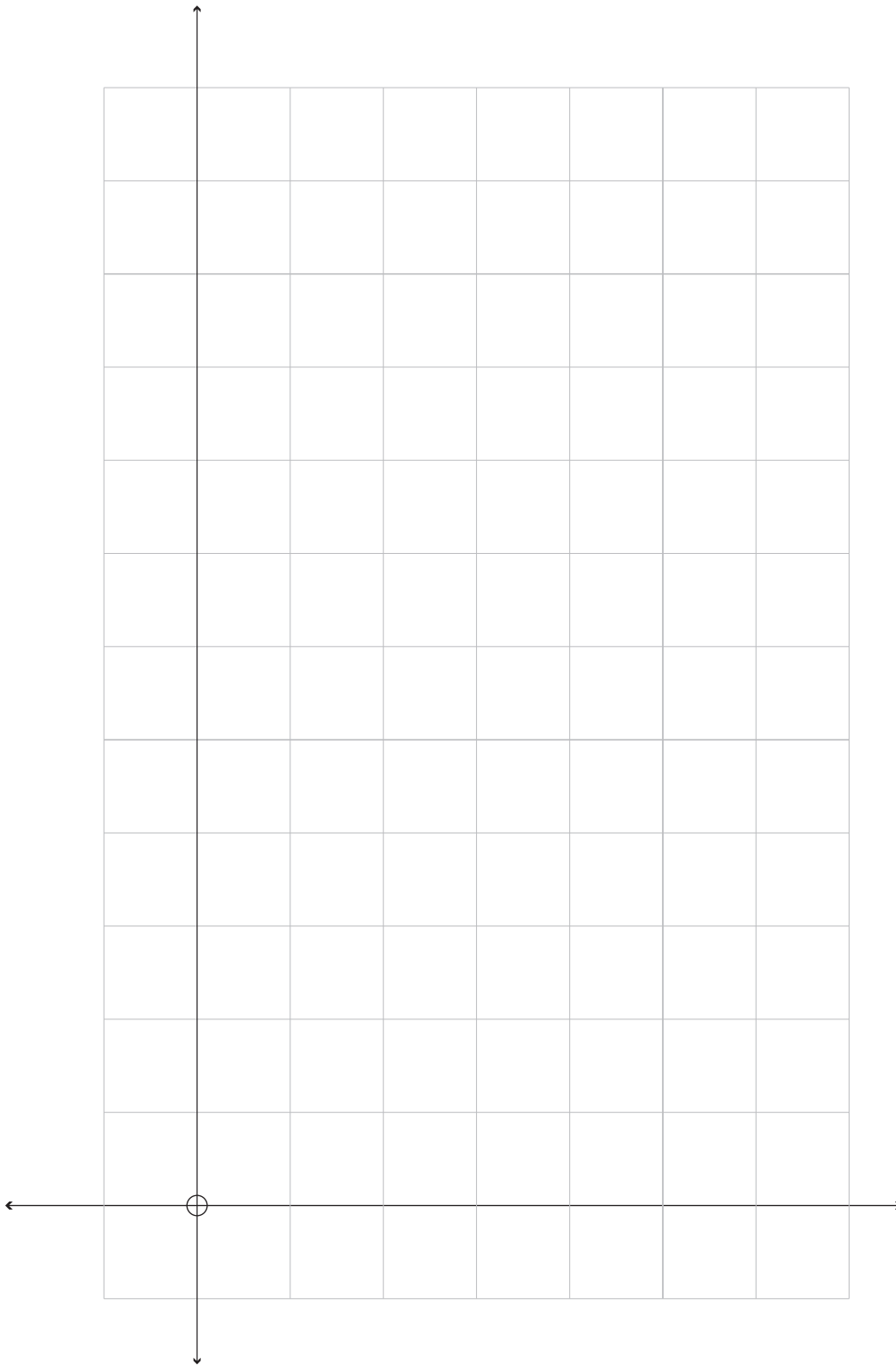


- (iv) Dani watched the ball from Hemi's second throw (as in part (iii) opposite) and could see that the ball was at a height of 3 metres above the ground as it passed above her head.

Using equations OR graphs, find the distance of Dani from the base of the apartment block.
Justify your answer with full and clear working.

