NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2, 2003

Mathematics: Sketch and interpret non-linear graphs (90285)

National Statistics

Assessment Report

Assessment Schedule

Mathematics: Sketch and interpret non-linear graphs (90285)

National Statistics

Number of Results	Percentage achieved			
	Not Achieved	Achieved	Merit	Excellence
20,545	41.1%	42.7%	15.3%	0.9%

Assessment Report

Every candidate for a National Certificate of Educational Achievement examination paper is expected to:

- read the question and do what the question asks
- allow adequate time to complete answers
- be accurate: check and/or proofread
- use appropriate technical terms
- bring the correct equipment
- write and/or draw clearly
- use pen if work is to be eligible for reconsideration.

General Comments

1. Candidates were often more successful at interpreting the features of the graphs as required at merit level than they were at identifying relevant features as required at achievement level. This suggests that candidates require more practice at using specific mathematical language to identify different features of non-linear graphs.

2. Numerous candidates drew straight-line graphs.

Specific Comments

1. Sketching and Plotting Graphs

Most candidates were successful in their attempts to sketch the quadratic graph. The hyperbola and exponential graphs were done less well, often with no graph for the negative x values and no indication that the candidate realised that there were asymptotes involved in these two graphs.

Almost all candidates were able to plot the exponential graph. The circle caused more difficulties because candidates were unable to correctly identify its centre. Few candidates had a good understanding of the translated hyperbola and were therefore unable to locate its asymptotes and intercepts.

2. Identifying and Interpreting Features

The candidates who did well at this aspect of achievement level had been prepared to use specific mathematical language to describe the features. Such candidates could state the period, amplitude and some of the axis intercepts of the trigonometric graph. Many candidates did not identify three different features and gave responses such as the maximum is 3 and the minimum is –3, which were classified as the same feature being referred to twice.

The candidates who interpreted the features well at merit level had been taught to focus on the features of the graph involved, and were specific about the features of the graph when responding to the contextual questions. These candidates knew that any questions about a hyperbola involving its features would be related to the y-intercept and the asymptote.

3. Writing Equations of Graphs

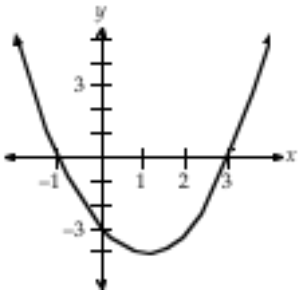
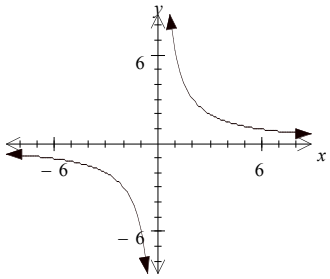
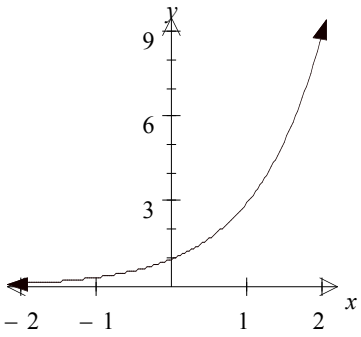
This part of the assessment was done extremely well.

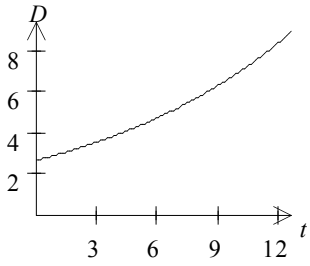
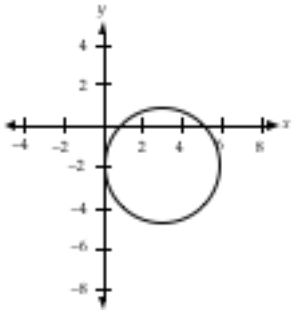
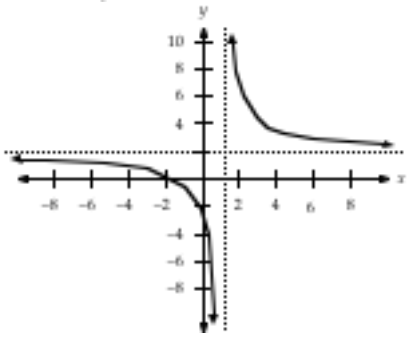
4. Determining and Applying a Graphical Model

It seemed that few candidates were adequately prepared to demonstrate these skills. The few who attempted the excellence question were usually successful if they had first achieved merit and could also work successfully with time calculations. Those candidates who were able to successfully determine the model often missed excellence because they failed to successfully apply the model to solve the problem.

Assessment Schedule – 2003

Mathematics: Sketch and interpret non-linear graphs (90285)

	Achievement criteria	No.	Evidence	Code	Judgement	Sufficiency
Achievement	Sketch non-linear graphs from equations and identify relevant features of graphs.	One (a)		**A1**	Correct shape and smoothly drawn through (3, 0) (–1, 0) (1, –4) (0, –3).	**Achievement:** **two** of Code **A1** and **two** of Code **A2.** **No repeated skills.**
		(b)		**A1**	Correct shape and smoothly drawn with two branches. 2 correct points on each branch. Curve should tend towards asymptotes but must not turn away from asymptotes.	Accept graphs where the axes are not labelled but unitary scale applied.
		(c)		**A1**	Correct shape and smoothly drawn through (0, 1) and (1, 3) Graph must extend from at least $x = -2$ to $x = 1$.	
		Two	Any correct features such as: • the amplitude is 3 • the period is 360° • the y-intercept is (0°, 3) **or** the x-intercepts are: (90°, 0), (270°, 0) etc • the maximum value of the function is 3 **or** the minimum value of the function is –3. The function has line symmetry, eg through the y-axis, **or** has point symmetry, eg about (90°, 0).	**A2** **A2** **A2** **A2** **A2**	Accept any two correct x-intercepts. Accept any equivalent wording that implies the feature.	

