To be completed by candidate and school

Name: _____

NSN | | | | | | | | | | |

School Code | | | | |

1

SUPERVISOR'S USE ONLY

DAY 1: TUESDAY

NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

COMMON ASSESSMENT TASK

Level 1 Mathematics and Statistics 2023

91027 Apply algebraic procedures in solving problems

Tuesday 12 September 2023
Credits: Four

You should attempt ALL the questions in this booklet. Show ALL working.

Calculators may NOT be used.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

You are required to show algebraic working in this paper. 'Guess and check' and 'correct answer only' methods do not demonstrate relational thinking and will limit the grade for that part of the question to a maximum of Achievement. 'Guess and check' and 'correct answer only' may only be used a maximum of one time in the paper and will not be used as evidence of solving a problem. A candidate cannot gain Achievement in this standard without solving at least one problem using algebra.

Answers must be given in their simplest algebraic form.

Where a question is given in words, you are expected to show the equation that you used to solve the problem.

Check that this booklet has pages 2–12 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.

ASSESSOR'S USE ONLY	Achievement Criteria	
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Apply algebraic procedures in solving problems.	Apply algebraic procedures, using relational thinking, in solving problems.	Apply algebraic procedures, using extended abstract thinking, in solving problems.
		Overall level of performance

QUESTION ONE

ASSESSOR'S USE ONLY

(a) Find the value of d, given that $d = 2c^2 - 9\,(2c - 2) + 5$ and $c = -3$.

(b) Using factorisation, simplify as far as possible:

$$\frac{(4x^2 + 3x - 1)(x - 1)}{(x^2 - 1)(4x - 1)}$$

(c) Solve the following equation: $20x^2 + 20x = (2x + 5)^2$

(d) At a certain point on a **1600 kilometre** road trip, one-third of the distance already travelled is equal to one-fifth of the distance remaining.

How many more kilometres of the trip are there remaining?

ASSESSOR'S USE ONLY

(e) The number of small squares used in the n^{th} shape of a pattern is given by $n^2 - 2n + 5$.

Show that the difference between the number of small squares used in two consecutive odd-numbered shapes is always divisible by 4.

QUESTION TWO

ASSESSOR'S USE ONLY

(a) The area of the rectangle shown in the diagram below is $40x^2 + 11x - 2$.

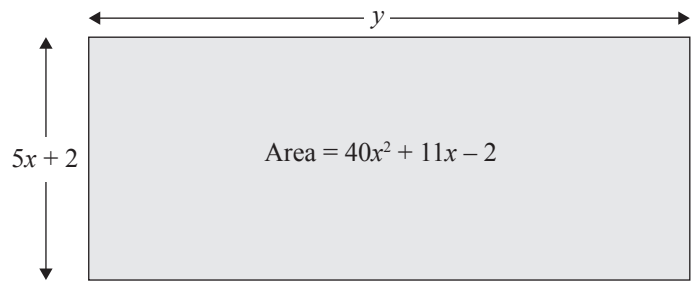
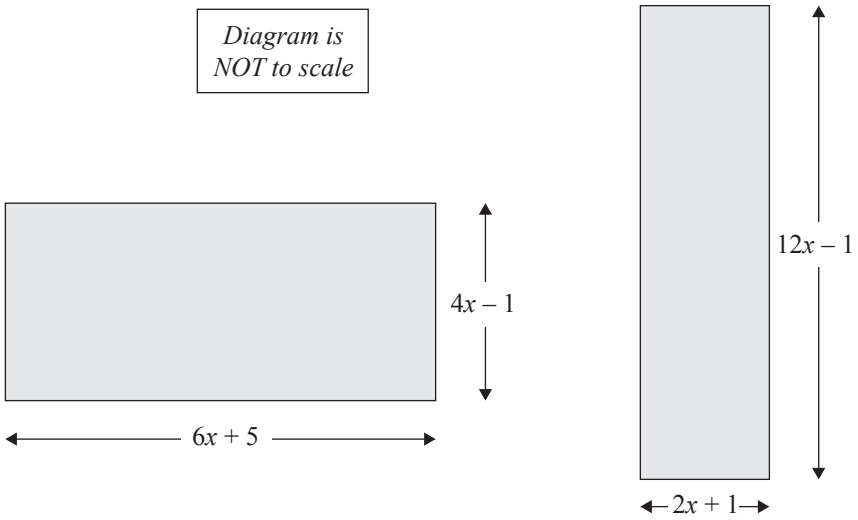


Diagram is NOT to scale

What is the length of the side y, giving your answer in terms of x.

(b) The **areas** of the two rectangles, shown below, are equal to each other.

Diagram is NOT to scale



Find the value of x.

ASSESSOR'S USE ONLY

(c) Solve the following inequality:

$$\frac{4x+1}{5}-\frac{3x-4}{2}\geq 5$$

(d) If $\frac{4w}{5}=\frac{v(w+3)}{4}$, give the equation for w in terms of v.

ASSESSOR'S USE ONLY

(e) The plan of a garden is shown in the diagram below. All measurements are in metres.

The shaded area in the diagram is 8 m².

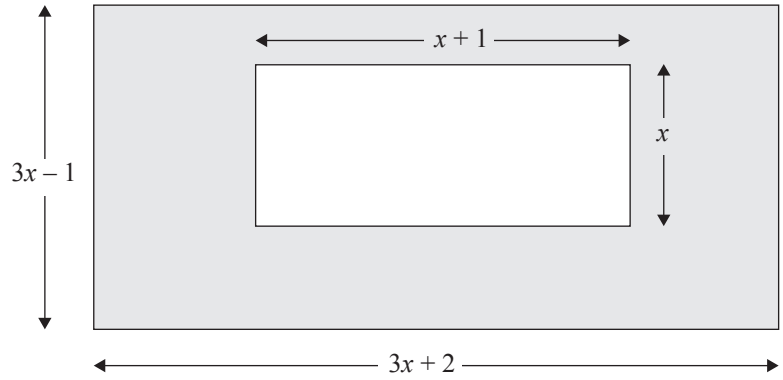


Diagram is NOT to scale

Find the value of x.

QUESTION THREE

ASSESSOR'S USE ONLY

(a) A new playground at a school is being designed in the shape of a regular hexagon, as shown in the diagram below.

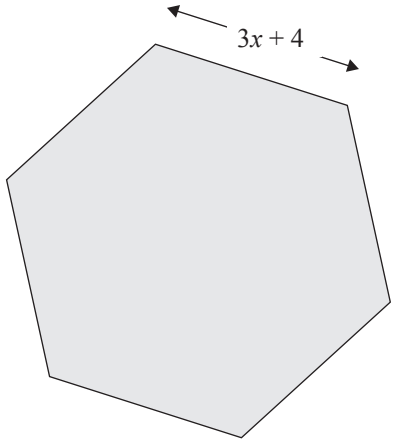


Diagram is NOT to scale

Given that the **perimeter** of the playground is 60 metres, find the value of x.

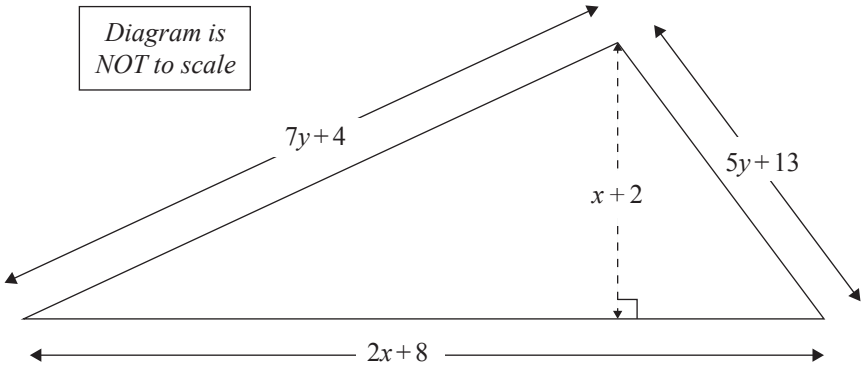
(b) Solve the equation:

$$\frac{2x}{2x-3} - \frac{x+4}{x+2} = 0$$

Question Three continues on the next page.

ASSESSOR'S USE ONLY

(c) The **area** of the triangle drawn below is 24 cm².



Find the value of x.

- Area of a triangle = ½ × base × height
- All measurements are in cm.

(d) Solve the equation $4^{x-2} \times 2^{x+1} = 32^{x}$

(e) A bank robber drops their bag containing some stolen $20 and $50 notes.

The total **number** of notes in the bag is 40.

The total **value** of the bank notes is $1700.

Calculate the **value** of the $20 notes and the **value** of the $50 notes that were stolen.

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

91027

To be completed by candidate and school

Name: _____

NSN | | | | | | | | | | |

School Code | | | | |

1

SUPERVISOR'S USE ONLY

DAY 2: THURSDAY

NZQA

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

COMMON ASSESSMENT TASK

Level 1 Mathematics and Statistics 2023

91027 Apply algebraic procedures in solving problems

Thursday 14 September 2023
Credits: Four

You should attempt ALL the questions in this booklet. Show ALL working.

Calculators may NOT be used.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

You are required to show algebraic working in this paper. 'Guess and check' and 'correct answer only' methods do not demonstrate relational thinking and will limit the grade for that part of the question to a maximum of Achievement. 'Guess and check' and 'correct answer only' may only be used a maximum of one time in the paper and will not be used as evidence of solving a problem. A candidate cannot gain Achievement in this standard without solving at least one problem using algebra.

Answers must be given in their simplest algebraic form.

Where a question is given in words, you are expected to show the equation that you used to solve the problem.

Check that this booklet has pages 2–12 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.

ASSESSOR'S USE ONLY	Achievement Criteria	
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Apply algebraic procedures in solving problems.	Apply algebraic procedures, using relational thinking, in solving problems.	Apply algebraic procedures, using extended abstract thinking, in solving problems.
		Overall level of performance

QUESTION ONE

ASSESSOR'S USE ONLY

(a) The area of the rectangle shown in the diagram below is $42x^2 + 11x - 3$.

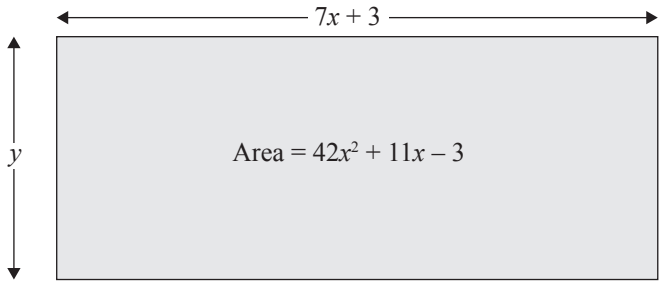


Diagram is NOT to scale

What is the length of the side y, giving your answer in terms of x.

(b) The **areas** of the two rectangles, shown below, are equal to each other.

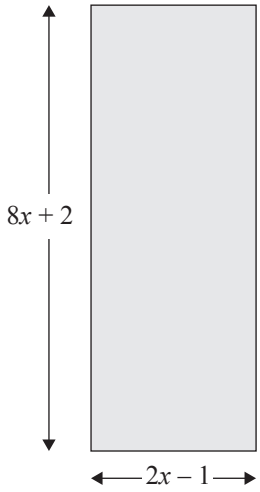
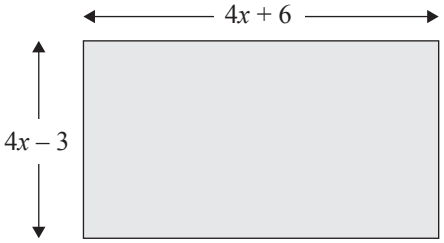


Diagram is NOT to scale



Find the value of x.

ASSESSOR'S USE ONLY

(c) Solve the following inequality:

$$\frac{3x+2}{4}-\frac{4x-1}{3}\geq 2$$

(d) If $\frac{5g}{6}=\frac{h(g+4)}{5}$, give the equation for g in terms of h.

ASSESSOR'S USE ONLY

(e) The plan of a garden is shown in the diagram below. All measurements are in metres.

The shaded area in the diagram is 6 m².

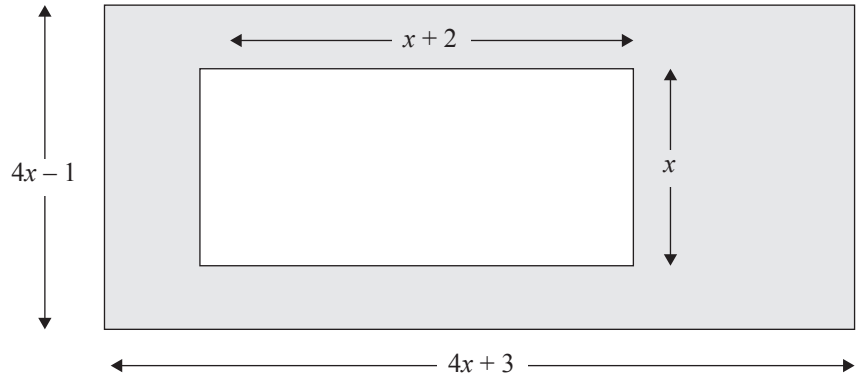


Diagram is NOT to scale

Find the value of x.

QUESTION TWO

ASSESSOR'S USE ONLY

(a) Find the value of w, given that $w = 3v^2 - 8(3v - 2) + 6$ and $v = -3$.

(b) Using factorisation, simplify as far as possible:

$$\frac{(5x^2 - 9x - 2)(x + 2)}{(x^2 - 4)(5x + 1)}$$

(c) Solve the following equation $18x^2 + 24x = (3x + 4)^2$

ASSESSOR'S USE ONLY

(d) At a certain point on a **1200 kilometre** road trip, one-quarter of the distance already travelled is equal to one-sixth of the distance remaining.