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

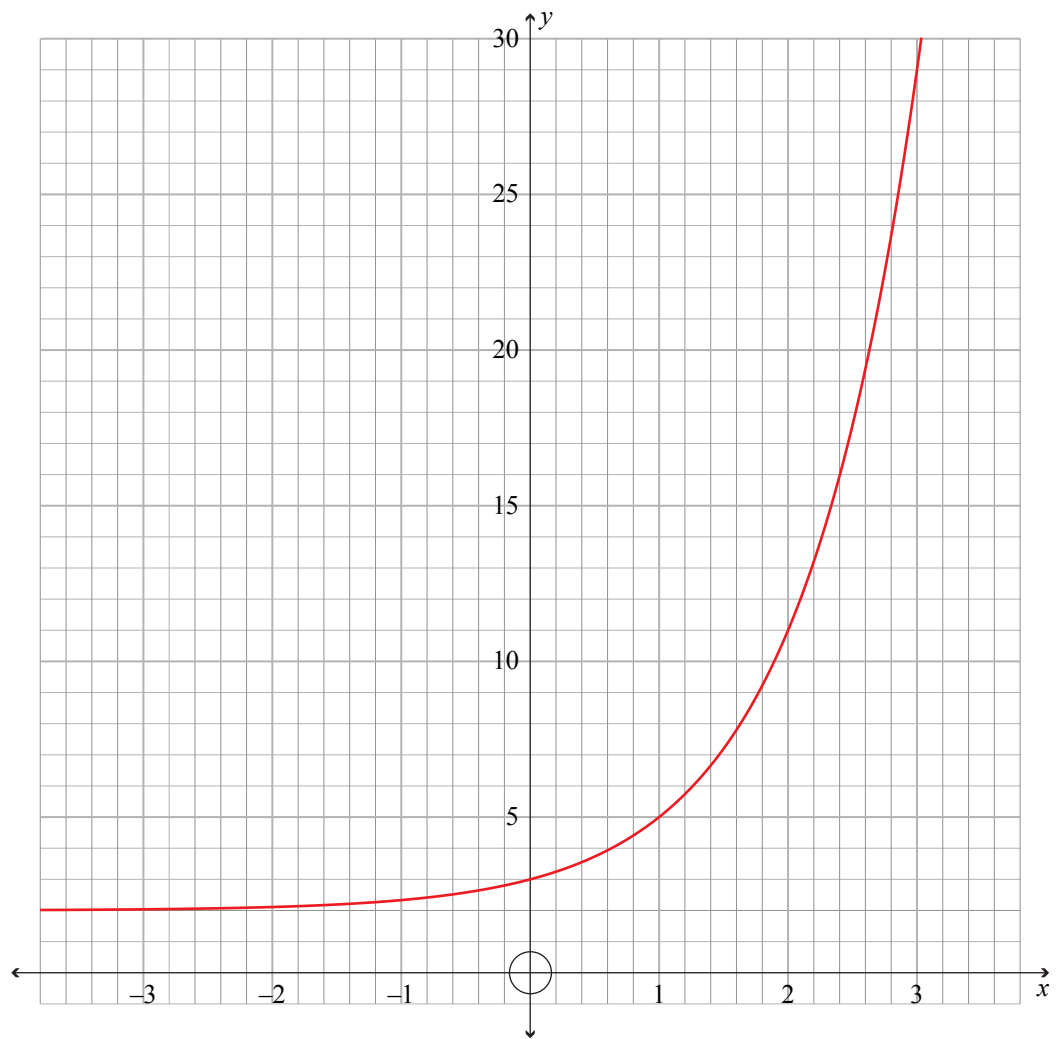




*If you need to redraw your graph,
use the grid on page 20.*

QUESTION THREE

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



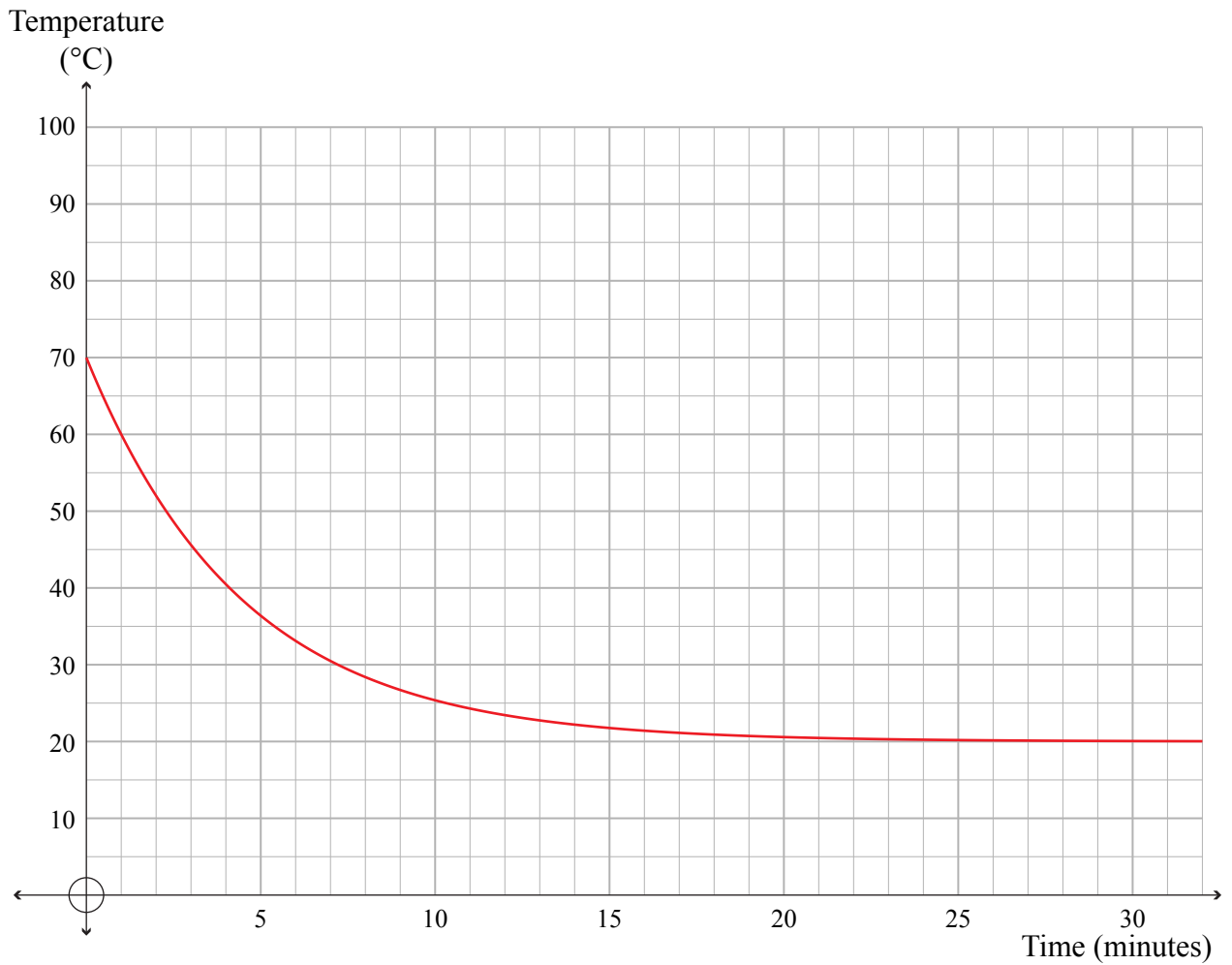
Equation is: _____

- (ii) What would be the equation of the new graph if the graph from part (i) is shifted 5 units up and reflected in the y -axis?

(b) Tim made a cup of coffee. The temperature of the coffee at the start was measured at 70°C .

The coffee was left on the kitchen table for 30 minutes.

The graph below shows the temperature, $H^{\circ}\text{C}$, of the coffee in its cup at time t minutes after it was made.



(i) What was the room temperature in the kitchen?

Justify your answer.

- (ii) The temperature of the coffee can be modelled by an exponential equation,

$$H = 50k^t + 20$$

where k is the rate at which the coffee temperature is decreasing,
 H is the temperature of the coffee, in degrees Centigrade
 and t is the time since the coffee was made, in minutes.

After the first minute the temperature of the coffee dropped to 60°C .

