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NZQA

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# Level 1 Mathematics and Statistics, 2019

## 91028 Investigate relationships between tables, equations and graphs

9.30 a.m. Wednesday 20 November 2019
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.

Grids are provided on some pages. This is working space for the drawing of a graph or a diagram, constructing a table, writing an equation, or writing your answer.

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 2–16 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.**

**TOTAL**

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## QUESTION ONE

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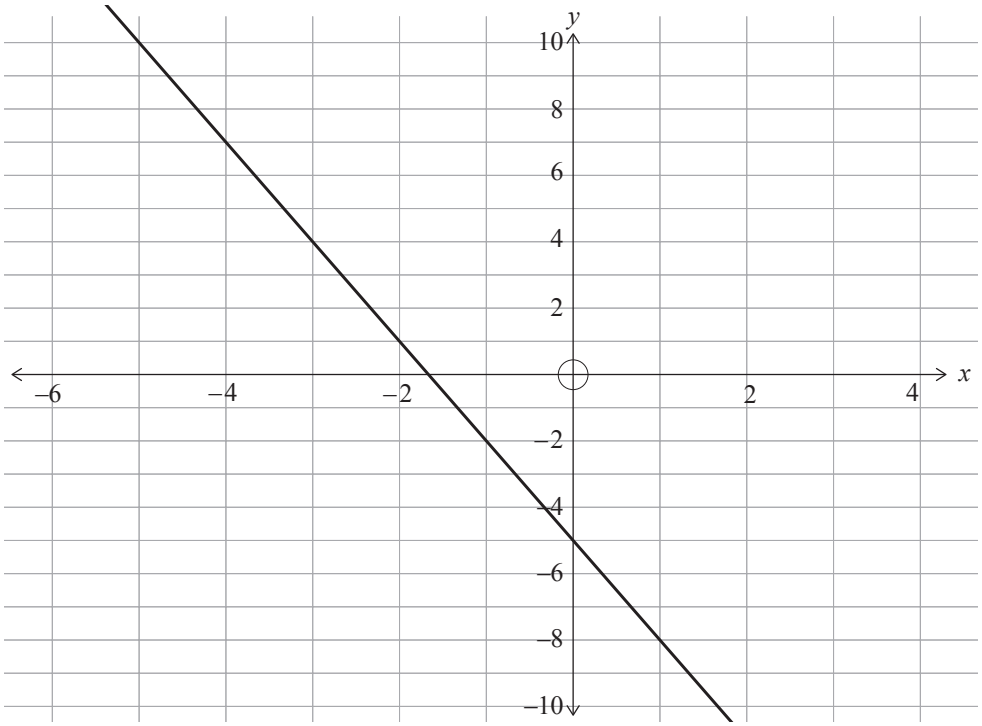
(a) (i) Give the equation of the graph shown below:




Equation: _____

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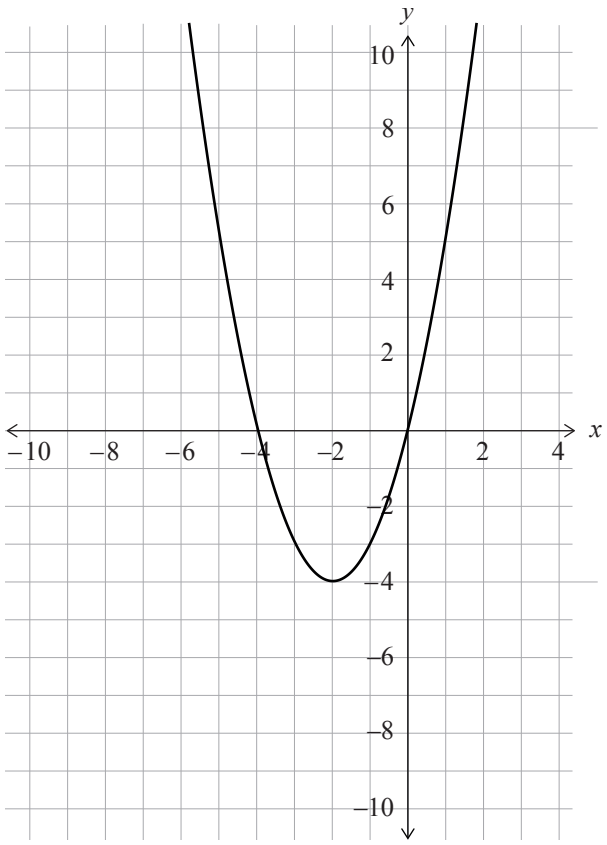
(ii) Give the equation of the graph shown below:




Equation: _____

(iii) Find the equation of the new curve if this graph shown above is translated 3 units to the left, translated downwards by 4 units, and reflected across the $x$-axis.

