



**Free-Standing Mathematics Qualification
June 2011**

Mathematics Advanced Level 6991

(Specification 6991)

**Working with Algebraic and Graphical
Techniques**

Mark Scheme

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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		
✓ 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	OE	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)

Application of Mark Scheme

No method shown:

Correct answer without working

mark as in scheme

Incorrect answer without working

zero marks unless specified otherwise

More than one method / choice of solution:

2 or more complete attempts, neither/none crossed out

mark both/all fully and award the mean mark rounded down

1 complete and 1 partial attempt, neither crossed out

award credit for the complete solution only

Crossed out work

do not mark unless it has not been replaced

Alternative solution using a correct or partially correct method

award method and accuracy marks as appropriate

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Advanced Level – Working with Algebraic and Graphical Techniques (6991/2)

Answers and Marking Scheme – June 2011

Question 1

(a)	133, 123, 87, 24, 0 or eg 132.7, 123.3, 87.1, 24.1, 0 132.6997, 123.3169, 87.13, 24.13, 0	B2	penalise truncation values to nearest integer B1 for 3 correct
(b)	5 plots on ft to $\frac{1}{2}$ sq accuracy smooth correct curve through points to $\frac{1}{2}$ sq accuracy	B1ft B1	 no double lines no thick lines
(c)(i)	75 to 80 233 to 239	B1 B1	
(c)(ii)	Tangent drawn at $x = 60$ 0.85 to 1.2	M1 A1	must see a tangent
(d)	7 to nearest integer	B1	answer need not be an integer
(e)	$A = 133$ to nearest integer some attempt at completing the square or use of a valid method to get B $B = 157.5$ or 158	B1 M1 A1	 just stating the value of B gets 2 marks
(f)	$A =$ maximum height or maximum y -value $B =$ value of x at maximum height or maximum y -value	B1 B1	OE OE middle x -value
	TOTAL	14	

Question 2

(a)	1, 27, 125, 343, 729, 1331	B2	B1 for 4 correct
(b)	6 correct plots to $\frac{1}{2}$ sq accuracy on ft valid line of best fit through their points	B2ft B1ft	B1 for 4 correct on ft
(c)	$c = \text{gradient}$ and vertical values \div horizontal values $c = 1.95$ to 2.25 $d = 820$ to 850	M1 A1 B1	set up simultaneous equations
(d)(i)	read off from graph at 512 to $\frac{1}{2}$ sq accuracy $y = 1860$ or ft	M1 A1ft	sub $t = 8$ in their equation
(d)(ii)	$5000 = \text{their equation for } ct^3 + d$ $t = 12.7$ 2009 or 2010	M1 A1 A1ft	trial and improvement scores 3 or 0 1997 + their integer t value
	TOTAL	13	

Question 3

(a)	8.16 or 8.2, 11.8, 15.5, 18.2, 19.8 or eg 8.1605, 11.8056, 15.52, 18.246, 19.807	B2	values to at least 1 dp B1 for 4 correct
(b)	5 correct plots to $\frac{1}{2}$ sq accuracy on ft valid line of best fit through their points	B2ft B1ft	B1 for 3 correct on ft
(c)	$\ln S = \ln k + t \ln a$ $\ln k = 8.1$ to 8.6 $\ln a = 0.3$ to 0.35	M1 A1 A1	SC2 for $y =$ $(0.3 \text{ to } 0.35)x + (8.1 \text{ to } 8.6)$ SC1 for one term correct in $y = mx + c$
(d)	$a = 1.35$ to 1.42 $k = 3294$ to 5432	B1ft B1ft	B2 for eg $S = e^{0.33t+8.2}$ B2 for eg $S = 3500e^{0.33t}$
	TOTAL	10	

Question 4

(a)(i)	3500×2^5 112 000	M1 A1	SC1 for 3 584 000 or SC1 for digits 112
(a)(ii)	$(134\,000 - \text{their } 112\,000) \div 134\,000 \times 100$ 16.4 or ft	M1 A1ft	accept – 16.4
(b)	intercept on positive S axis correct curvature with no turning point	B1 B1	
	TOTAL	6	

Question 5

(a)	36.15	B1	
(b)	$15h + 30 = 90$ 4 or 4am	M1 A1	
(c)	37.45	B1	
(d)	$15h + 30 = 270$ 16 or 4pm	M1 A1	
(e)	$15h + 30 = 0$ or 180 or 360 10 or 10am 22 or 10pm	M1 A1 A1	
(f)(i)	0.65	B1	
(f)(ii)	24, 24 hours	B1	1 day
(g)	translation along h or t or x axis of -30	B1	translation $\begin{pmatrix} -30 \\ 0 \end{pmatrix}$ translate 30 left on x axis
(h)	1 way stretch along T or y axis of scale factor 0.65 translation along T or y axis of 36.8	B1 B1	OE vertical stretch scale factor 0.65 translation $\begin{pmatrix} 0 \\ 36.8 \end{pmatrix}$ translate up 36.8 ignore order of answers
	TOTAL	14	

Question 6

	curve through (8, 0) and (16, 12) and any two of (10,4) (14,8) (16,12) to 2 mm accuracy correct curvature at (8,0) and (16,12)	B2 B1	B1 through 2 of these ignore extra curves
	TOTAL	3	
	TOTAL MARK FOR PAPER	60	