Find and interpret the value of k , with relation to the room temperature.

Justify your answer.

- (iii) Tim's mother made a cup of tea at exactly the same time as Tim made his coffee.
 She left her tea to cool in a different room to Tim.

The temperature of the tea at the start was 92°C .

The temperature of this different room was 16°C .

The temperature of the tea can be modelled by the exponential equation,

$$H = w \times 0.85^t + v$$

where H is the temperature of the tea, in degrees Centigrade
 and t is the time since the tea was made, in minutes.

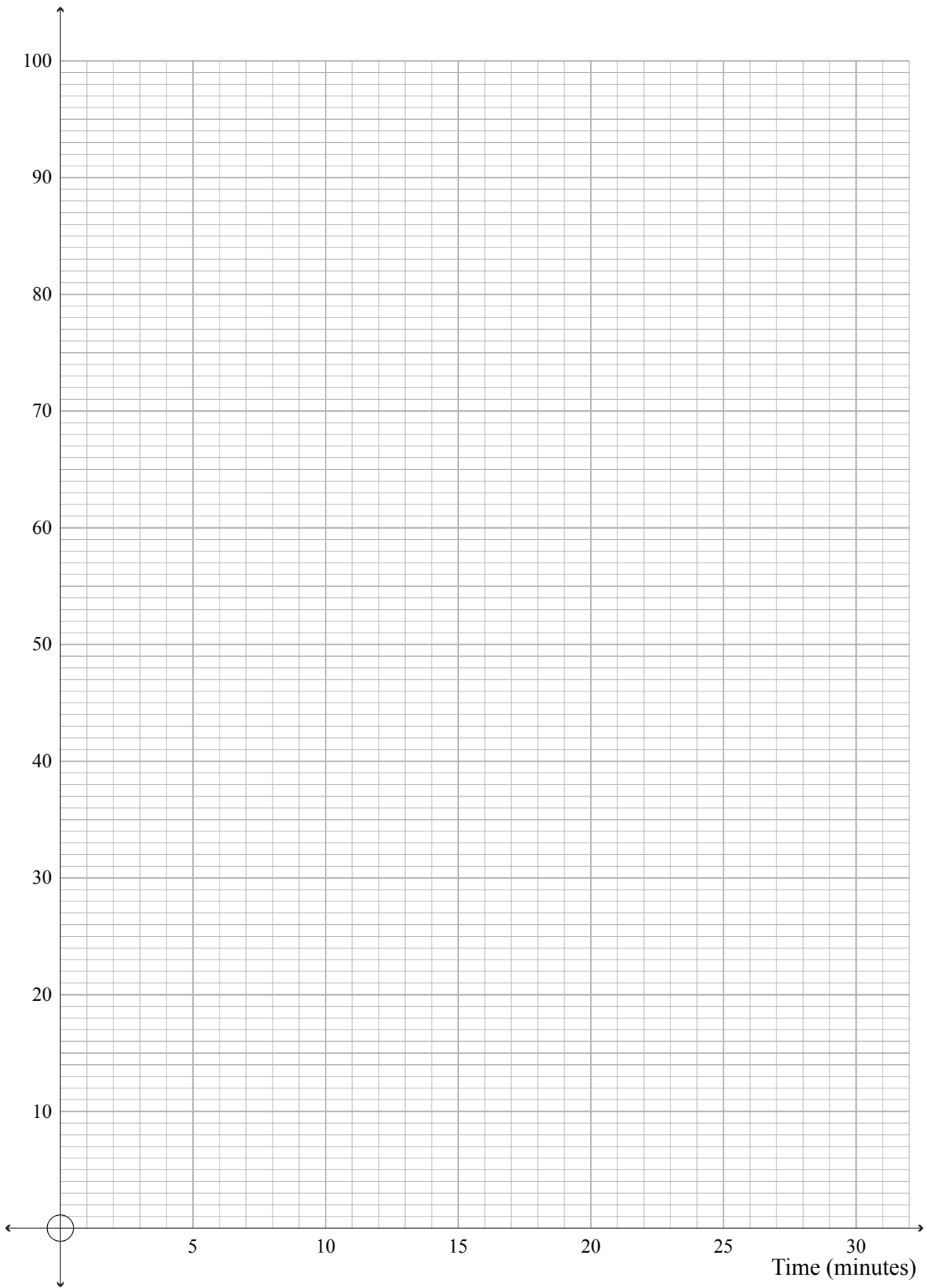
Using tables, graphs OR equations, find how long it took for Tim's mother's cup of tea to be cooler than Tim's cup of coffee.