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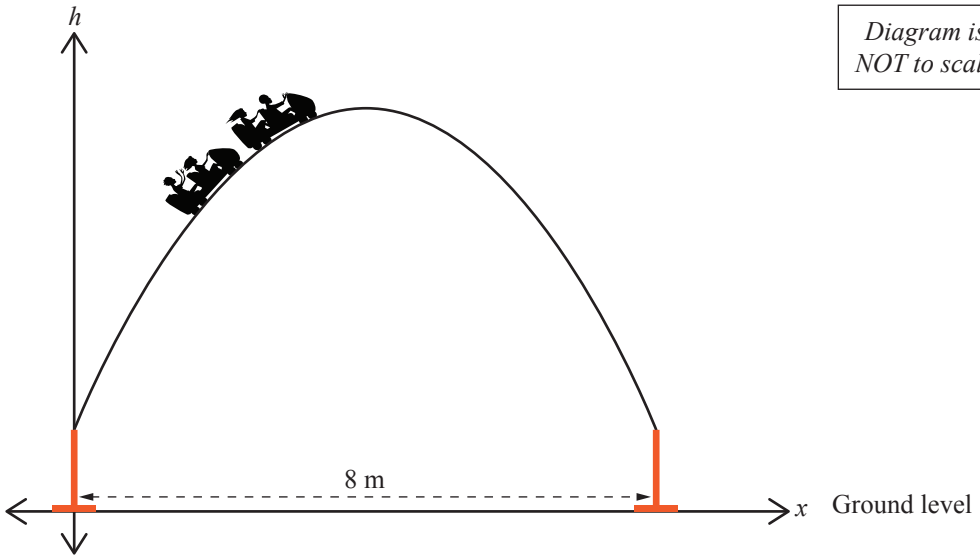
(b) A roller coaster is the most popular ride in a theme park.

One part of the roller coaster track can be modelled by a parabola, as shown in the sketch below. The track is supported by two thin pillars, which are 8 metres apart.

The shape of the roller coaster track can be modelled by the equation

$$h = -\frac{x}{2}(x - r) + 2$$

where $h$ is the height, in metres, of the roller coaster track above the ground and $x$ is the horizontal distance, in metres, from the pillar on the left, and $r$ is a fixed constant.




(i) How high, in metres, is the top of each pillar above the ground?

(ii) Calculate the value of $r$ in the equation of the roller coaster.

*Justify your answer.*

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(iii) How high, in metres, is the roller coaster above the ground at its highest point?

*Justify your answer.*

(c) Some people want the roller coaster to be steeper and higher in order to make it scarier.

Give a detailed description of what changes would need to be made to the equation to make the roller coaster steeper **or** higher and explain how this would affect the shape of the roller coaster track.

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**The examination continues on the following page.**

