Assessment Schedule – 2023

Mathematics and Statistics: Investigate relationships between tables, equations and graphs (91028)

Evidence

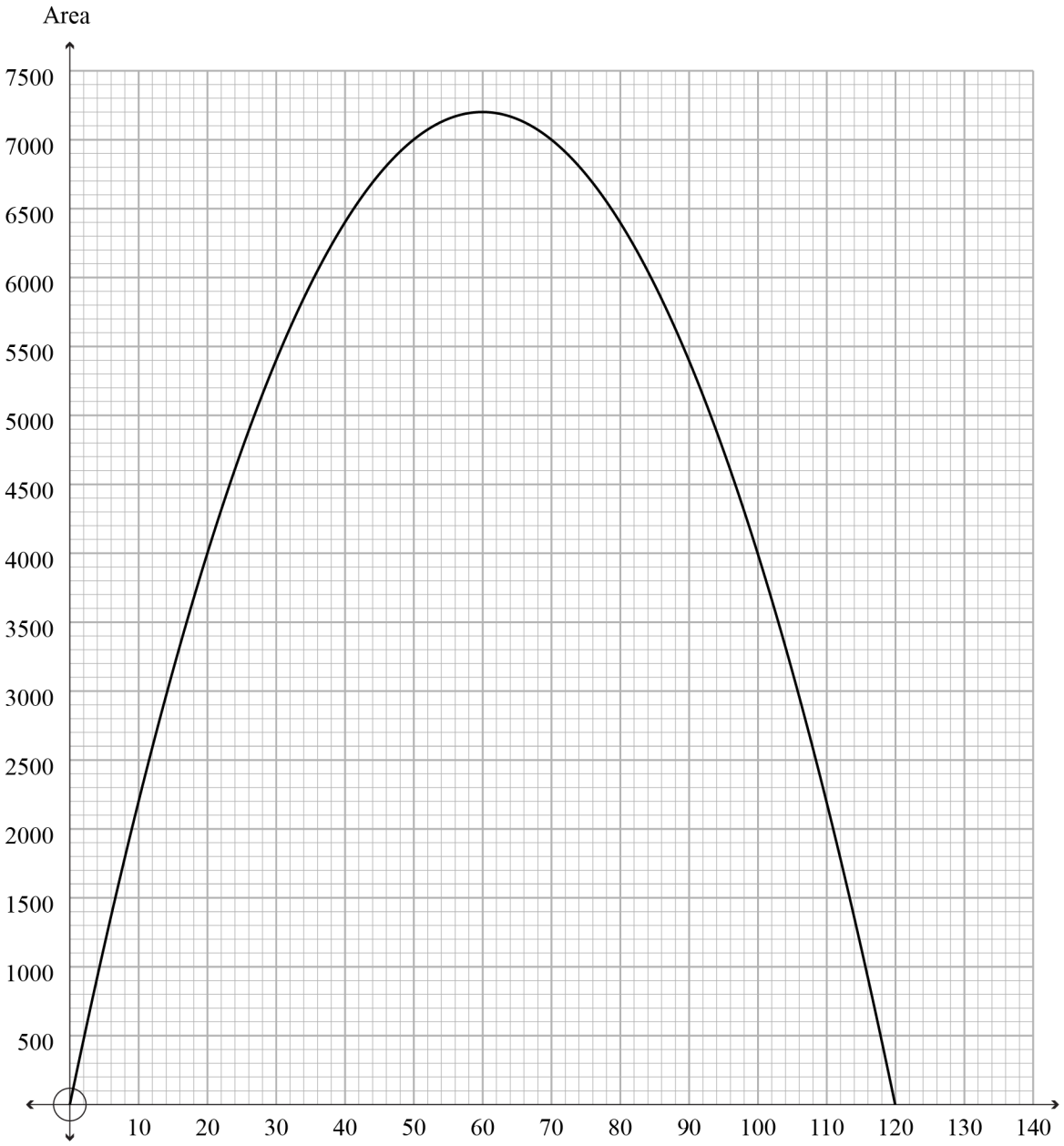
Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)	$y = \frac{-5}{2}x + 15$ Allow alternative forms. Allow C.A.O.	• Correct equation.		
(ii)	$y = \frac{5}{2}x + 15 + 10$ $y = \frac{5}{2}x + 25$ Allow alternative forms. Allow C.A.O.	• Correct equation after one of the transformations. OR Both transformations correct from wrong equation in (a)(i).	• Correct equation after both of the transformations.	
(b)(i)	$H = k(x-60)^2 + 36$ $x = 0, y = 45$ gives $k = \frac{9}{3600} = \frac{1}{400} = 0.0025$ i.e. $H = \frac{1}{400}(x-60)^2 + 36$ OR Alternative formats: $H = \frac{1}{400}x(x-120) + 45$ OR $H = \frac{1}{400}x^2 - \frac{3}{10}x + 45$	• Equation given but with no k-value considered. OR Attempt made to find the value of k in a correct set up of the equation. OR C.A.O.	• Correct equation for H, including full and clear working.	
(ii)	Possible changes are : The whole graph could be shifted downwards. This would represent shifting downwards where the chain fixes onto the post. This would be shown in the equation by reducing the size of the constant at the end. e.g. $H = \frac{1}{400}(x-60)^2 + 20$ This would lower the chain totally by 16 cm. OR other examples where the chain is lowered.	• Valid suggestion of how the equation should be changed. OR Example of equation of new design.	• Valid suggestion of how the equation should be changed with an example equation AND Description of the minimum point of the chain fence, in context .	