Justify your answer with full and clear working.

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

There is more room for your answer on the next page.

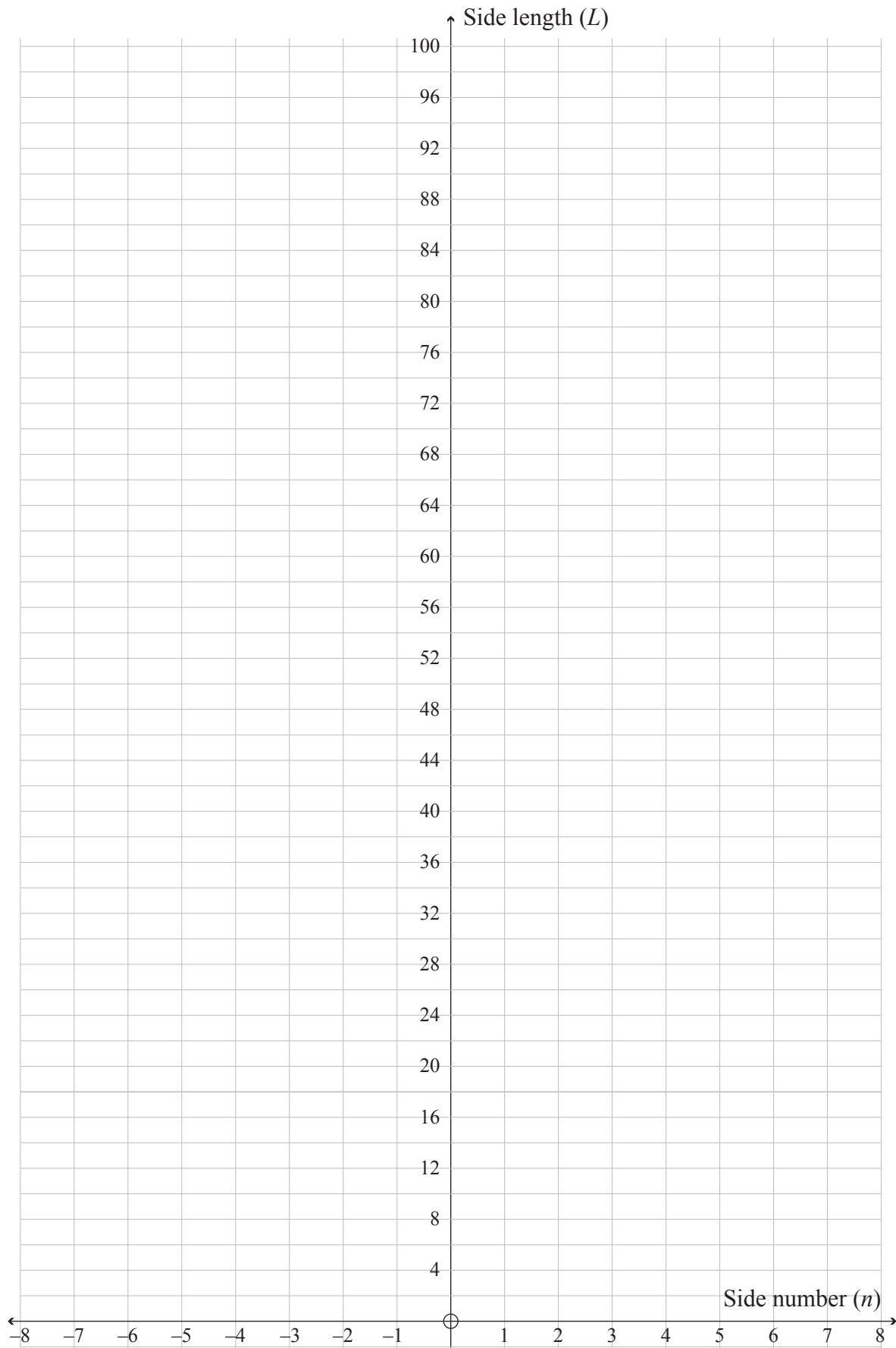
Temperature
(°C)