How many more kilometres of the trip are there remaining?

(e) The number of small squares used in the n^{th} shape of a pattern is given by $n^2 - 3n + 6$.

Show that the difference between the number of small squares used in two consecutive odd-numbered shapes is always divisible by 2.

QUESTION THREE

ASSESSOR'S USE ONLY

(a) A new playground at a school is being designed in the shape of a regular octagon, as shown in the diagram below.

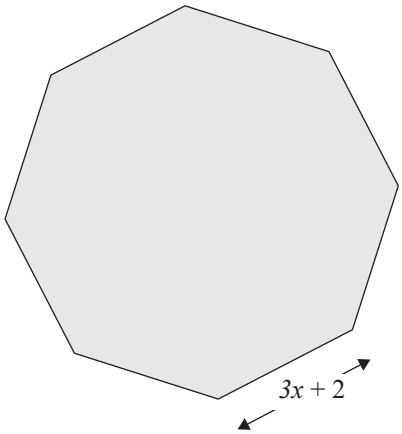


Diagram is NOT to scale

Given that the **perimeter** of the playground is 88 metres, find the value of x.

(b) Solve the equation:

$$\frac{4x}{4x-3} - \frac{x+6}{x+3} = 0$$

Question Three continues on the next page.

ASSESSOR'S USE ONLY

(c) The **area** of the triangle drawn below is 32 cm².

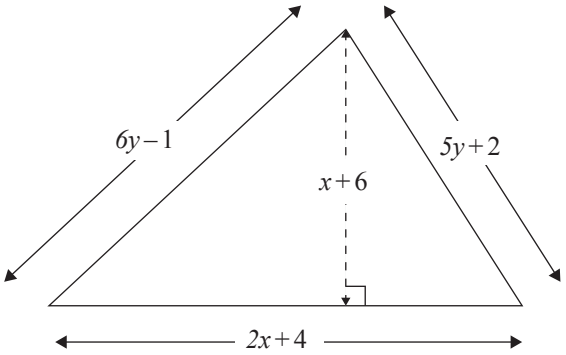


Diagram is NOT to scale

Find the value of x.

- Area of a triangle = ½ × base × height
- All measurements are in cm.

(d) Solve the equation $2^{5x-2} \times 4^{x+2} = 16^{x}$

(e) A farmer has a shed containing sacks of potatoes; some sacks weigh 20 kg and other sacks weigh 50 kg.

The total **number** of sacks in the shed is 60.

The total **weight** of all the sacks of potatoes is 1500 kg.

Calculate the total **weight** of all of the 20 kg sacks, and the total **weight** of all of the 50 kg sacks in the shed.

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

91027

SUPERVISOR'S USE ONLY

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91028

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Draw a cross through the box (☒) if you have NOT written in this booklet

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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Mathematics and Statistics 2023

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.

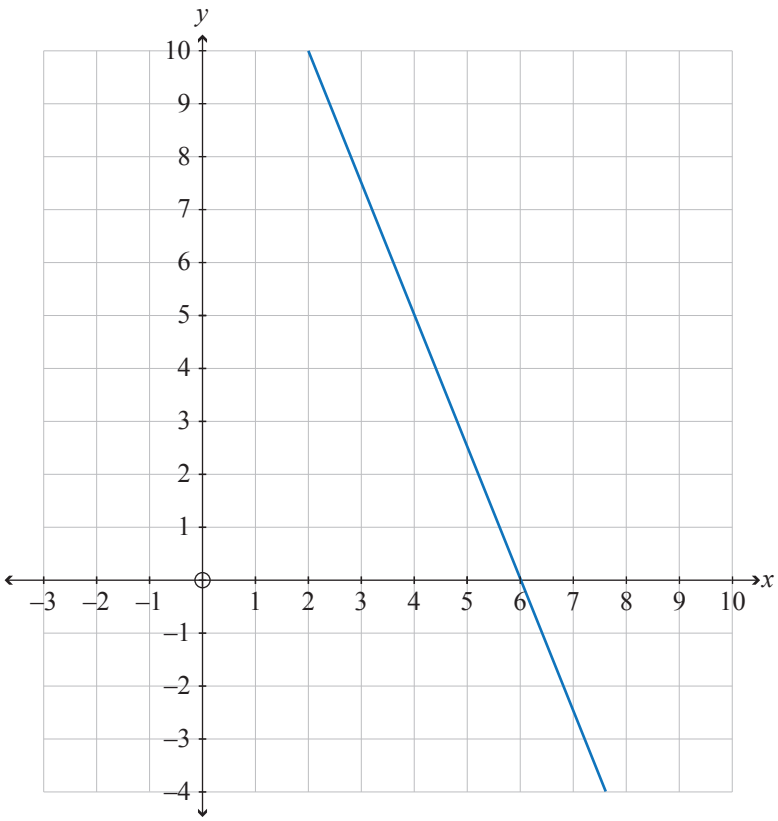
Do not write in any cross-hatched area (DO NOT WRITE IN THIS AREA DO NOT WRITE). This area will be cut off when the booklet is marked.

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

This page has been deliberately left blank.
The assessment starts on the following page.

QUESTION ONE

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



Equation is: _____

(ii) Find the equation of the new line if the graph shown above is reflected in the y-axis, and also shifted 10 units vertically upwards.

(b) A city council plans to create a fenced grassed area in Fantail Reserve.

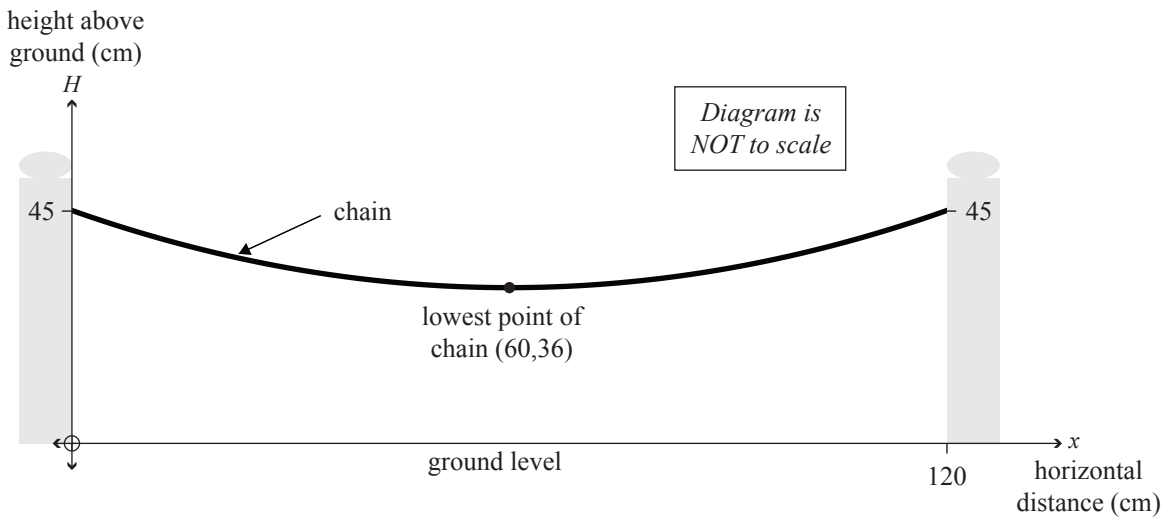
They decide to install some posts with a chain fence between them, as shown right.

The distance between the inside of each of the two posts is 120 cm.

The chain is attached to each post 45 cm above the horizontal ground, and hangs symmetrically.

The lowest point on the fence is 36 cm above the ground.

One section of the fencing is shown in the diagram below.



(i) Find an equation that would model the height of the chain between the two posts, as shown in the diagram above, where x is the horizontal distance from the inside of the left-hand post and H is the vertical height of the chain above the ground.

The x-axis will be at ground level, and the H-axis will be in line with the inside of the left-hand post.

Justify your answer with full and clear working.

(ii) After reviewing the design, the council decides that the lowest point of the chain should actually be lower than the design shown. The posts cannot be moved or changed, as they have already been installed, but where the chain fixes onto the post could be changed if required.

Suggest at least one way in which the original equation of the chain fence design could be altered to make the chain hang lower, but with the chain being in the same shape as the original chain.

Describe how your suggested change would affect the shape of the chain fence AND provide the equation of your alternative design.

(c) One side of the reserve has trees along it, and this side will not be fenced.

The council has a budget to purchase only 240 metres of material for the total of the other three sides of the rectangular grassed area, as shown in the diagram below.

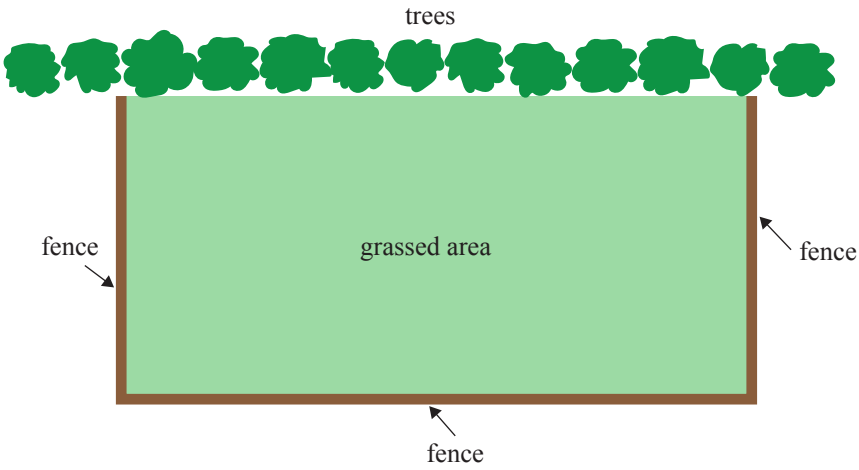
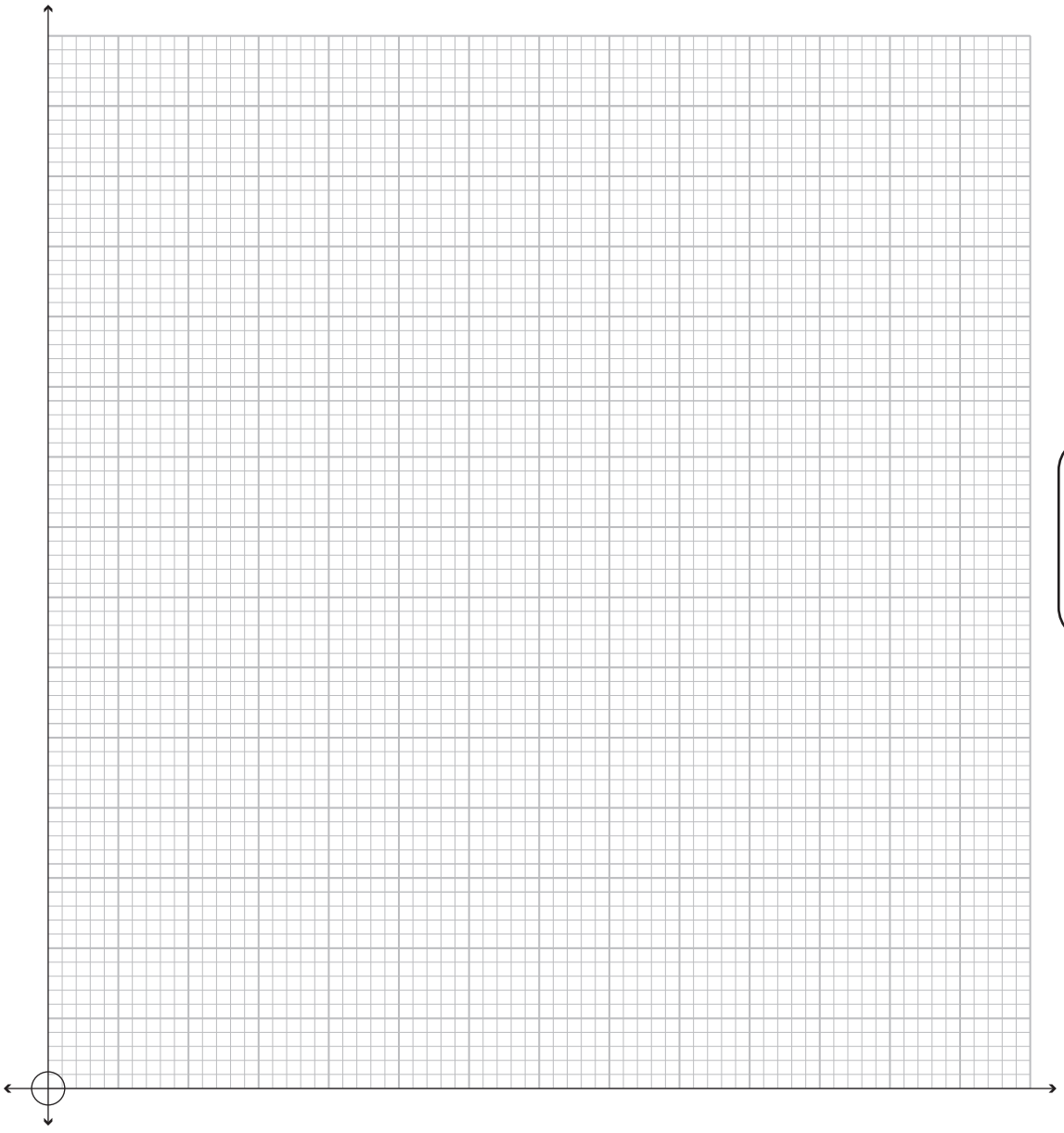


Diagram is NOT to scale

Use tables, equations, AND graphs to investigate the relationship between the length and the width of the grassed reserve and the area enclosed by the fences.