(c)	Total perimeter (3 sides). $2x + y = 240$ $y = 240 - 2x$ Area $= x(240 - 2x)$ Allow other versions of this equation, e.g. $y = -2(x - 60)^2 + 7200$. (Allow any correct equation which starts with x + 2y = 240) e.g. $y = -\frac{1}{2}(x - 120)^2 + 7200$ Table produced of the relationship between the two sides of the grassed space and their area with at least 5 correct values. Graph produced relating length of one side and area. Evidence of the use of tables, equations, and graphs to model the area of the grassed space as the lengths of the sides change. Sample comments: • Maximum area is 7200 m^2. • Maximum area is when x = 60 m and y = 120 m. • Graph and area size is symmetrical. • Minimum area is 0 cm^2 (theoretically). • Rate of increase of the area changes for different x-values. • The graph will be a continuous one, as all different x-values are possible, if measurements are taken accurately. • In reality, some of the x-values close to 0 or close to 120 are likely to be inappropriate for the council to design their grassed area with these dimensions.	• Forming equation for area in terms of only one variable. OR Table only with one non-trivial comment. OR Graph only with ONE non-trivial comment. OR Finding maximum area only. OR Table and graph drawn with no comments.	• Evidence of only two aspects of tables, equations, and graphs. AND TWO non-trivial comments.	**E7 / T1** Evidence of table of values. AND Graph drawn. AND Formula for area provided. BUT Only maximum area discussed. OR As evidence for E8 but graph is discrete or of poor quality. **E8 / T2** Evidence of table of values. AND Graph drawn. AND Formula for area provided. AND At least three valid non-trivial comments.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	ONE question attempted towards solution.	1u	2u	3u	2r	3r	1t	2t

Question One

x	$y = 240 - 2x$	$A = x(240 - 2x)$
0	240	0
20	200	4000
40	160	6400
60	120	7200
80	80	6400
100	40	4000
120	0	0