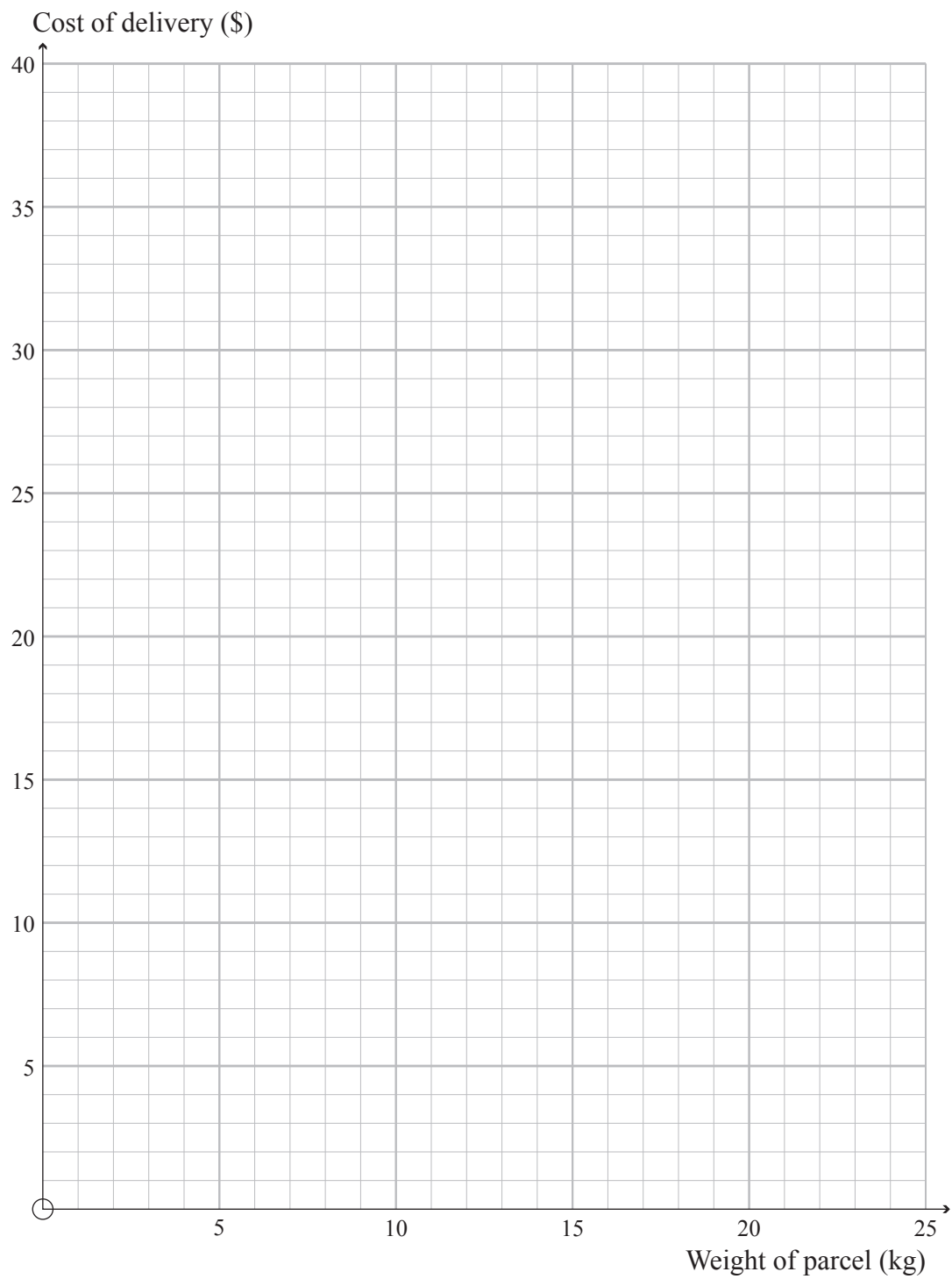
*If you need to redraw your graph,
use the grid on page 21.*