Provide at least THREE different comments that follow from your investigation.

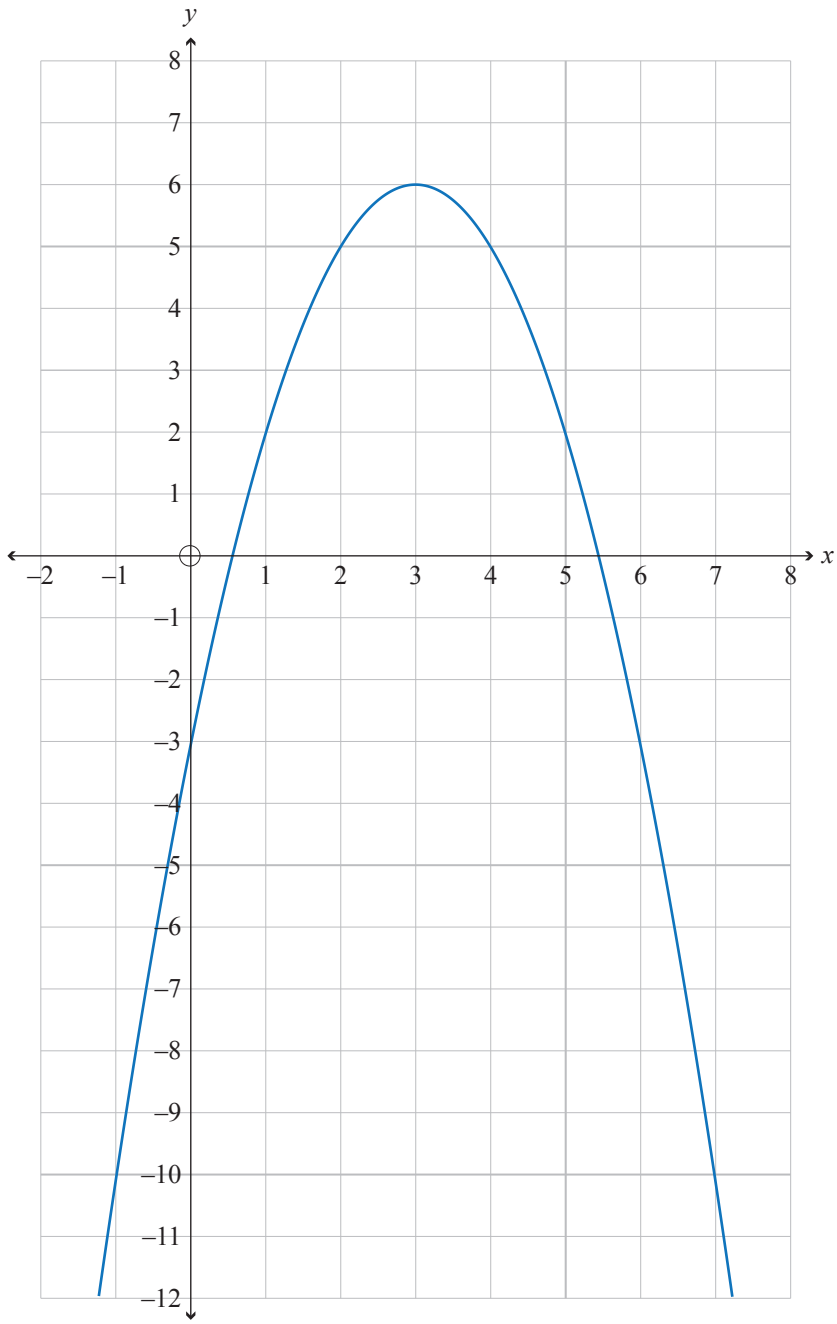
Justify your comments with full details.



If you need to redraw your graphs, use the grid on page 17.

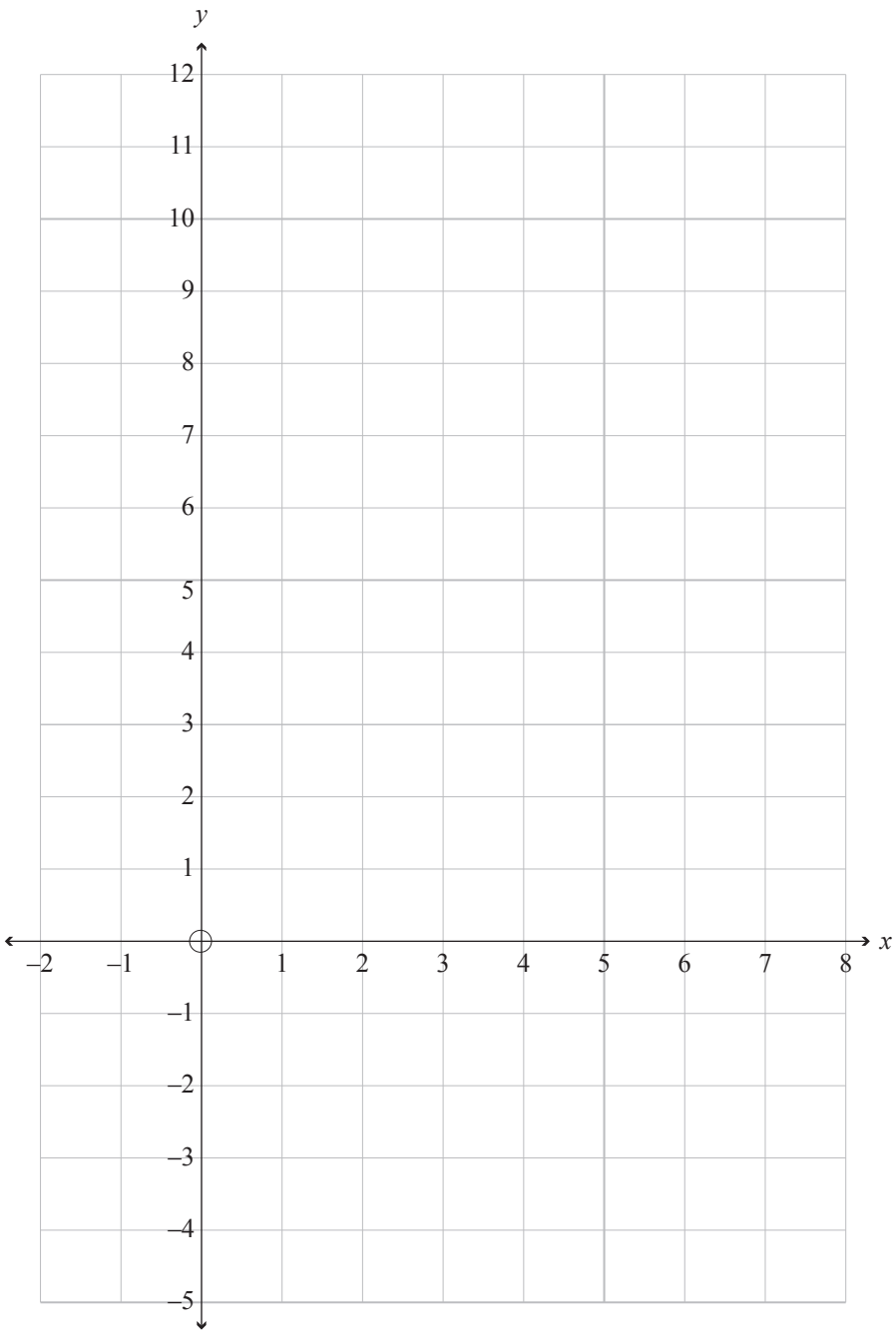
QUESTION TWO

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



Equation is: _____

(b) Using the set of axes provided below, draw the two graphs $y = 2^{x-3}$ and $y = 2x - 3$.
Using your graphs, solve the equation $2^{x-3} = 2x - 3$.



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

(c) Adam is looking at the number of flowers on a particular tree in his garden.

He counts the number of flowers on each level of branch on the tree. Branch level 1 is the branch closest to the ground, branch level 2 is the next one up, and so on.

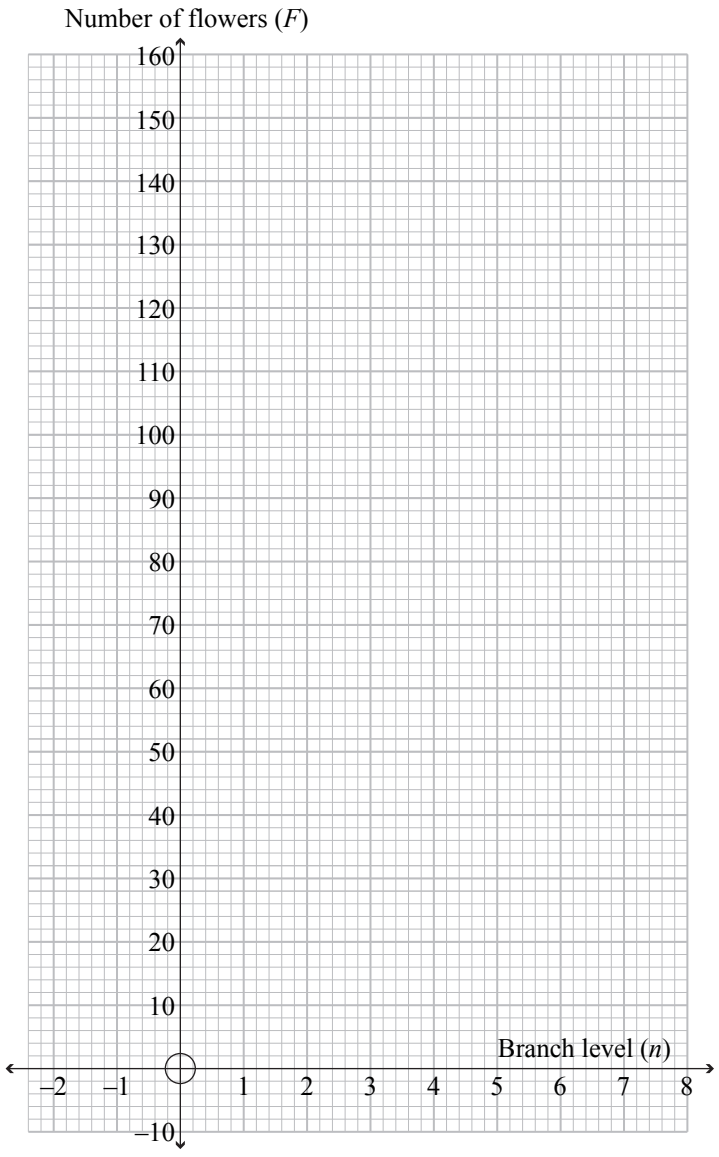
The table below lists the results from his research.

Branch level (n)	Number of flowers on that branch (F)
1	6
2	16
3	30
4	48
5	70
6	
7	
8	

https://www.southernliving.com/garden/trees/cherry-blossom-tree

(i) Using the axes below, draw the graph that best represents the relationship between "Branch level" (n) and "Number of flowers on that branch" (F).

Show the results as far as $n = 8$.



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

(ii) Find an equation that represents the "Number of flowers" on any given branch.

Justify your answer with clear working, **including an appropriate domain**.

(iii) Adam counts the number of flowers on each level of branch on a different tree.

The table below lists the results from his research on this second tree.

Branch level (n)	**Number of flowers on that branch (F)**
1	1
2	4
3	16
4	64
5	256
6	
7	
8	

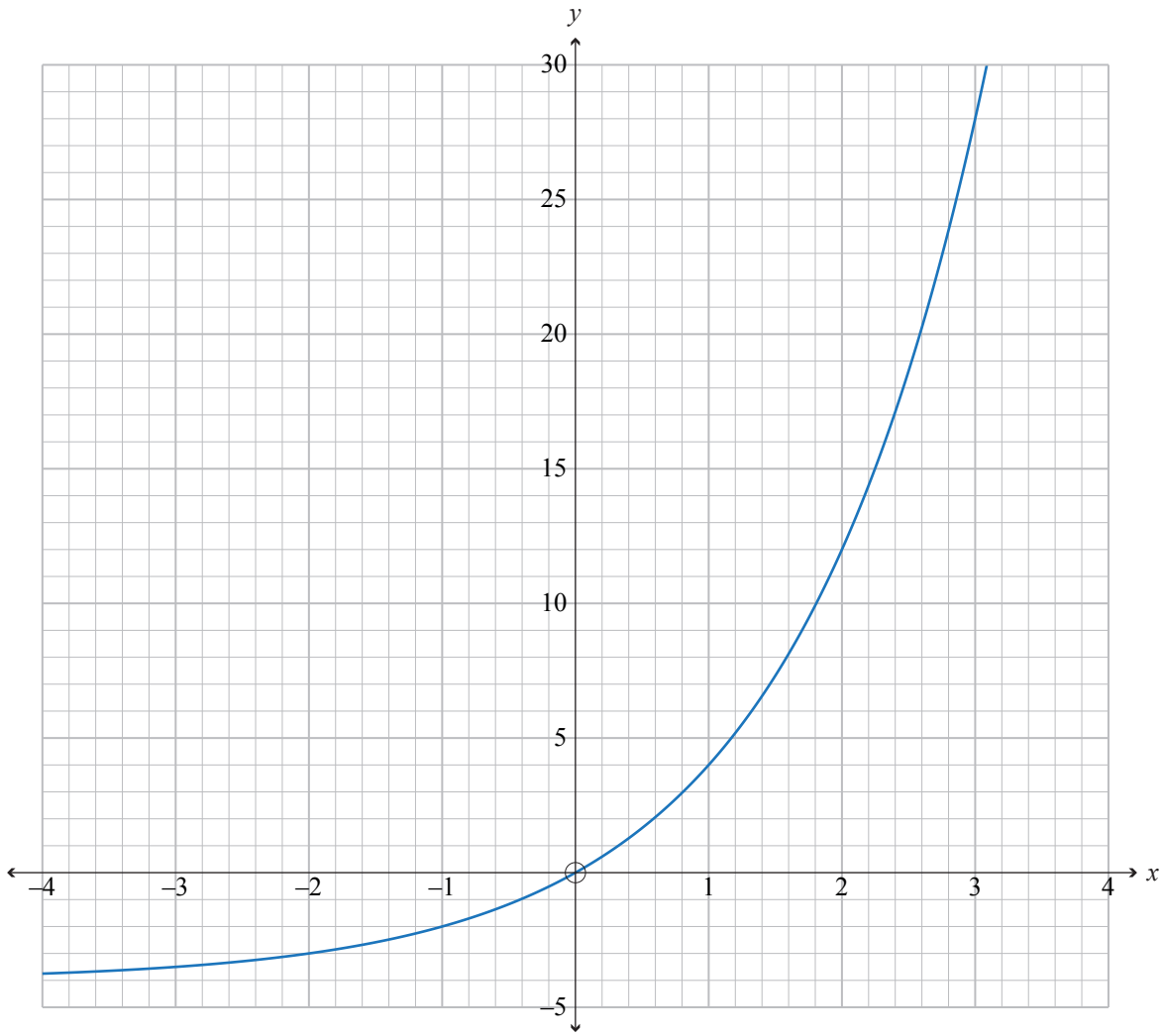
Find an equation that represents the "Number of flowers" on any given branch on this second tree. Justify your answer.

