



**Free-Standing Mathematics Qualifications
June 2010**

**Working with Algebraic and
Graphical Techniques**

6991/2

Advanced Level

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Key to mark scheme and abbreviations used in marking

M	mark is for method		
m or dM	mark is dependent on one or more M marks and is for method		
A	mark is dependent on M or m marks and is for accuracy		
B	mark is independent of M or m marks and is for method and accuracy		
E	mark is for explanation		
\surd or ft or F	follow through from previous incorrect result	MC	mis-copy
CAO	correct answer only	MR	mis-read
CSO	correct solution only	RA	required accuracy
AWFW	anything which falls within	FW	further work
AWRT	anything which rounds to	ISW	ignore subsequent work
ACF	any correct form	FIW	from incorrect work
AG	answer given	BOD	given benefit of doubt
SC	special case	WR	work replaced by candidate
OE	or equivalent	FB	formulae book
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme
-x EE	deduct x marks for each error	G	graph
NMS	no method shown	c	candidate
PI	possibly implied	sf	significant figure(s)
SCA	substantially correct approach	dp	decimal place(s)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

Free-Standing Mathematics Qualification**Advanced Level – Working with Algebraic and Graphical Techniques (6991/2)****Answers and Marking Scheme – June 2010****Question 1**

(a)	Gives negative, less than 0	B1	oe. B0 for unrealistic B0 for goes past 0
(b)	7 correct values eg (0,0) (5, 625) (10, 1000) (15, 1125) (20, 1000) (25, 625) (30,0) with 3 values <15 and 3 values >15 6 correct plots smooth correct curve through their 6 correct points to $\frac{1}{2}$ square accuracy	B2 B1ft B1	B1 for 5 correct with 2 values <15 and 2 values >15 Can be inferred from graph No double lines, no thick lines, no kinks, max at 15
(c)(i)	1125	B1	
(c)(ii)	15	B1	
(d)	$q = 15$ or $(x - 15)^2$ seen $p = 5q^2$ $p = 1125$	B1 M1 A1	Can score (d) in (e) $1125 - 5(x+15)^2$ gets 3/3
(e)	$q =$ value of x , price $p =$ income	B1 B1	oe Can score (e) in (d) oe max. value of I/y B0 for pounds
(f)	set up 3 term quadratic with $c = \pm 800$ $\frac{30 \pm \sqrt{(900 - 640)}}{2}, \frac{150 \pm \sqrt{(150^2 - 4 \times 5 \times 800)}}{10}$ 23.1, 6.94	M1 M1 A1	$150x - 5x^2 = 800$ $(x - 15)^2 = (1125 - 800) \div 5$ allow arithmetic errors SC1 one answer to 3sf with no working
	TOTAL	15	

Question 2

(a)(i)	289 or 290, 359, 385	B2	B1 for 2 correct
(a)(ii)	5 correct plots to $\frac{1}{2}$ square accuracy smooth correct curve through their 5 correct points to $\frac{1}{2}$ square accuracy	B2 B1	B1 for 4 correct No double lines, no thick lines, no kinks
(b)	$2 = 300e^{-0.1t}$ 50.(1)	M1 A1	Allow embedded answer $400 - 300e^{-0.1 \times 50} = 398$
(c)	375 $\frac{\text{'their' } 375 - 360}{360} \times 100$ 4.3	B1 M1 A1	375.37 or reversed 4.2 allow -ve
(d)	400	B1	
	TOTAL	11	

Question 3

(a)	$100 = a$ $395 = a + b\sqrt{40}$ $\frac{395 - \text{'their' } a}{\sqrt{40}}$ $46.6 = b$	B1 M1 M1 A1	B0 for $100 = a + b\sqrt{0}$ $395 = a + b6.32$ $\pm(395 - 100) \div \sqrt{40}$ 46.64
(b)	$a + b\sqrt{30}$ 355	M1 A1	'their' a + b must see values 355.457
(c)	N gets large (when t gets large)	B1	oe
	TOTAL	7	

Question 4

(a)	7 values eg (0, 0) (10, 139) (20, 264 or 265) (30, 364) (40, 428) (50, 450) (60, 428) 6 correct plots smooth correct curve through points to $\frac{1}{2}$ square accuracy	B2 B1 B1	B1 for 4 correct values can be inferred from graph No double lines, no thick lines, no kinks
(b)(i)	450	B1	
(b)(ii)	2000	B1	allow $t = 50$
(c)	2050	B2	B1 for $t = 100$, B1 for 1950
(d)	Stretch, y or R axis (scale) factor 450 Stretch, x or t axis (scale) factor 50 Stretch, x or t axis (scale) factor $\frac{1}{90}$	B1 B1 B1	y stretch by 450 B0 stretch upwards by 450 x stretch by 50 B2 for x or t axis stretch B2 for x or t axis stretch (factor) or (by) $\frac{50}{90}$
	TOTAL	11	

Question 5

(a)	$\ln N = \ln k + \ln(t^c)$	B1	
(b)	$\ln t$: 0, 1.79, 2.77, 3.26, 3.43 $\ln N$: 7.07 or 7.08, 5.63, 4.79, 4.39, 4.28	B1 B1	SC1 for 7 correct out of 10 SC1 for all correct but >3sf
(c)	6 correct plots to $\frac{1}{2}$ square accuracy Line of best fit, at least 8cm long	B1 B1ft	No double lines, no thick lines, no kinks
(d)	$\ln k = 7.07$ to 7.08 $c =$ gradient and vertical values \div horizontal values $\ln N =$ their $\ln k +$ their $c \times \ln t$	B1 M1 A1ft	Allow 7.1 Allow +ve answer c negative and in range -0.7 to -0.9 SC2 for eg $y = -0.8x + 7.07$
(e)	$N = 1182 t^c$ $c = -0.7$ to -0.9	M1 A1	Any value for c
(f)(i)	Model predicts decreasing values between 1935 and 1955	B1	oe Real data has a turning point where model doesn't B1 t would be negative, cannot do (negative) ^c , need sine or cosine model (rather than exponential) B0 values of N are too high, t would be negative and so N will be 0
(f)(ii)	Real data increases	B1	oe Model decreases B0 model is linear but admissions are increasing
(g)(i)	Tangent drawn and vertical values \div horizontal values 100 to 150	M1 A1	
(g)(ii)	Millions per year	B1	oe B0 for cinema admissions per year
(g)(iii)	How much cinema admissions are increasing by each year	B1	oe Rate of change of cinema admissions
	TOTAL	16	
	TOTAL MARK FOR PAPER	60	