SPARE DIAGRAMS

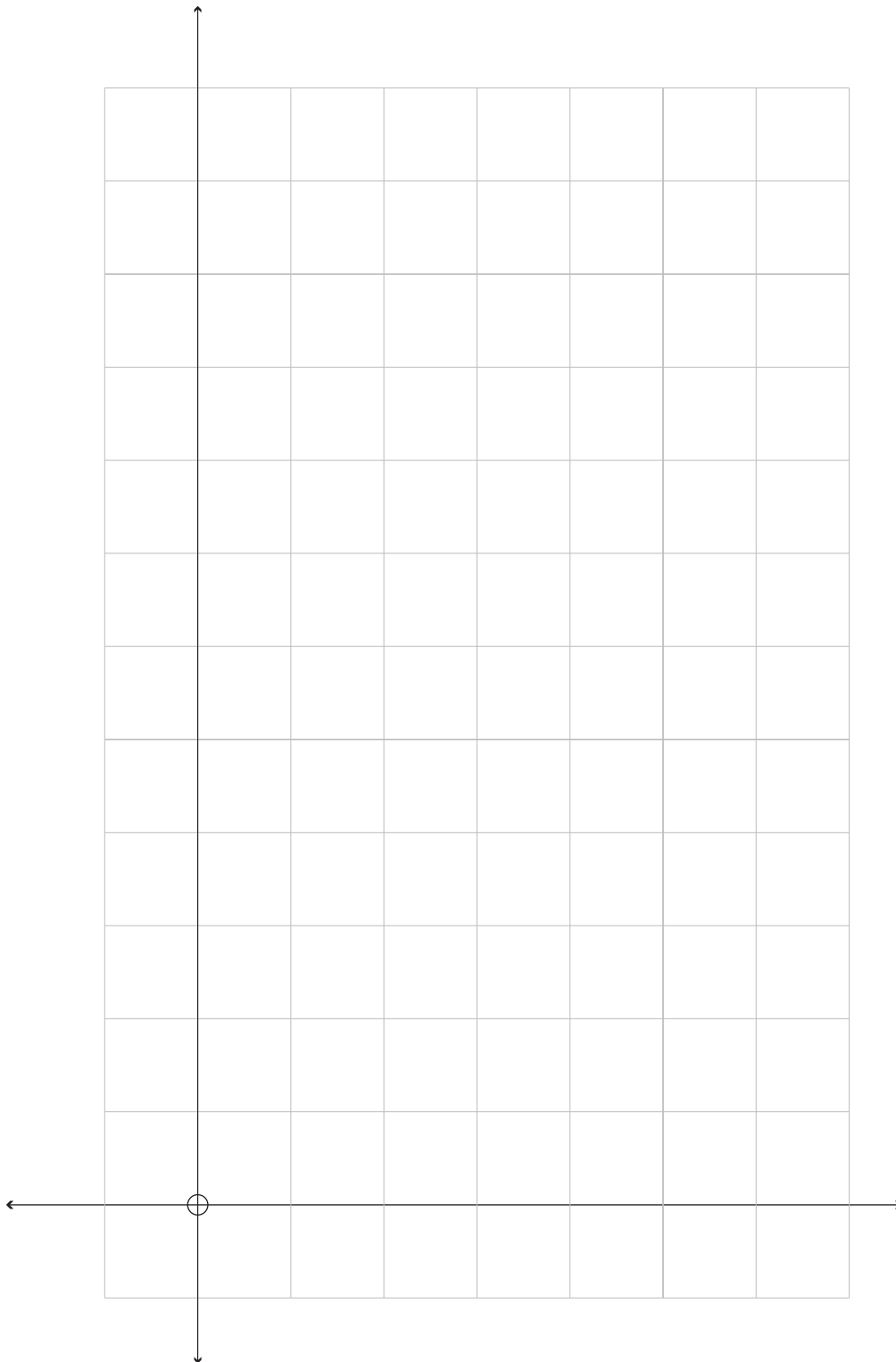
If you need to redraw your response to Question One (b)(ii), use the diagram below. Make sure it is clear which answer you want marked.