(iv) Adam claims that this formula will help him predict the number of flowers on trees in New Zealand.

Comment on this claim giving at least TWO different statements to support your reasoning.

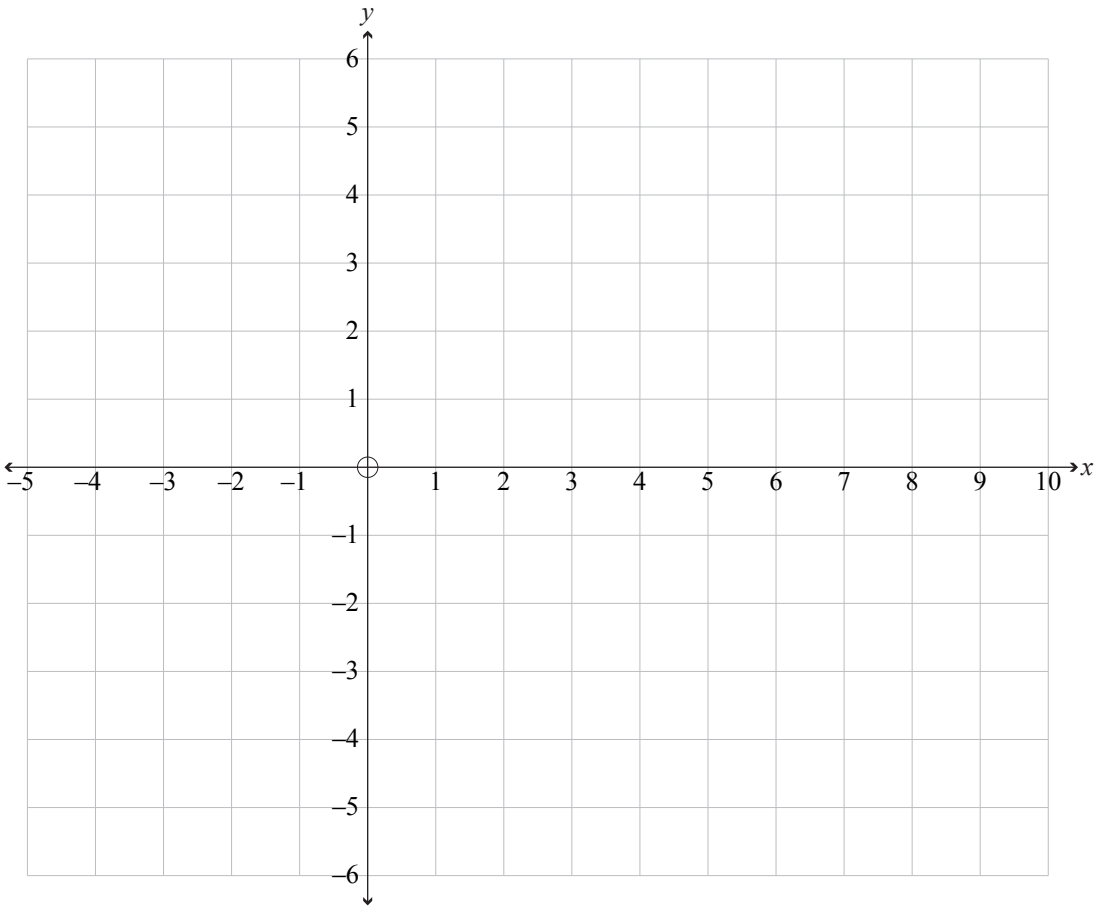
QUESTION THREE

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



Equation is: _____

(ii) On the axes below, draw the graph of $3y - 2x + 6 = 0$.



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

(b) Bronwyn plans to invest **$1000** using her bank. The bank offers three different types of savings plans, and she needs to decide which one to choose.

She wants to compare how her savings will increase over the next 6 years.

The details of each savings plan are listed below.

Bronwyn does not plan to take out any money during the 6 years.

Note: All graphs in this question can be considered to be continuous.

Savings Plan A: Invest $1000 at the start, and then receive the same regular payment of **$250** at the end of each year.

Savings Plan B: The equation for Savings Plan B is modelled by the formula

$$S = 60t^2 + 10t + 1000$$

where t represents the number of years since Bronwyn started her savings plan,
and S represents the total amount ($) in Bronwyn's account.

Savings Plan C: The details of Savings Plan C are shown in the table below, which can be modelled by an exponential equation of the form $S = p \times q^t$.

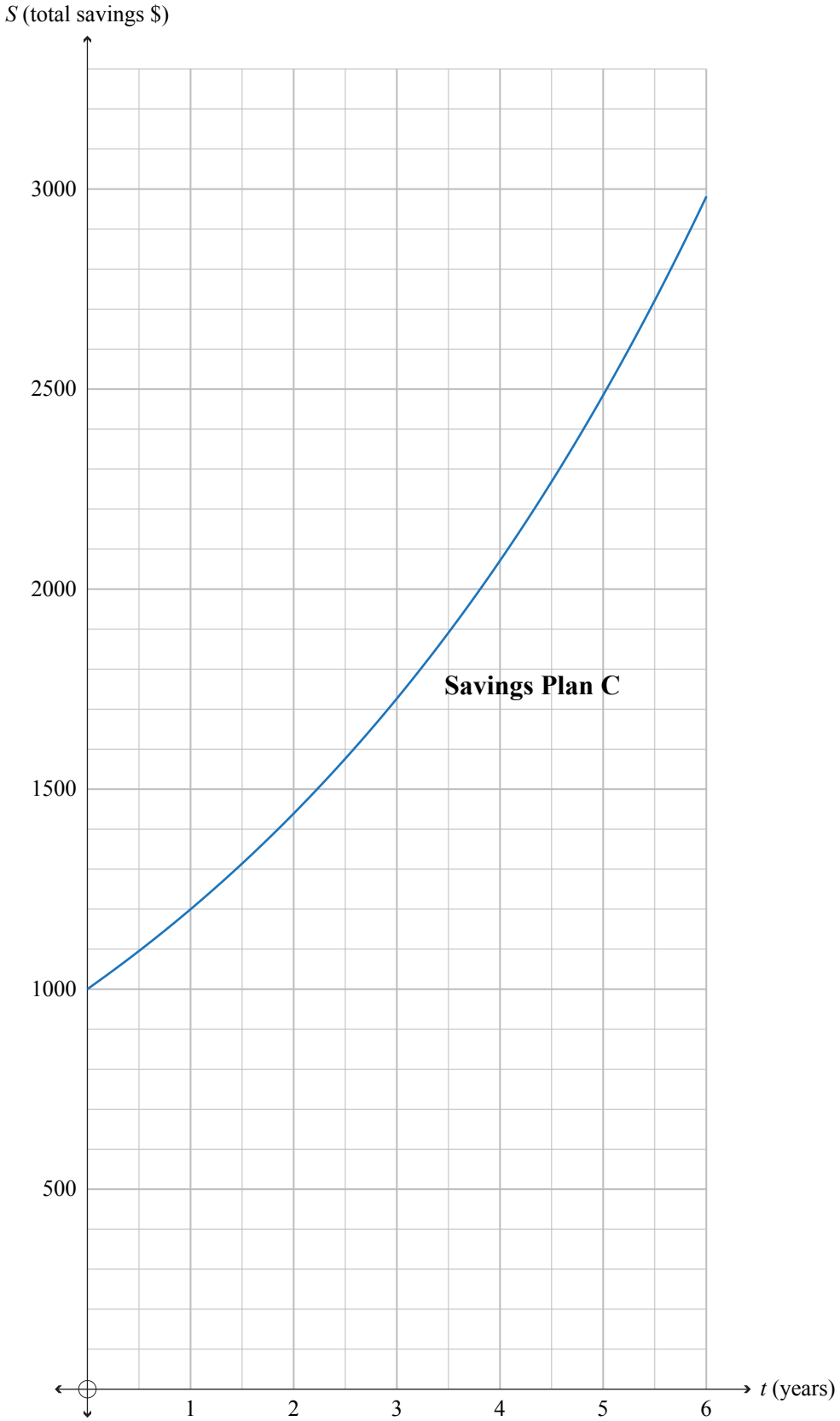
where p and q are numbers to be found,
t represents the number of years since Bronwyn started her savings plan,
and S represents the total amount ($) in Bronwyn's account.

Note: The graph of Savings Plan C has already been drawn for you on page 15.

End of year (t)	**Total savings amount (S) ($)**
0 (at the start of saving)	1000.00
1	1200.00
2	1440.00
3	1728.00
4	2073.60
5	2488.32
6	2985.98

(i) Write the equation of **Savings Plan C**.

(ii) Draw the graphs that model **Savings Plan A** and **Savings Plan B** below.
(The graph of **Savings Plan C** has been drawn for you.)



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

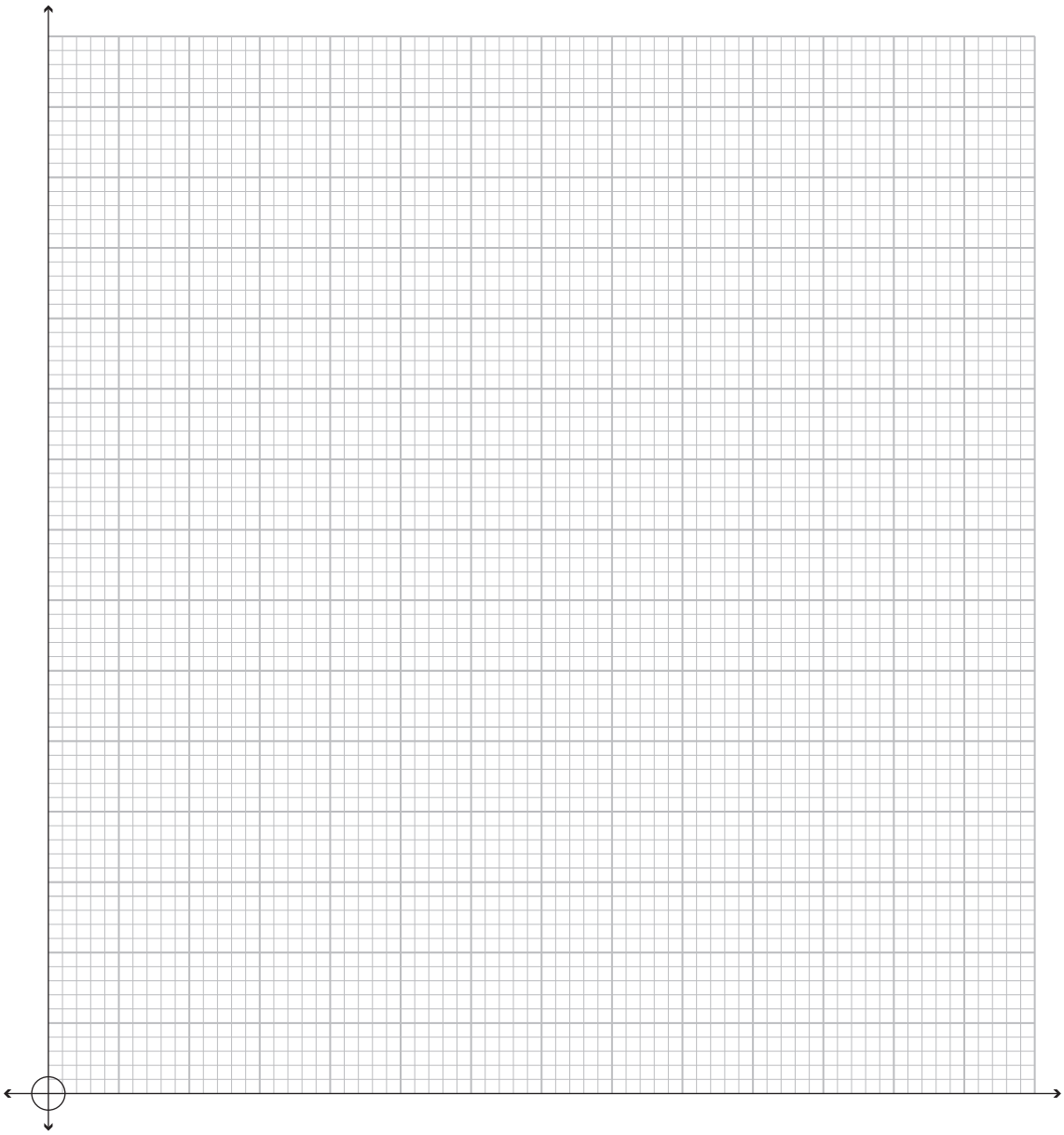
(iii) Using tables and the graphs in part (ii) on page 15, give a detailed comparison between the three savings plans at various stages during the first six years.