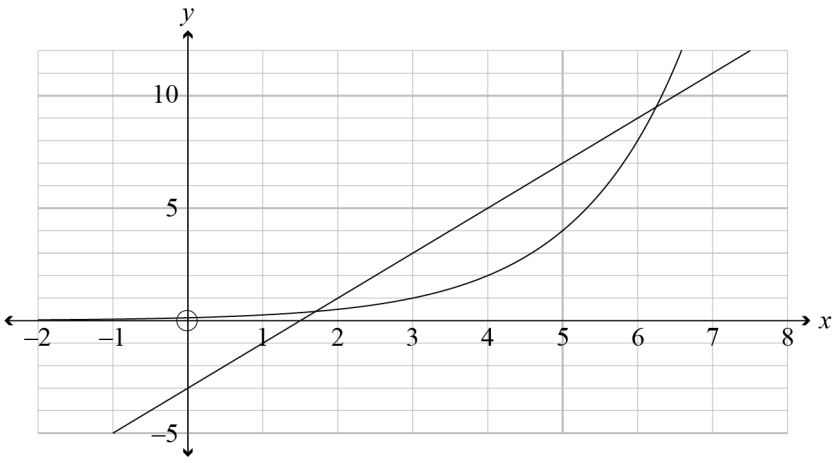

Area
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
10
20
30
40
50
60
70
80
90
100
110
120
130
140

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
TWO (a)	$y = -(x-3)^2 + 6$ OR $y = -x^2 + 6x - 3$ OR $y = -(x-1)(x-5) + 2$ Allow other equivalent solutions.	• Correct equation.		
(b)	Draw the graph $y = 2^{x-3}$ Draw the graph $y = 2x - 3$ Intersection at $x = 1.7$ and $x = 6.25$ Allow margin of error in the accuracy, consistent with the graph drawing. Allow an error of ±0.2.	• Drawing the graph of $y = 2^{x-3}$ OR Consistent solutions from minor error. OR Only one solution provided. OR CAO	• Two values of x found from the intersection of the two graphs. • Graph must show both intersection points	
(c)(i)	Graph drawn, as discrete points, for $0 < x \le 8$ Allow for minor error in graph	• Graph drawn, as a continuous graph. Do not penalise negative values included.	• Graph drawn as discrete points for $0 \le x \le 8$ OR $0 < x \le 8$	E7 / T1 Correct discrete graph drawn for $0 \le x \le 8$ OR $0 < x \le 8$ AND Correct justified equation, but not with an appropriate domain. OR Correct justified equation, with appropriate domain BUT with a continuous graph E8 / T2 Correct discrete graph drawn for $0 \le x \le 8$ OR $0 < x \le 8$ AND Correct justified equation, with appropriate domain
(ii)	Equation found, with some justification, e.g. second difference of +4 indicated in the table. $F = 2n^2 + 4n$ OR $F = 2n(n+2)$ OR $F = 2(n+1)^2 - 2$ AND Domain for $1 \le x \le 8$ (with integer points) Also allow for x > 0 or equivalent Allow equation given in terms of y and x.	• Recognition that the equation is a quadratic with the coefficient of x^2 as 2. OR Table of first and second differences shown and indication that the equation is a quadratic. OR C.A.O.	• Correct equation, with some valid justification.	
(iii)	Exponential equation of $F = 4^{n-1}$. OR $F = 0.25 \times 4^n$ Allow other equivalent solutions. Allow C.A.O.	• Equation identified as an exponential, with base of 4.	• Correct equation of $F = 4^{n-1}$.	