## QUESTION TWO

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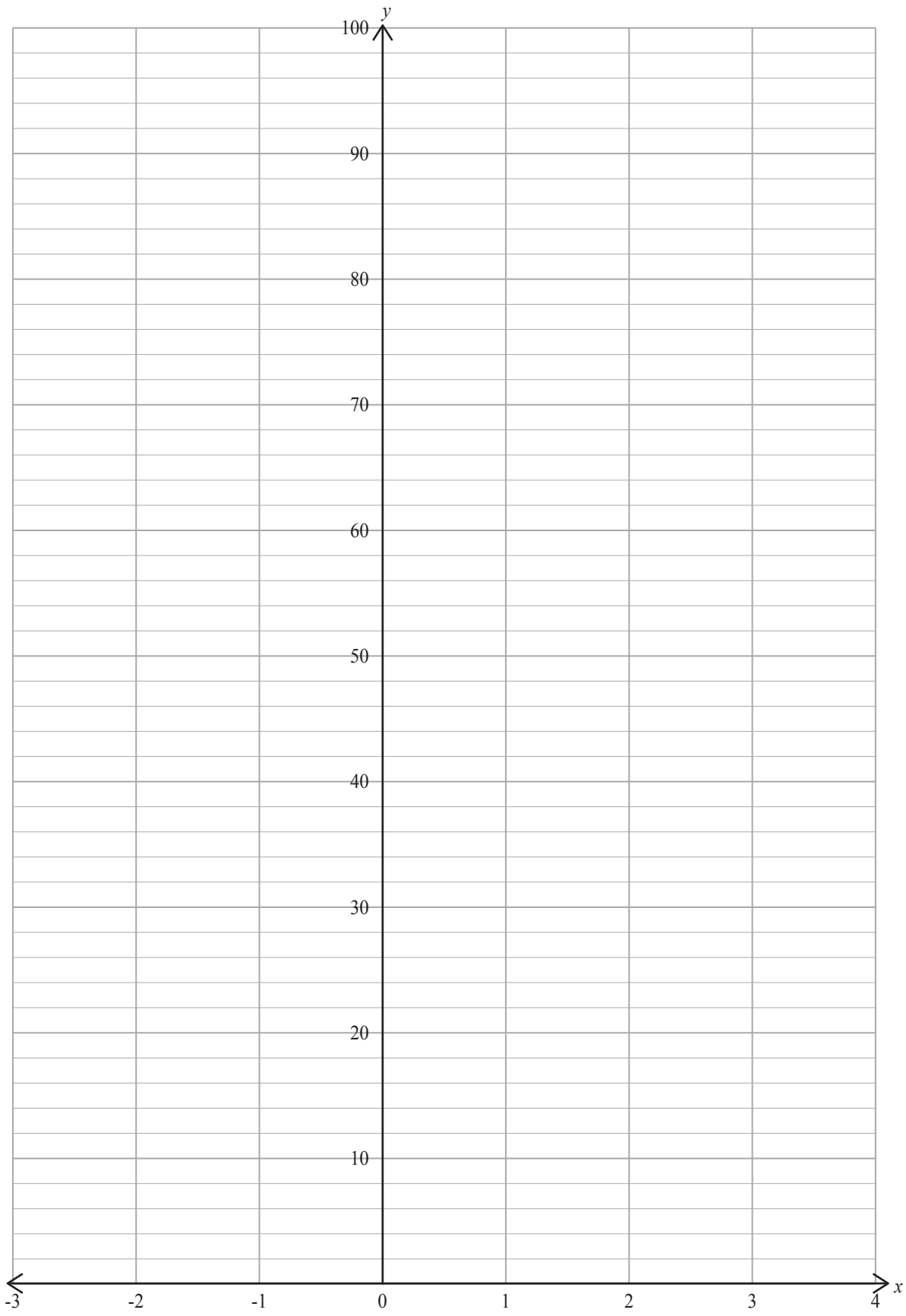
(a) Using the set of axes below, sketch the graph of $y = 3^x + 2$.



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(b) A colony of bacteria, C, is monitored over a 7-day period.

The area, cm², that the bacteria colony covers is displayed in the table below.

| Day ($d$) | Area ($A$) |
|---|---|
| 0 | 4 |
| 1 | 8 |
| 2 | 16 |
| 3 | 32 |
| 4 | 64 |
| 5 | |
| 6 | |
| 7 | |

(i) Write the equation that represents the area covered over the first 7 days.

(ii) Describe any similarities and differences between the graphs representing the area of bacteria C compared to a different type of bacteria that increases in size by three times bacteria C's area.

Provide at least three statements.

(iii) After the first 7-day period, the colony of bacteria C starts dying, and the area covered starts decreasing each day by 20 % of the area present.

Investigate, using equations, tables, and graphs, what happens to the area of the bacteria over a longer period of time.