Provide at least THREE comments that follow from your comparison.

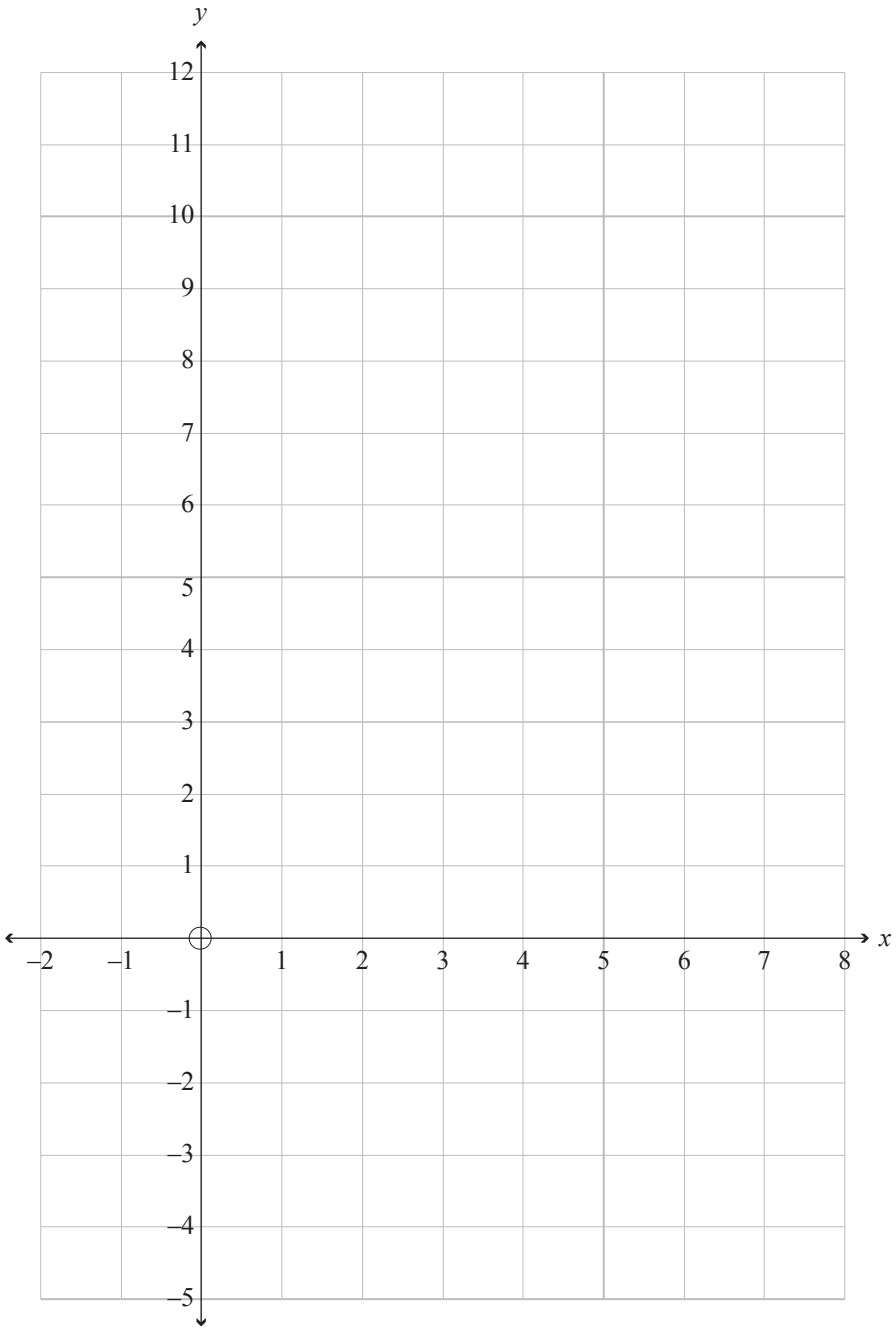
End of Year (t)	Total savings Savings Plan A	Total savings Savings Plan B	Total savings Savings Plan C	
0			1000.00	
1			1200.00	
2			1440.00	
3			1728.00	
4			2073.60	
5			2488.32	
6			2985.98	

SPARE DIAGRAMS

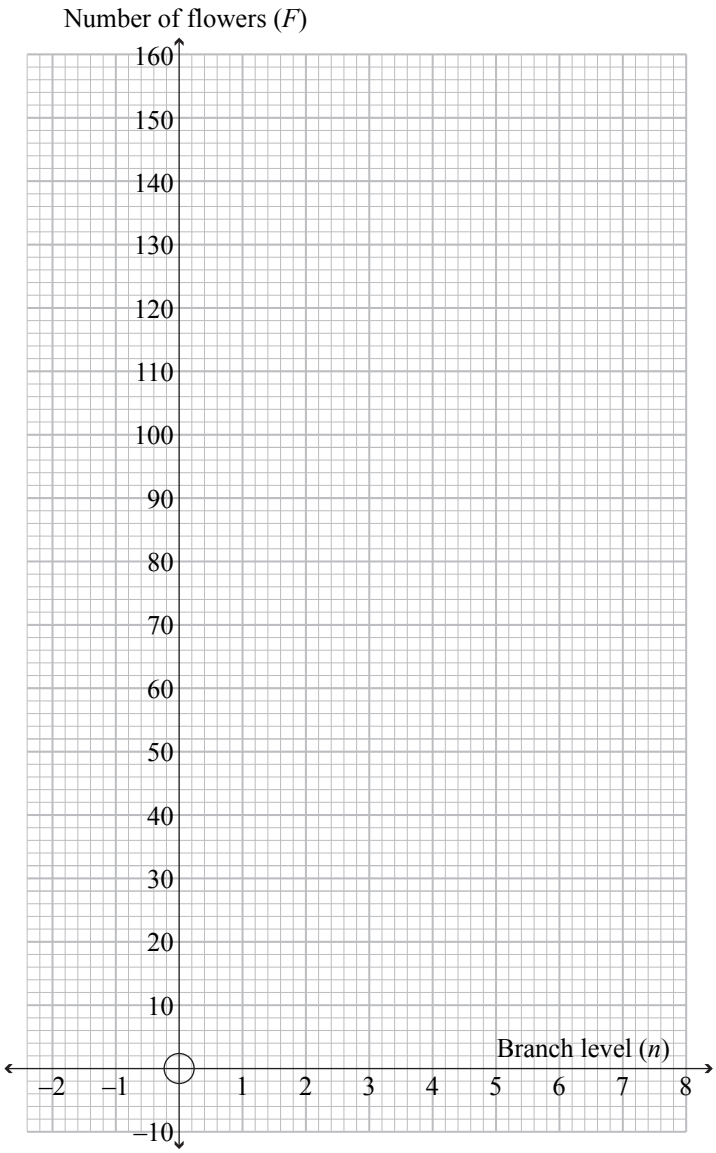
If you need to redraw your graphs for Question One (c), use the grid below. Make sure it is clear which answer you want marked.



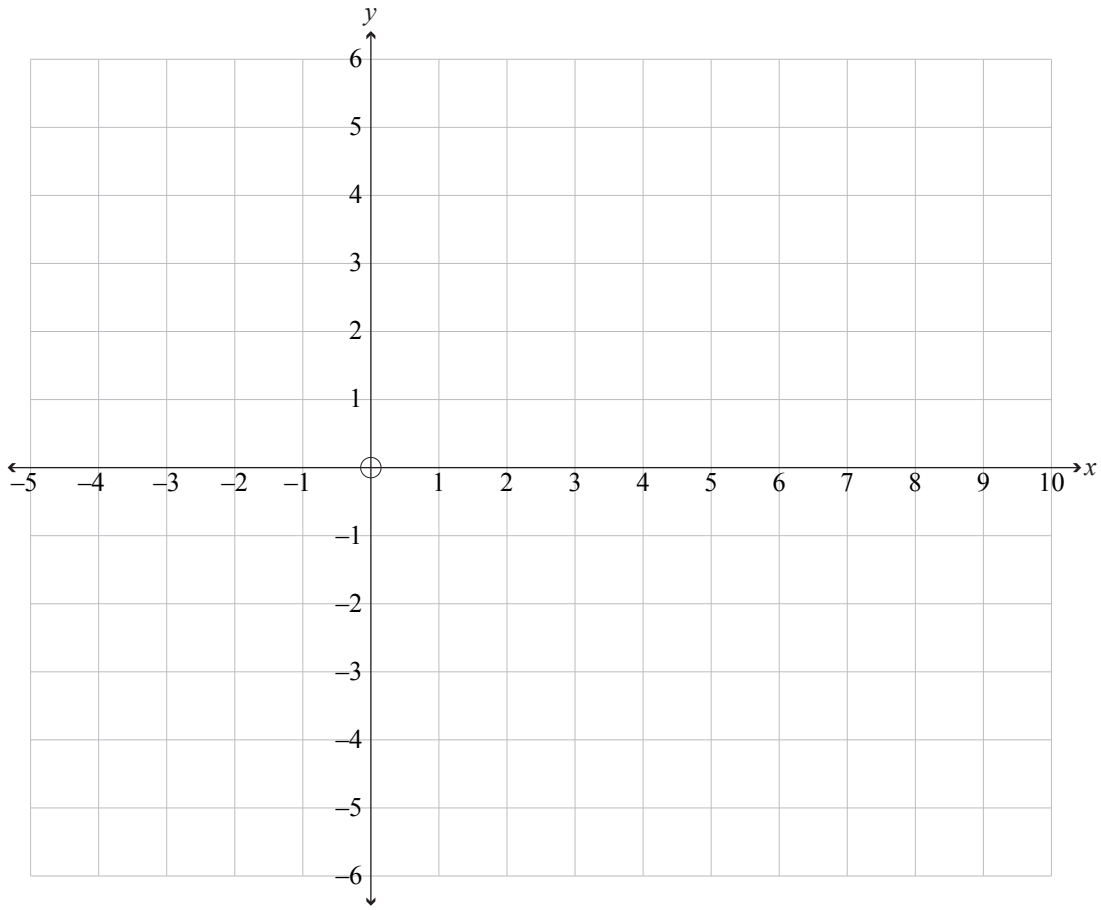
If you need to redraw your response to Question Two (b), use the diagram below. Make sure it is clear which answer you want marked.



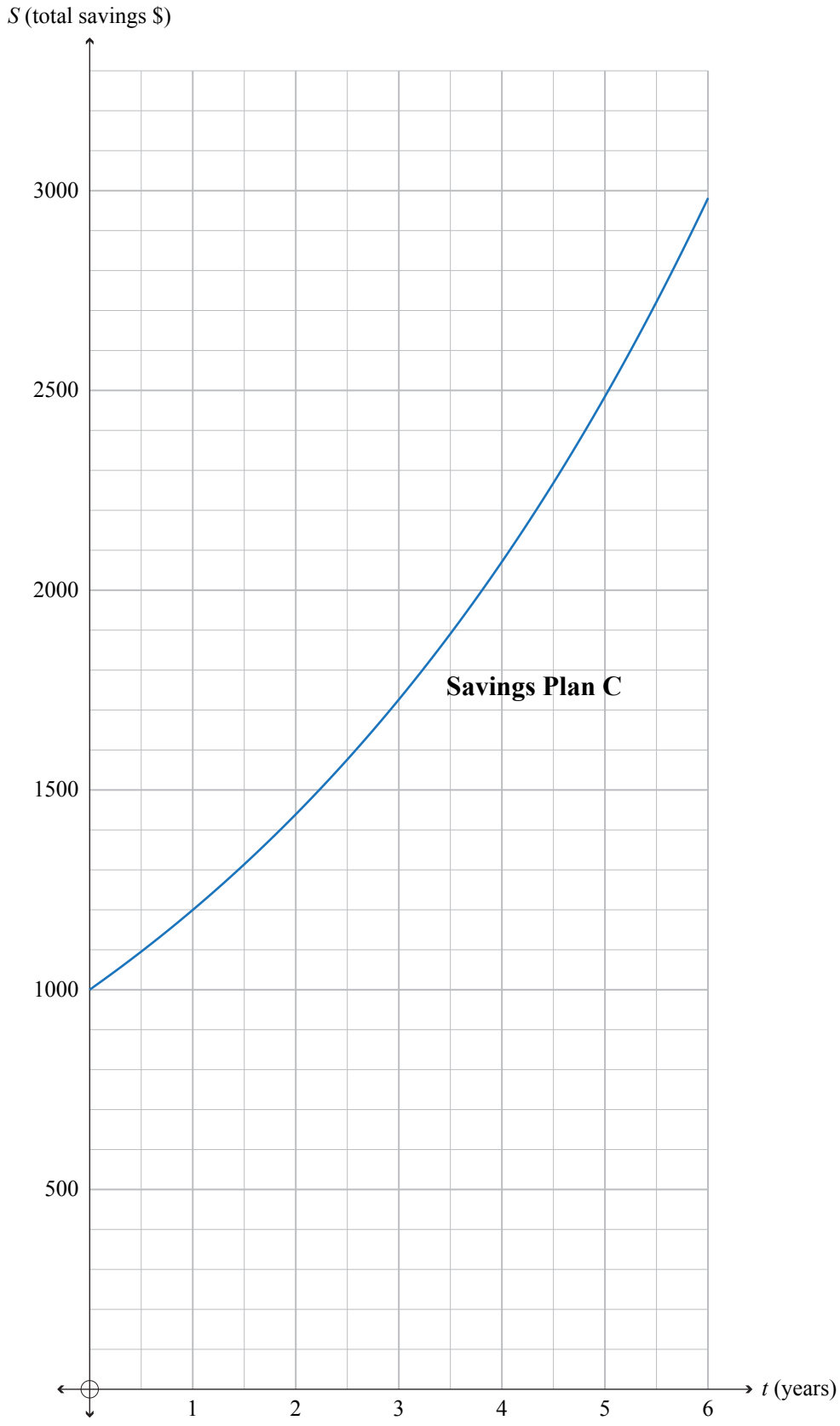
If you need to redraw your response to Question Two (c)(i), use the diagram below. Make sure it is clear which answer you want marked.