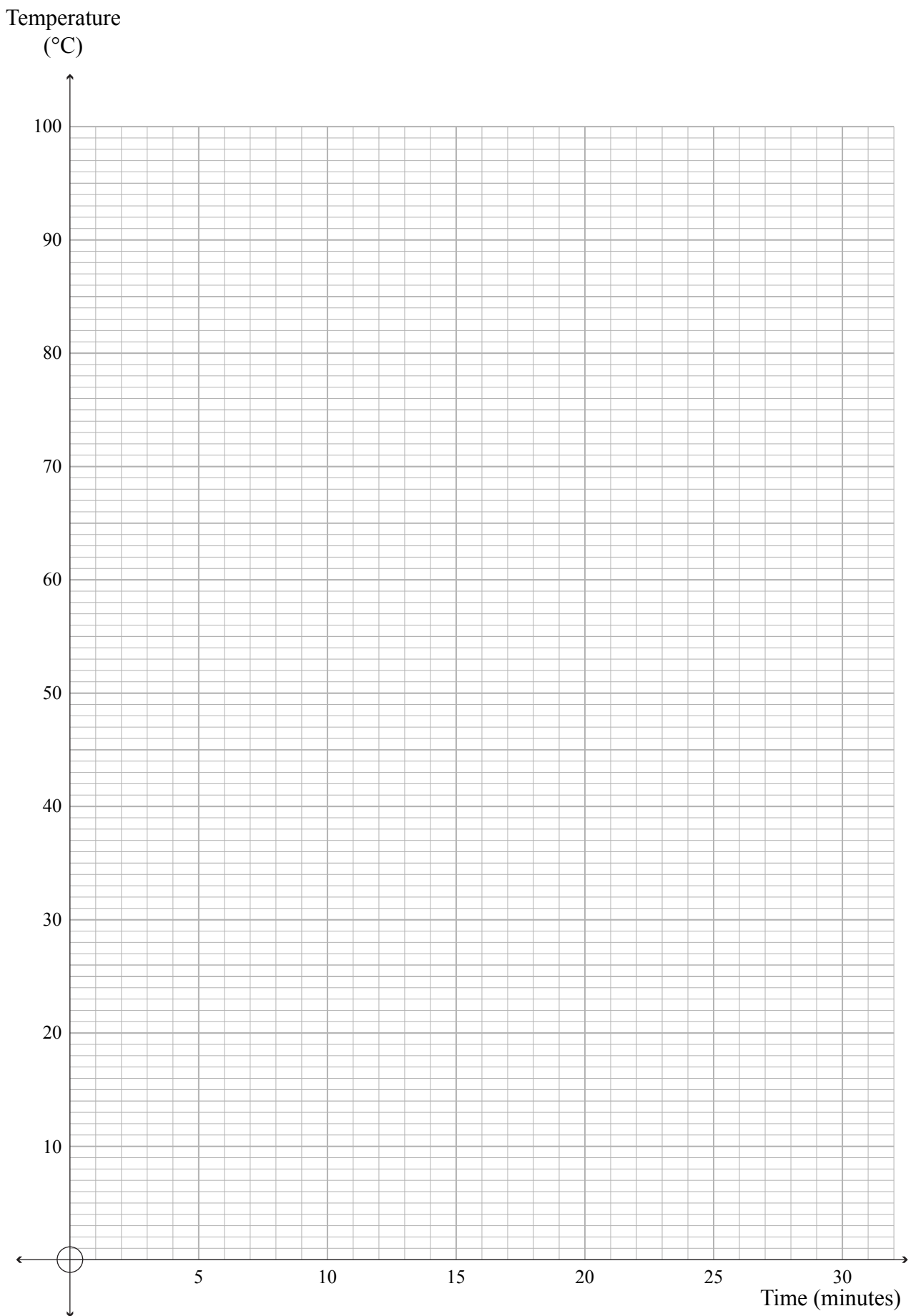
If you need to redraw your response to Question One (c)(i), use the diagram below. Make sure it is clear which answer you want marked.



If you need to redraw your response to Question Two (b)(iv), use the diagram below. Make sure it is clear which answer you want marked.



If you need to redraw your response to Question Three (b)(iii), use the diagram below. Make sure it is clear which answer you want marked.



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

QUESTION
NUMBER

91028