	Achievement Criteria	No.	Evidence	Code	Judgement	Sufficiency
Achievement with Merit	Plot graphs of equations and interpret their features.	Three	 <table><tr><th>t</th><th>D</th></tr><tr><td>0</td><td>2.7</td></tr><tr><td>3</td><td>3.6</td></tr><tr><td>6</td><td>4.8</td></tr><tr><td>9</td><td>6.4</td></tr><tr><td>12</td><td>8.5</td></tr></table>	**A1 M1**	Smooth increasing curve from $t = 0$ to $t = 12$ with correct D-intercept through at least 3 correct points.	**ACHIEVEMENT WITH MERIT: Achievement** **plus** **two** of Code **M1** **and** **two** of Code **M2** **and** **two** of Code **M3** **OR** **nine** of Code **M.**
		Four (a)		**A1 M1**	Circle, centre (3, –2) radius = 3 passing through 3 correct points, such as (0, –2), (3, 1), (6, –2) and (3, –5)	
		(b)		**A1 M1**	Need: Four (b): <table><tr><th>x</th><th>y</th></tr><tr><td>–10</td><td>1.5</td></tr><tr><td>–9</td><td>1.5</td></tr><tr><td>–8</td><td>1.4</td></tr><tr><td>–7</td><td>1.4</td></tr><tr><td>–6</td><td>1.3</td></tr><tr><td>–5</td><td>1.2</td></tr><tr><td>4</td><td>1.0</td></tr><tr><td>–3</td><td>0.8</td></tr><tr><td>–2</td><td>0.3</td></tr><tr><td>–</td><td>-0.5</td></tr><tr><td>0</td><td>-3.0</td></tr><tr><td>1</td><td>∞</td></tr><tr><td>2</td><td>7.0</td></tr><tr><td>3</td><td>4.5</td></tr><tr><td>4</td><td>3.7</td></tr><tr><td>5</td><td>3.3</td></tr><tr><td>6</td><td>3.0</td></tr><tr><td>7</td><td>2.8</td></tr><tr><td>8</td><td>2.7</td></tr><tr><td>9</td><td>2.6</td></tr><tr><td>10</td><td>2.6</td></tr></table>	
		Five (a)	Rate is decreasing: eg aid money came in quickly during the first week and then very gradually over the next 4 weeks	**A2 M2**		
		(b)	the total continued to grow gradually towards 80 million euros	**A2 M2**		
		(c)	the government already had 10 million euros available for aid before the flood.	**A2 M2**		
	Write equations of graphs.	Six (a)	$y = (x + 3)(x + 1)(x – 1)$	**M3**	* 2 correct axis intercepts (0, –3) and (–1.5, 0). * asymptotes $x = 1$ and $y = 2$ [can be implied by shape of the graph]. Or equivalent.	
		(b)	$x^2 + y^2 = 16$	**M3**		
		(c)	$y = \sin x + 2$	**M3**		

	Achievement Criteria	No.	Evidence	Code	Judgement	Sufficiency
Achievement with Excellence	Determine and apply an appropriate graphical model for a situation.	Seven (a)	$a = 8.5(12 - b)$ $a = 3.9(84 - b)$ $102 - 8.5b = 327.6 - 3.9b$ $b = -49.04$ $a = 518.87$ $D = \frac{519}{t + 49}$	**M3 E**	Or equivalent.	**Achievement with Excellence**: **merit plus** **two** of Code **E.**
		(b)	$t = 143$ hours (143.2) 5 days, 23.2 hours so 5 pm (5.13 pm) on 19 August	**E**	Need time and date. Allow one minor error.	

Additional Notes

The high number of blank scripts and the low standard of some of the scripts would seem to indicate that some candidates are studying inappropriate courses.

There is little support material provided in the usual Year 12 Mathematics textbooks for teachers wanting to prepare their students for some of the important aspects of this standard, most notably the identification and interpretation of features, and the determining and application of a model as required for excellence.

Judgement Statement

Judgement statements (formerly referred to as sufficiency statements) help students understand how their overall results for each standard were arrived at.

Achievement	Achievement with Merit	Achievement with Excellence
Sketch non-linear graphs from equations **(A1)** *and identify relevant features of graphs* **(A2)**	*Plot graphs of equations* **(M1)** *and interpret their features* **(M2)** *Write equations of graphs* **(M3)**	*Determine and apply an appropriate graphical model for a situation* **(E)**
2 × **A1** ***and*** 2 × **A2**	Achievement ***plus*** 2 × **M1** ***and*** 2 × **M2** ***and*** 2 × **M3** ***or*** 3 × **M1,** 3 × **M2 and** 3 × **M3**	Merit ***plus*** 2 × **E**

Note: Insufficient evidence to support a judgement above **(X)**