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



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QUESTION NUMBER

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QUESTION NUMBER

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Draw a cross through the box (☒) if you have NOT written in this booklet

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New Zealand Qualifications Authority

Level 1 Mathematics and Statistics 2023

91031 Apply geometric reasoning in solving problems

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply geometric reasoning in solving problems.	Apply geometric reasoning, using relational thinking, in solving problems.	Apply geometric reasoning, using extended abstract thinking, in solving problems.

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

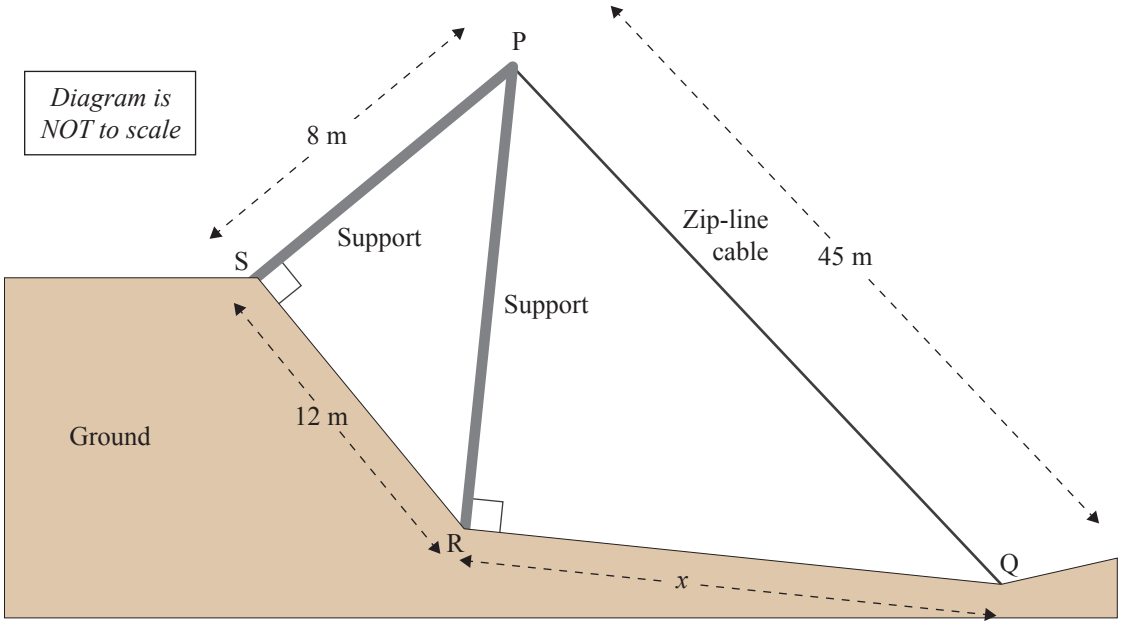
Do not write in any cross-hatched area (DO NOT WRITE IN THIS AREA DO NOT WRITE). This area will be cut off when the booklet is marked.

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

QUESTION ONE

(a) A zip-line is being built at a theme park that will attract tourists to the area.
Towers and cables are being designed that will support the zip-line cable.
The diagram below represents one of the possible designs.

Angle PSR = angle PRQ = 90°, SR = 12 metres, PS = 8 metres, PQ = 45 metres.



Calculate the length, x, from R to Q.

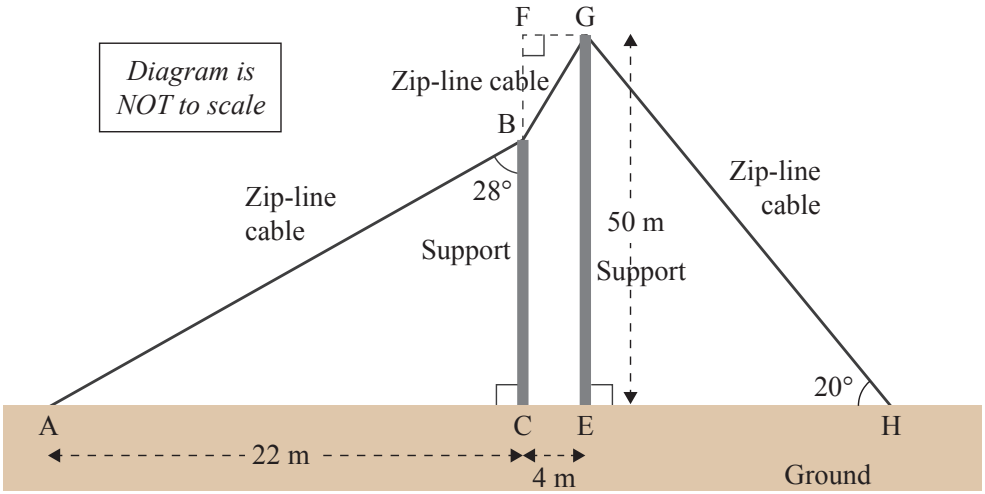
Show your working clearly.

(b) The diagram below represents another possible design for a zip-line.

The zip-line cable is attached joining A to B, then B to G, and then G to H.

Angle ABC = 28°, angle EHG = 20°, angle FCA = angle GEH = angle CFG = 90°.
AC = 22 metres, CE = 4 metres, EG = 50 metres. AH is on horizontal ground.

An advertisement claims "more than 200 metres of zip-line fun".



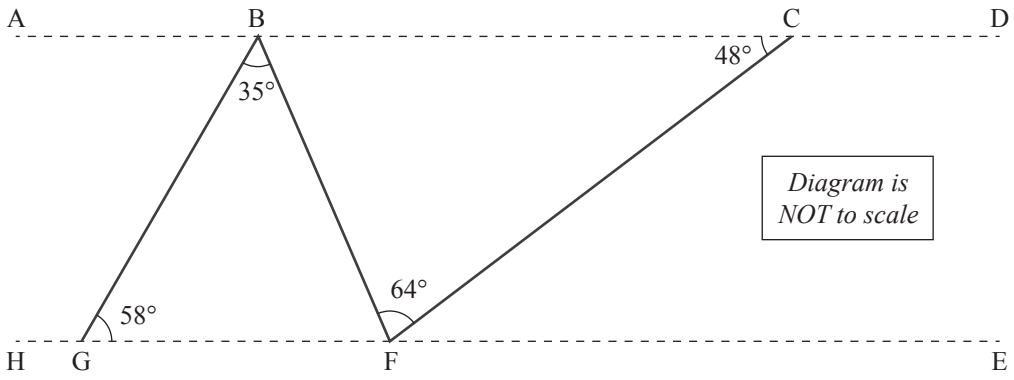
Show whether the advertisement's claim is true or false.

Show your working clearly.

(c) The diagram below represents another zip-line design.

The designers claim that the straight lines ABCD and HGFE are parallel to each other.

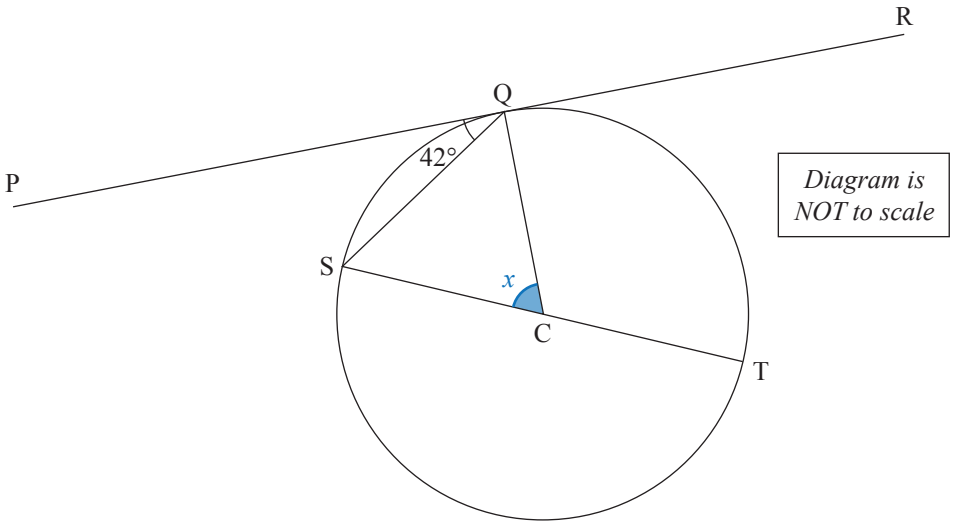
Angle GBF = 35°, angle BGF = 58°, angle BFC = 64°, angle BCF = 48°.



Show whether the designers' claim is true.

Justify your answer with clear geometric reasoning.

(d) The points Q, S, and T all lie on the circumference of a circle, with centre C.
The straight line PQR is a tangent to the circle at Q. SCT is a diameter of the circle.
Angle PQS = 42°.

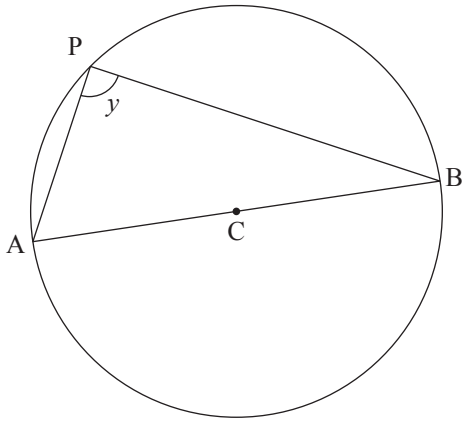


Find the size, x, of angle QCS.

Justify your answer.

(e) The points A, B, and P all lie on the circumference of a circle, centre C.

A student says that the size of angle APB, y, will always be 90°, whatever the size of the circle or the position of P on the circumference.



Prove that the student is correct.

Justify your answer with clear geometric reasoning.

QUESTION TWO

(a) The points P, Q, R, and S all lie on the circumference of a circle, centre C.
Angle PTQ = 110°, angle QSR = 40°.

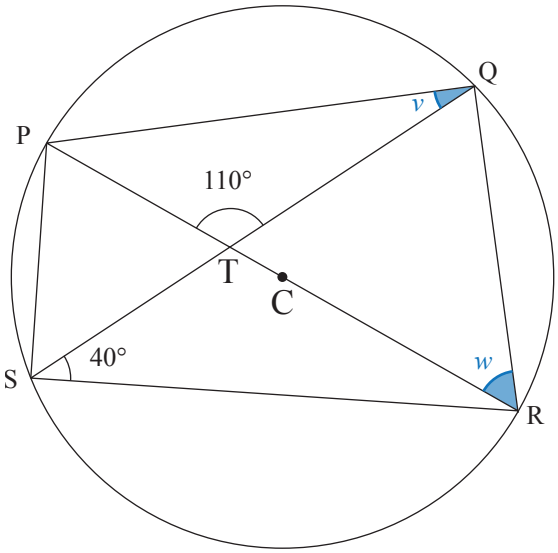


Diagram is NOT to scale

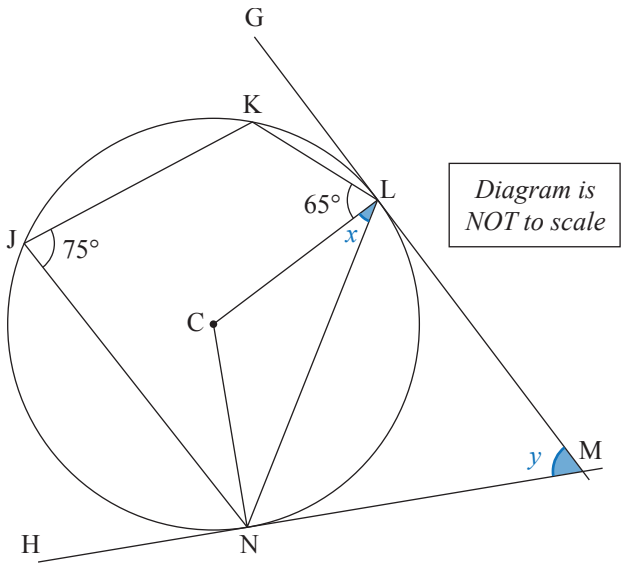
(i) Find the size, *v*, of angle PQS.

Justify your answer.

(ii) Find the size, *w*, of angle PRQ.

Justify your answer with clear geometric reasoning.

(b) The points J, K, L, and N all lie on the circumference of a circle, centre C.
Straight lines GLM and HNM are both tangents to the circle at L and N respectively.
Angle KLC = 65°, angle KJN = 75°.



(i) Show that the size, x, of angle CLN is 40°.

Show your working clearly.

(ii) Find the size, y, of angle LMN.

Justify your answer with clear geometric reasoning.

(c) Angle AEB = angle ADC = 90°. ABC and AED are both straight lines.
AB = 53 cm, BE = 45 cm, CD = p cm.