*Justify your answer.*

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## QUESTION THREE

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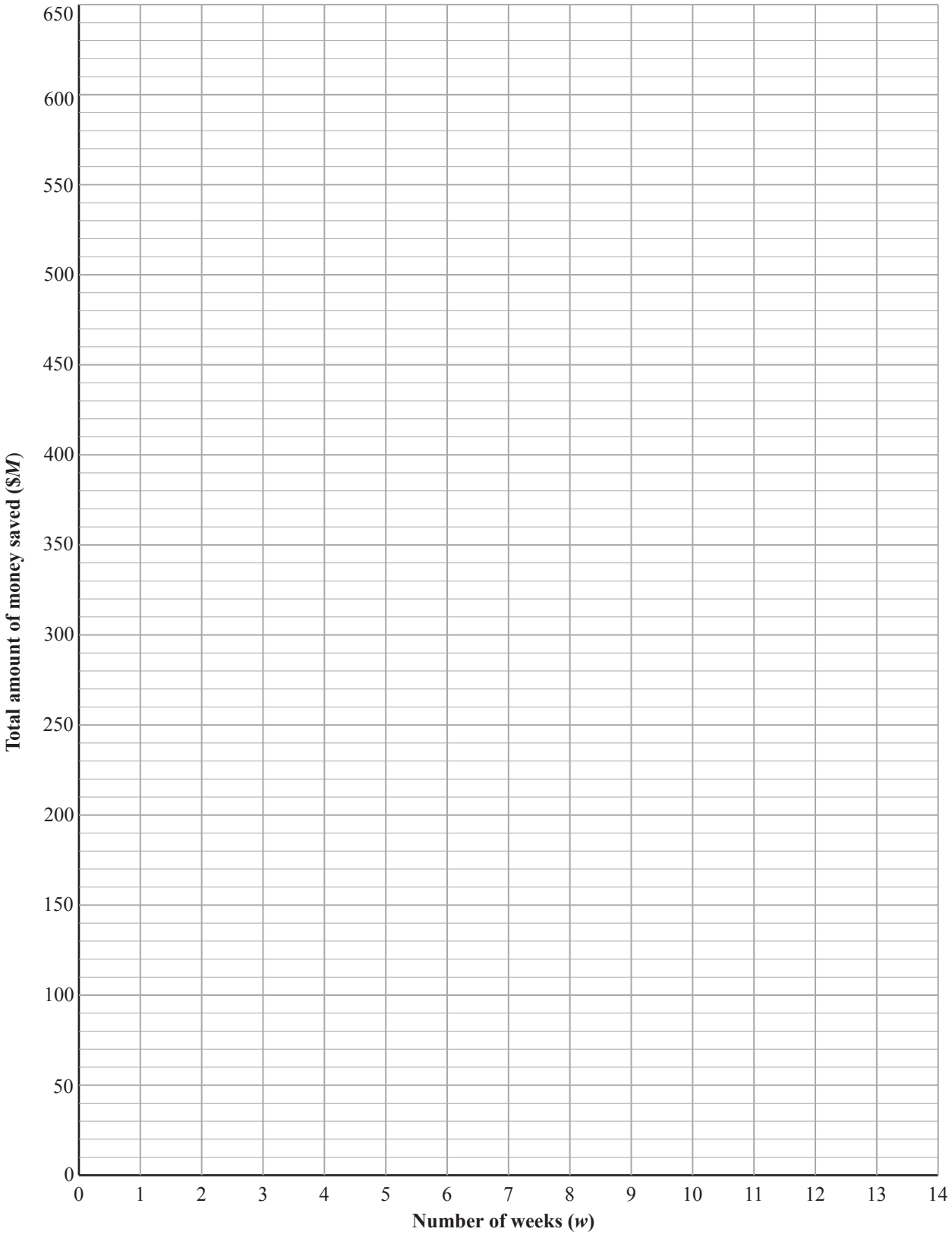
Keita is saving for a holiday. She already has $70 saved when she gets a part-time job after school and in the weekends, in order to save more money. She earns $30 per week from her part-time job, and receives her pay at the end of each week.

(a) On the axes below, draw the graph that would best represent Keita's "Total Amount Saved" ($\$M$) for the first FOUR weeks ($w$) after she starts her part-time job.



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(b) After four weeks of saving, Keita unfortunately breaks her leg and is unable to work for a total of three weeks. Consequently, Keita cannot save any money for her trip during these three weeks.

Keita then finishes school for the year so she is able to work more hours per week and therefore she increases her savings to $60 per week.

(i) Include this extra information on the graph on page 10 for Keita's "Total Amount Saved" up to and including Week 14.

(ii) Give the equation for Keita's "Total Amount Saved", $M$, at the end of each week, $w$, between weeks 8 and 14 inclusive.

**Question 3 continues on page 12 ➤**

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(c) Dylan is planning to join Keita on her holiday. The cost for Dylan's trip will be $550 and the trip begins at the end of Week 14. Dylan starts saving four weeks after Keita does.