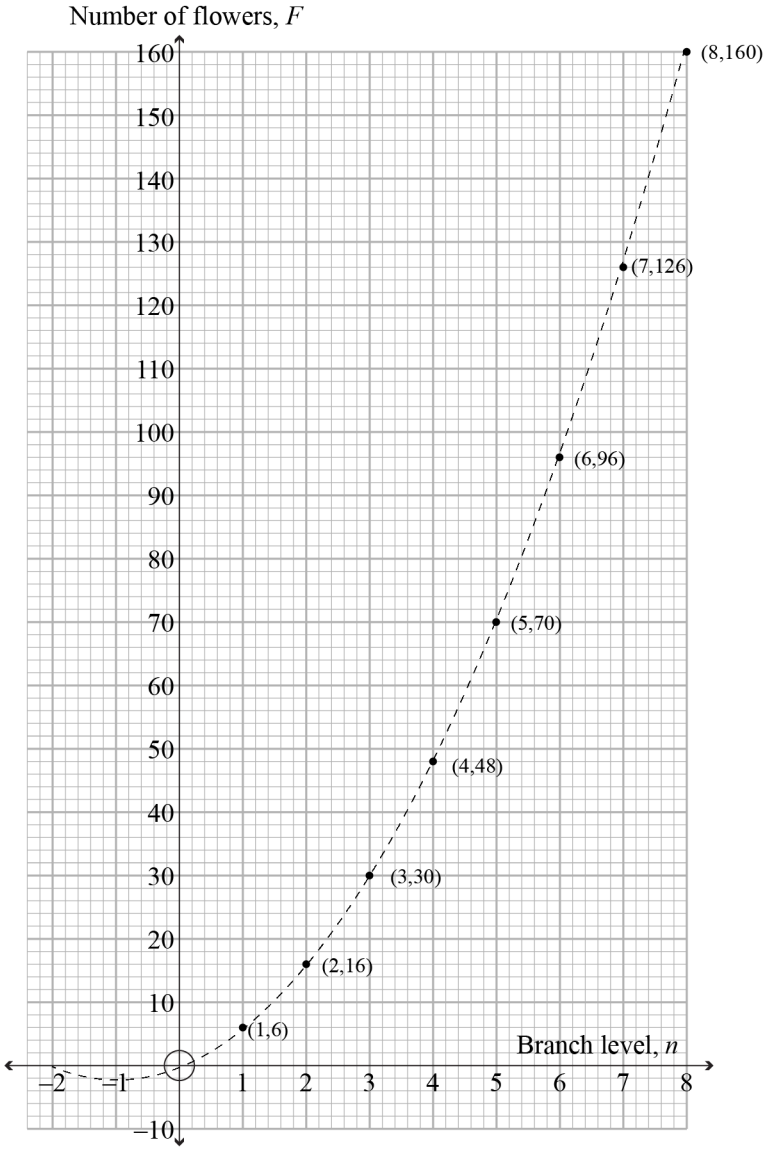
(iv)	Sample comments regarding the false claim are: • No, it is only one set of results from one tree, so cannot be generalised to claim that this will always occur. • No, these results are from only one tree in one particular place, so cannot be generalised to all trees in NZ. • No, different growing conditions in different locations will lead to different results and hence a different formula. • No, the results are only for up to branch 8 flowers. Other-sized trees may not follow the same pattern. • No, trees may be diseased, which would affect the number of flowers on the branches. Allow other valid reasons.	• Recognising that the claim is false. AND With ONE valid comment.		

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	ONE question attempted towards solution.	1u	2u	3u	2r	3r	1t	2t

Question Two (b)



Question Two (c)(i)