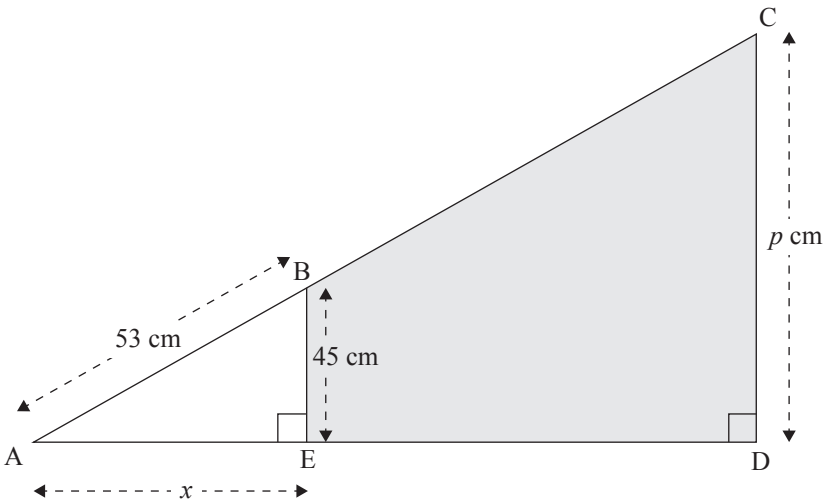


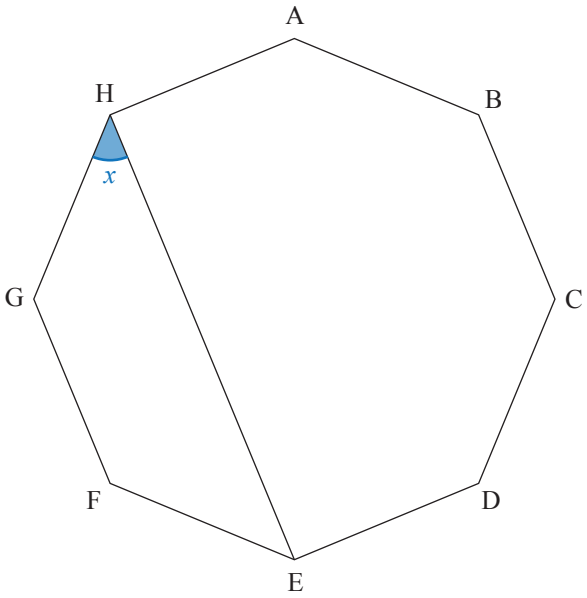
Diagram is NOT to scale

(i) Show that the distance, x, from A to E is 28 cm.
Show your working clearly.

(ii) Find the perimeter of the shaded quadrilateral BCDE, giving your answer in terms of p.
Justify your answer with clear geometric reasoning and working.
Show all appropriate working as a fraction or as a decimal correct to 4 decimal places.

QUESTION THREE

(a) The diagram below shows a regular octagon.



Find the size, x, of angle GHE.

Justify your answer.

(b) Angle QSR = 32°, angle SRP = 90°, PQ = 6.8 cm, SQ = 25 cm.

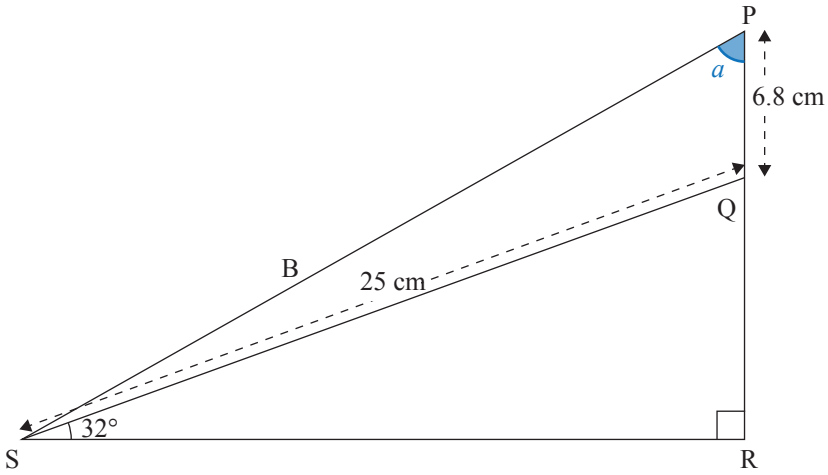


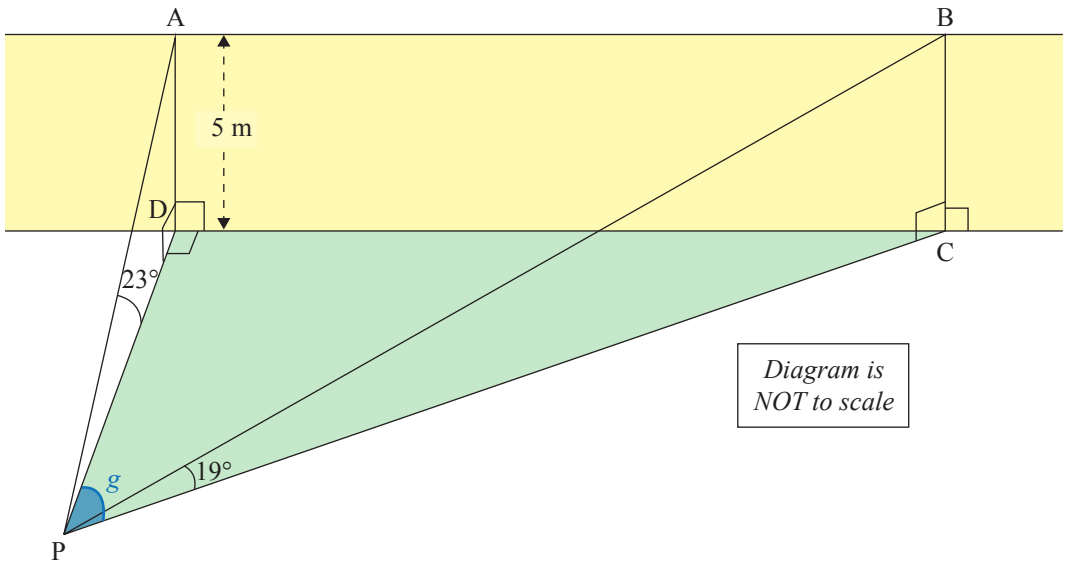
Diagram is NOT to scale

Find the size, *a*, of angle SPR.

Show your working clearly.

(c) The diagram below represents a vertical yellow wall, ABCD, built on horizontal flat ground, CDP.

Angle PDA = Angle PCB = Angle PDC = Angle ADC = Angle BCD = 90°.
Angle APD = 23°, Angle BPC = 19°. AD = 5 metres. The line AB is parallel to the line DC.



(i) Petra is stood directly in front of the wall, at the point P.

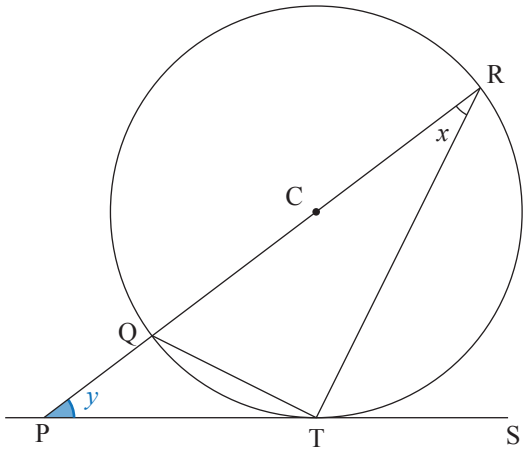
Calculate the shortest distance, PD, from Petra to the wall.

Show your working clearly.

(ii) Angle *g* is the angle on the ground between the lines PD and PC.

Find the size, *g*, of angle DPC.

(d) The points Q, R, and T all lie on the circumference of a circle, with centre C.
The straight line PTS is a tangent to the circle, at T. Angle QRT = x.



Find the size, y, of angle RPT, giving your answer in terms of x.

Justify your answer with clear geometric reasoning.

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

QUESTION NUMBER

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QUESTION NUMBER

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Level 1 Mathematics and Statistics 2023

91037 Demonstrate understanding of chance and data

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of chance and data.	Demonstrate understanding of chance and data, justifying statements and findings.	Demonstrate understanding of chance and data, showing statistical insight.

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You should attempt ALL the questions in this booklet.

Show ALL working.

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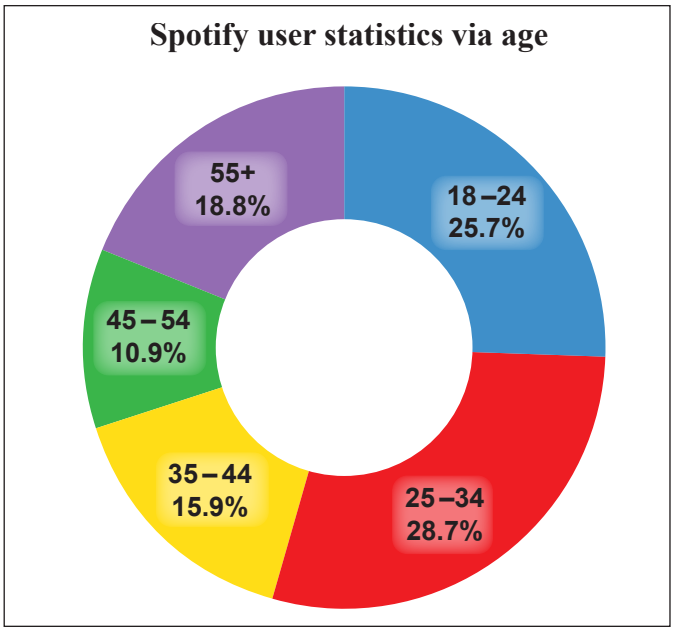
QUESTION ONE

Spotify is one of the largest online music streaming providers, which continues to grow in popularity around the world.

The diagram below shows the ages of the 587 million Spotify users in 2021.



(a) (i) What is the probability that a randomly selected Spotify user is aged 45 or over?

(ii) In terms of gender, 54% of Spotify users identify as male and 46% identify as female.

Assuming that these percentages are true for all age groups, what is the probability that a randomly selected Spotify user is a female aged between 25 and 34 years old?

Show clearly the calculations that give your probability value.

(iii) Niko conducted a survey among his family members and his work colleagues.

Niko surveyed 81 people and the results showed that 63 of them use Spotify.

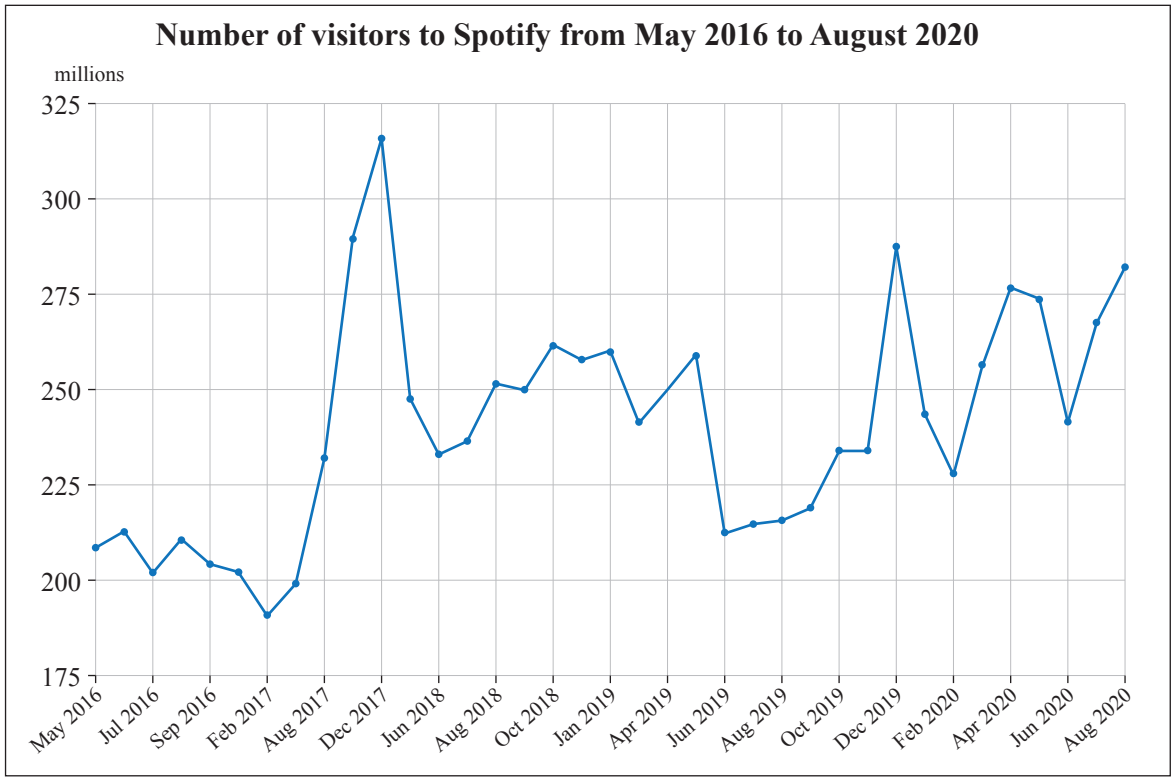
His results indicated that 8 Spotify users out of these 63 Spotify users were aged 55 or over.

Based on his results, and by comparing his results to the diagram on page 2, Niko claims that this result of 8 Spotify users in the age category of 55 years or over is nothing strange, and within what could be expected.

Comment on Niko's claim.