Dylan also knows that two weeks after he starts saving, he will have some family visiting, and he won't be able to save anything for the three weeks of their stay.

Dylan is planning his budget and believes that the minimum that he can save each week would be $50, while the maximum per week would be $100.

Using a table and a graph, investigate a possible savings plan that Dylan could follow.
Use the axes provided on page 13 to draw the graph of Dylan's possible savings plan.

| | | | | |
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**Axes repeated from page 10**

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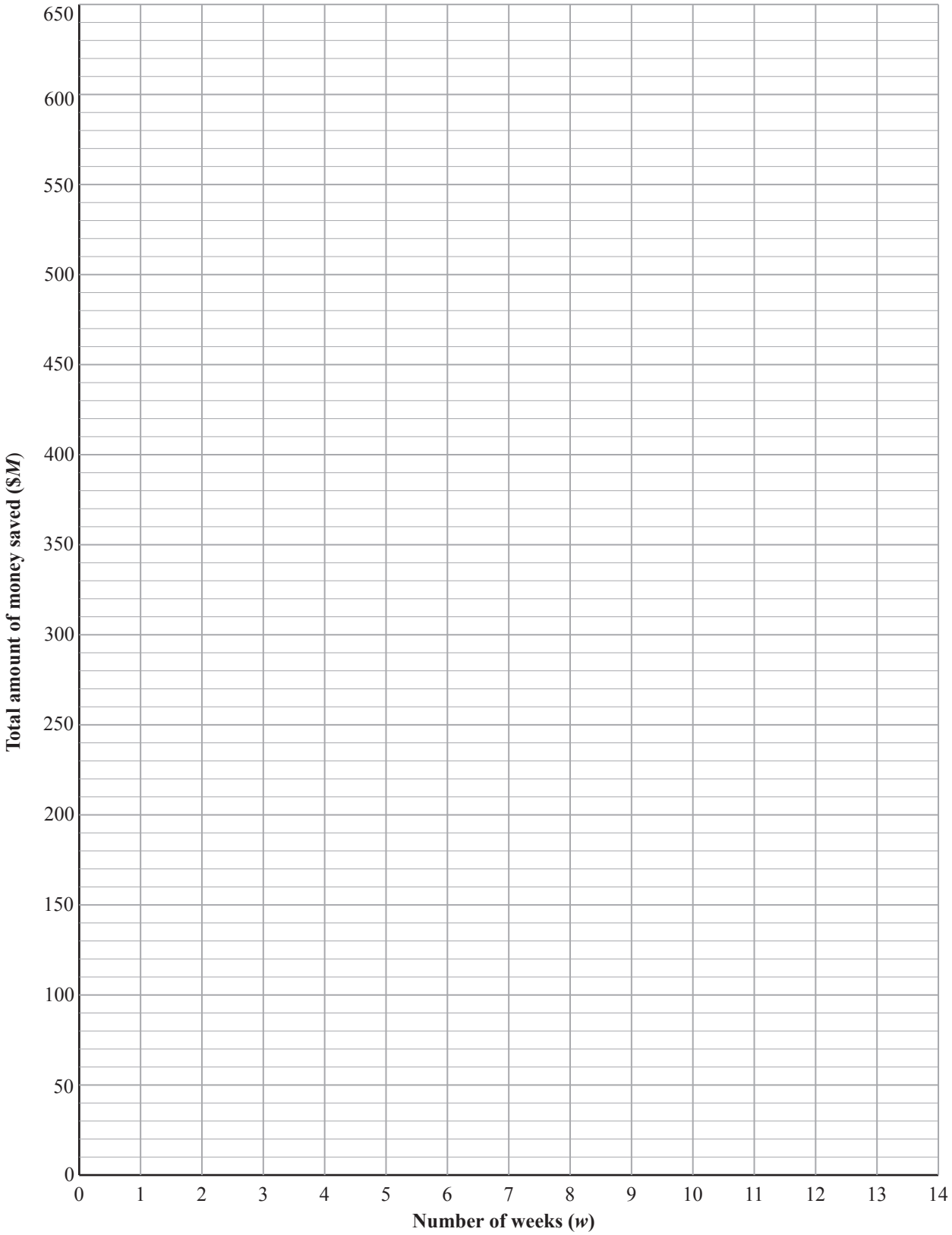

**Extra space if required.**
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QUESTION NUMBER

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