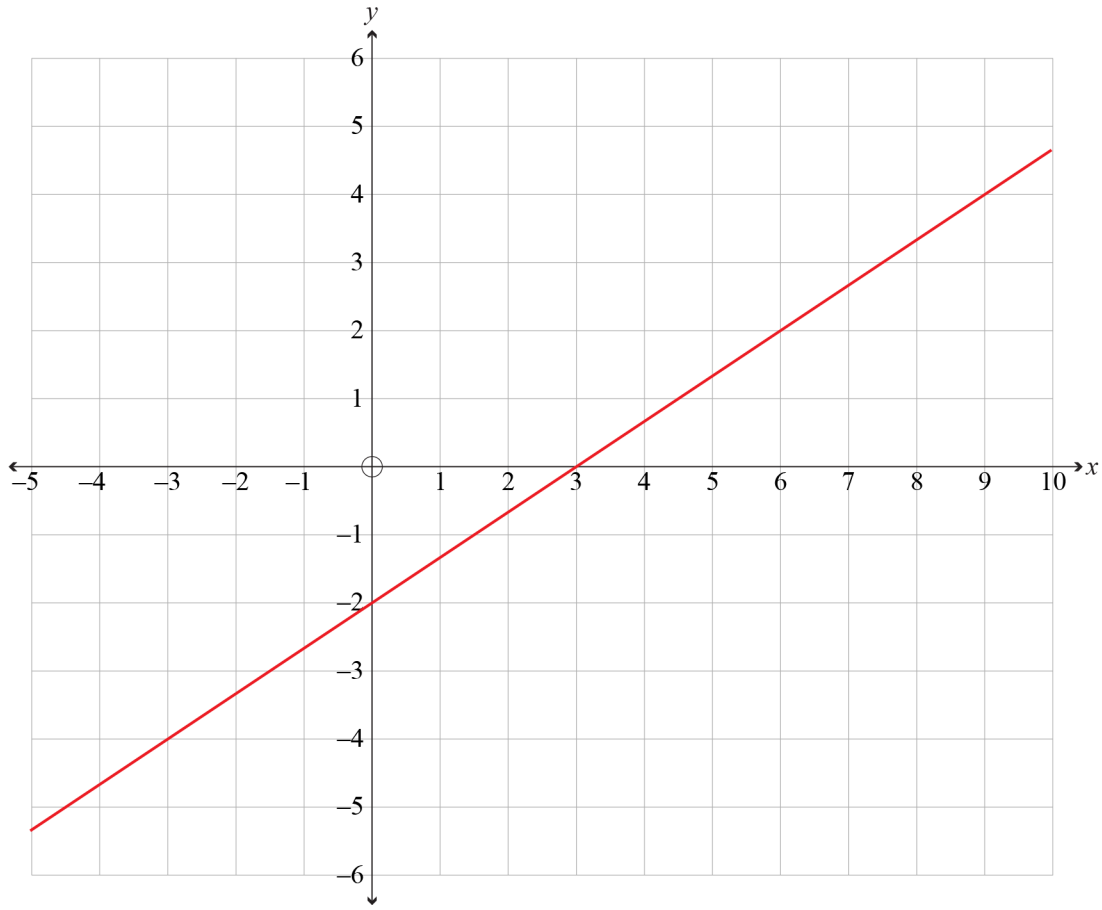


Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
THREE (a)(i)	Correct equation of $y = 2^{x+2} - 4$ OR equivalent.	• Equation identified as an exponential, with base of 2.	• Correct equation.	
(ii)	Straight line graph drawn, showing x-axis intercept at (3,0) AND y-axis intercept at (0,–2).	• Straight line with only one axis-intercept correct.	• Accurate graph drawn.	
(b)(i)	Correct equation of $y = 1000 \times 1.2^x$ OR $S = 1000 \times 1.2^t$	• Included 1000 in the exponential equation. OR Recognised that the base is 1.2.	• Correct equation.	