Justify your answer using statistical reasons.

(b) The graph below shows the number of users who visited Spotify from May 2016 through to August 2020.



Adapted from: https://www.statista.com/statistics/244989/number-of-unique-us-visitors-to-spotifycom/

(i) When was the least number of users visiting Spotify recorded in the time period shown in this graph?

Provide evidence from the graph to justify your answer.

(ii) Discuss and describe any trends and unusual features that you notice in the graph above.

Provide evidence from the graph to back up your statements.

Justify your answer using statistical reasons.

In your answer, describe at least THREE key features.

(iii) Margo studied the time series graph and decided that "this is a misleading graph".

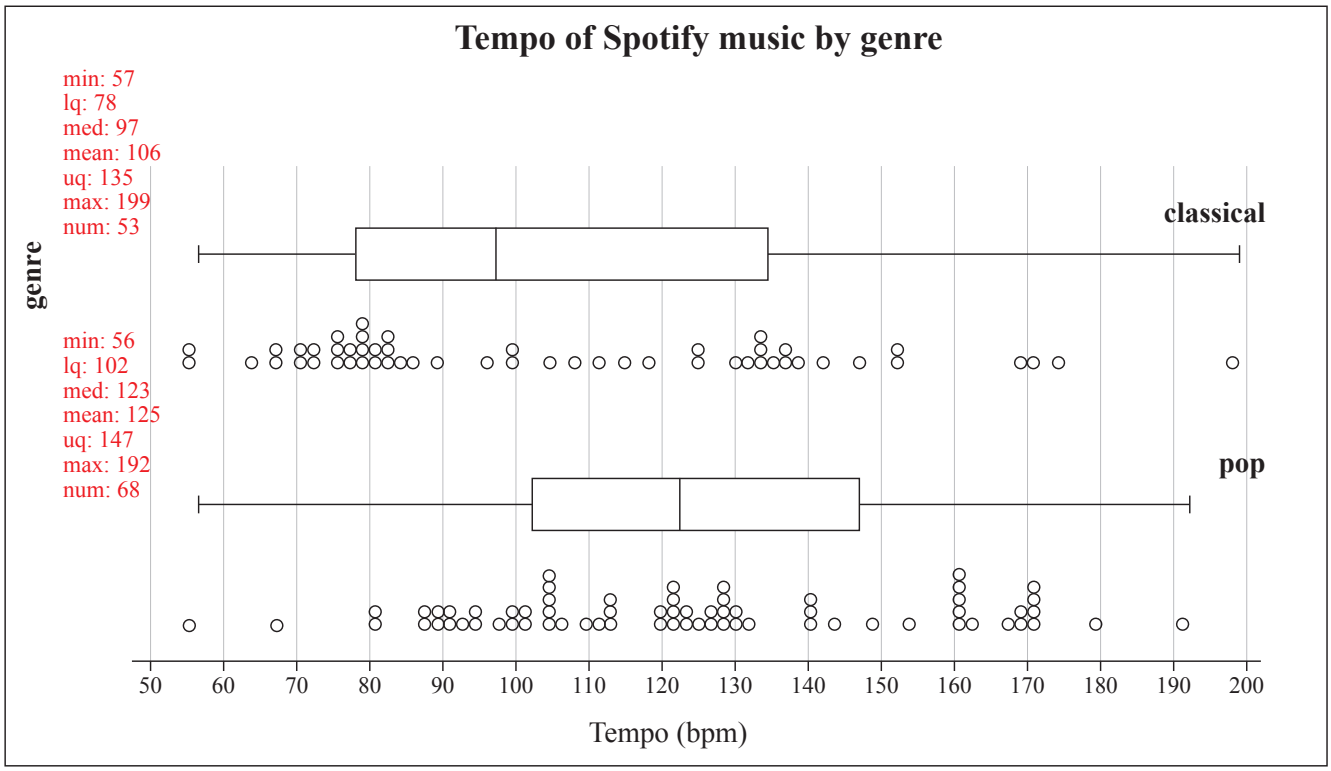
Do you agree?
Justify your answer using the evidence from the graph and statistical reasons.
Explain how any misleading aspects will have an effect.

QUESTION TWO

(a) In musical terminology, tempo is the speed or pace of the piece of music. It is measured as beats per minute (bpm).

Random samples of classical music and pop music are selected from the Spotify collection.

The graph below compares the tempo between the two genres of "classical" and "pop" music.



(i) If two pieces of pop music are randomly selected from the above sample, what is the probability that the tempos of both pieces of music are greater than 147 bpm?

(ii) Compare the distributions of the music tempo shown in the sample data opposite.
Note any similarities and differences considering centre, shift/overlap, shape, spread.
Provide numerical evidence where appropriate.
In your answer, describe at least THREE different key features.

(iii) Thom made a claim that it is not possible to decide that classical music tempo tends to be slower than pop music tempo for all music on Spotify.

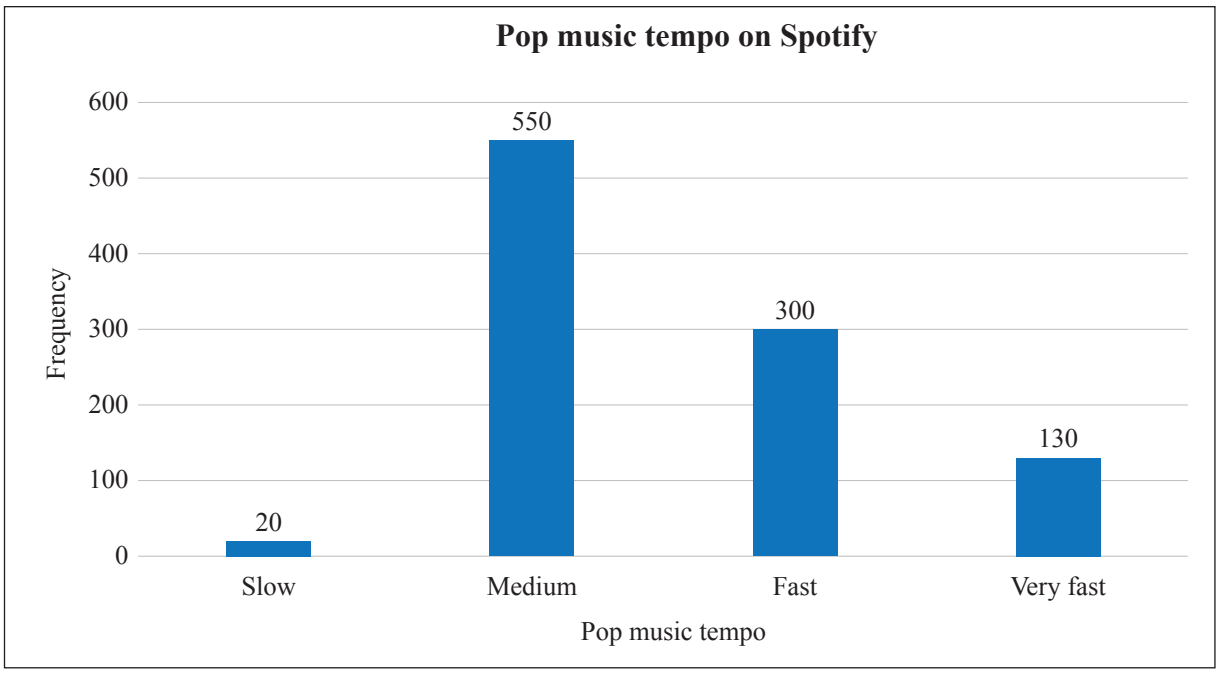
Comment on this claim, based on the sample of music tempo provided (shown in the diagram on page 6).

Justify your answer using statistical reasons, and include numerical evidence where appropriate.

Comment on how confident you are in your answer.

(b) There are four levels of pop music tempo. These are slow, medium, fast, and very fast.

A random sample of **1000 pop songs** selected from Spotify is shown in the graph below.



(i) If a piece of music is randomly selected from this sample, what is the probability that it is NOT a slow tempo or medium tempo piece of music?

(ii) Another sample of 200 pop songs is selected from Spotify.

Describe any similarities and differences that you would expect to see in this new sample compared to the random sample shown.

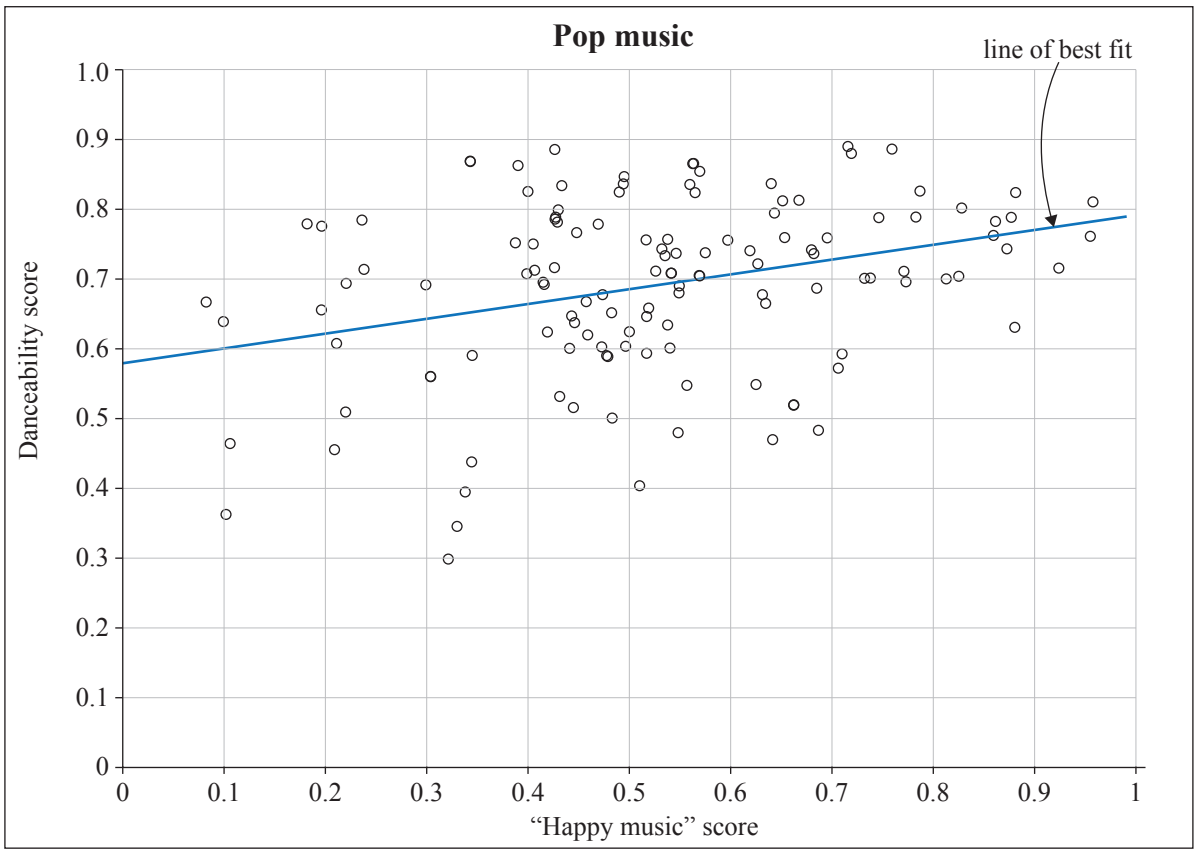
Justify your answer using statistical reasoning.

QUESTION THREE

(a) Most people would agree that dancing makes people feel happy. But does "Happy music" encourage people to dance?

A sample of 120 pieces of pop music was selected from Spotify to study the possible relationship between "Happy music" and "Danceability".

Variable	Description
Danceability	A piece of music is given a "Danceability" rating with a score between 0 and 1. This score gives a numerical value to how much the piece of music encourages the listener to dance. E.g. A "Danceability" rating with a low score, lowest of 0, would mean that the piece of music does not encourage the listener to dance. A "Danceability" rating with a high score, highest of 1, would mean that the piece of music is encouraging the listener to "get on their feet and dance".
"Happy Music"	A piece of music is given a "Happy music" rating with a score between 0 and 1. This score gives a numerical value to the feeling of "happiness" in the piece of music. E.g. A "Happy music" rating with a low score, lowest of 0, would mean that the piece of music is a very sad piece of music. A "Happy music" rating with a high score, highest of 1, would mean that the piece of music is cheerful and fun.



(i) If a piece of music has a "Happy music" score of 0.1, what "Danceability" score would you expect it to have?

Comment on how confident you feel with the accuracy of your answer, with justification.

(ii) Describe and interpret at least TWO different **features** of the relationship shown in the graph above of "Danceability" score versus "Happy music" score.

Justify your answer using statistical reasons.

(iii) Meremere believes that this scatter graph would be very useful to predict the "Danceability" score based on a piece of music's "Happy music" score.

Evaluate Meremere's claim using statistical reasoning, giving at least TWO justified statements, providing numerical evidence where appropriate.

Question Three continues on the next page.

(b) A survey was conducted among **500** randomly selected Spotify users.

They were asked how many hours they listened to Spotify in the past week.

The results are shown in the table below.

Spotify weekly usage	**Less than 2 hours**	**Between 2 and 5 hours**	**More than 5 hours**	**Total**
Free subscription	40	133	27	200
Premium subscription	21	187	92	300
Total	61	320	119	500

(i) One Spotify user was randomly selected from this sample.

What is the probability that it is a premium user who listens for more than 5 hours?

(ii) Based on the data from this survey, Meremere claimed that the free subscription users are more likely to spend less than 2 hours per week listening to Spotify than the premium subscription users.

Comment on Meremere's claim using the information in the table, and providing numerical evidence.

Extra space if required.
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