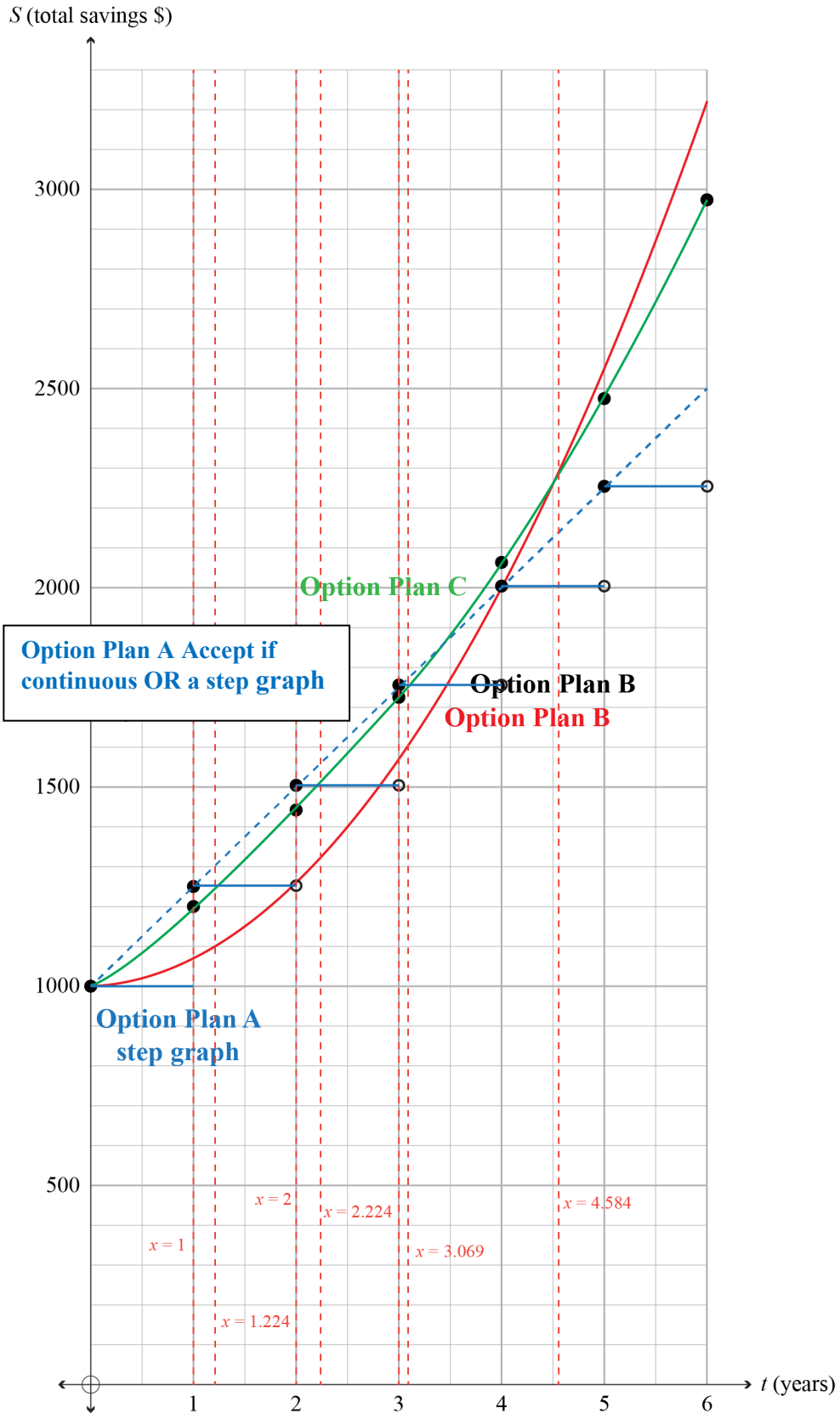
(ii)	Graph drawn for Savings Plan A.	• Continuous graph drawn of $y = 250x + 1000$		**E7/T1** Savings Plan A drawn as a continuous graph OR a correct step-graph AND Equation for savings plan C AND Savings Plan B drawn accurately. AND At least two valid comparisons made before and after the intercept point of $t = 4.6$ years. **E8 / T2** As for E7 AND At least three valid comparisons of the options made both before and after the intercept point of $t = 4.6$ years.
	Graph drawn for Savings Plan B Parabola continuous graph.	• Parabola graph drawn, showing (0,1000) and at least THREE other values drawn, but lacking accuracy.	• Parabola graph drawn correctly	
(iii)	Table of values for Savings Plan A and Savings Plan B produced. Valid comparisons made between the various Option Plans, including the evidence of dates, at least. Examples of possible comparison comments are: • Generally, Savings Plan C will be the best if $t < 4.6$ years (approximately). • Generally, Savings Plan B will be the best if $t > 4.6$ years (approximately). • As the years increase, so Savings Plan B will become better and better compared to the other savings plans. • Occasionally, but for only short time periods, Savings Plan A is the best, just after 1 year and just after 2 years. • Savings Plan A is generally the weakest choice. Other non-trivial valid comparisons acceptable.	• Table for Savings Plan A OR Savings Plan B correct AND ONE valid, non-trivial comparison made.	• Savings Plan A AND Savings Plan B correct in Table AND TWO valid non-trivial comparisons made before and after $t = 4.6$ years. (Can use whole number of years)	

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	ONE question attempted towards solution.	1u	2u	3u	2r	3r	1t	2t

Question Three (a)(ii)



Question Three (b)(ii)



Question Three (b)(iii)

End of Year (t)	Total Savings Option Plan A	Total Savings Option Plan B	Total Savings Option Plan C
0	1000	1000	1000
1	1250	1070	1200
2	1500	1260	1440
3	1750	1570	1728
4	2000	2000	2073.60
5	2250	2550	2488.32
6	2500	3220	2985.98

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 13	14 – 18	19 – 24