

Version



**Free-Standing Mathematics Qualification  
June 2012**

**Mathematics Advanced Level                      6991**

**(Specification 6991)**

**Working with Algebraic and Graphical  
Techniques**

**Final**

***Mark Scheme***

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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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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## Key to mark scheme abbreviations

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
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
-x EE	deduct x marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
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.

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 2012**

<b>Q</b>	<b>Solution</b>	<b>Marks</b>	<b>Total</b>	<b>Comments</b>
1(a)	26.6 or 26.7, 30, 26.6 or 26.7 16.6 or 16.7, 0	B2	2	or better accuracy B1 for 3 correct
(b)	7 plots on ft smooth curve through points to ½ square accuracy	B1ft B1ft	2	No double lines, ruled sections, sharp kinks
(c)	16.5 (15) 163.48	B1 B1	2	15 to 18 162 to 165
(d)(i)	$b = 90$ completing the square $a = b^2$ or $a = 8100$	B1 M1 A1ft	3	
(ii)	$a = 270 \times$ distance of string from bow in the centre $b =$ distance to centre of bow from one end	B1 B1	2	oe oe
(e)	$y = x(110 - x)$ must see 'y =' $\div 151.25$	B1 B1	2	$y = 55^2 - (55 - x)^2$ $y = \frac{55^2 - (55 - x)^2}{151.25}$
<b>Total</b>			<b>13</b>	

Q	Solution	Marks	Total	Comments
2				
(a)(i)	2.05, 1.62, 1.19, 0.76, 0.32	B2	2	Work to 2dp or 3sf or better B1 for 4 correct B1 for all correct but rounded to 2sf
(ii)	6 correct plots to $\frac{1}{2}$ square accuracy on ft valid line of best fit through their points	B2ft B1ft	3	B1 for 4 correct on ft not freehand
(iii)	$C = 12$ $k =$ (negative) gradient and vertical $\div$ horizontal seen	B1 M1		use their $C$ to set up correct equation for $k$ on ft
	$k = 0.082$ to $0.090$	A1	3	
(b)(i)	$12 \times 2^{\left(\frac{-3}{8}\right)}$ 9.25 (grams) or better	M1 A1	2	sub $t = 3$ in 9.3, 9.25326
(ii)	$5 = 12 \times 2^{\left(\frac{-t}{8}\right)}$ $\ln\left(\frac{5}{12}\right) = \left(\frac{-t}{8}\right) \ln 2$ 10.1 (days), 10 days 2 or 3 hours	M1 M1 A1	3	oe Allow 10 with working
	<b>Total</b>		<b>13</b>	

Q	Solution	Marks	Total	Comments
3(a)	410 (tonnes)	B1	1	
(b)	$30t + 150 = 360$ July	M1 A1	2	$t = 7$
(c)	80 (tonnes)	B1	1	
(d)	$30t + 150 = 180$ January	M1 A1	2	$t = 1$
(e)	$245 + 165 \cos(30t + 150) = 300$ 4.65 and 9.35 April or May September	M1 A1 A1 A1	4	No working answer April or May scores B2 No working answer September scores B2 penalise – 1 for each error or omission
(f)(i)	165	B1	1	Not 165 tonnes
(ii)	12	B1	1	not 1 year, not 12 months
(g)	387.9 or 388 or 387.89 or 387.8 (their $388 - 400 \div 400(\times 100)$ ) 3	M1 M1 A1	3	Or $t = 6$ in formula 3 to 3.03 allow –ve
(h)	stretch along $A$ or $y$ axis scale factor 165 (then) translation $\begin{pmatrix} 0 \\ 245 \end{pmatrix}$	B1 B1	2	vertical stretch scale factor 165 translation along (or up) $A$ or $y$ axis of 245 both correct but wrong way round B1
(i)	stretch along $t$ or $x$ axis scale factor $1/30$ (then) translation $\begin{pmatrix} -150 \\ 0 \end{pmatrix}$ <b>OR</b> translation $\begin{pmatrix} -5 \\ 0 \end{pmatrix}$ (then) stretch along $t$ or $x$ axis scale factor $1/30$	B1 B1 (B1) (B1)	2	translation along $t$ or $x$ axis of – 150 both correct but wrong way round B1 translation along $t$ or $x$ axis of – 5 (then) both correct but wrong way round (B1)
	<b>Total</b>		<b>19</b>	

Q	Solution	Marks	Total	Comments
4(a)	$20 = k \div 220^2$ 968000	M1 A1	2	
(b)	Tangent drawn at $v = 100$ and vertical/horizontal - 1.7 to - 2.1	M1 A1	2	
(c)	$\text{nsm}^{-1}$ or $\text{n/ms}^{-1}$ oe	B1	1	oe (thousand) newtons per metre per sec not newtons $\div$ $\text{ms}^{-1}$
<b>Total</b>			<b>5</b>	
5(a)	(0, 0) plotted to $\frac{1}{2}$ square accuracy (160, 6.4) plotted to $\frac{1}{2}$ square accuracy Correct curvature	B1 B1 B1	3	no double lines
(b)	(20, 25) plotted to $\frac{1}{2}$ square accuracy (160, 0.39) plotted to $\frac{1}{2}$ square accuracy Correct curvature	B1 B1 B1	3	B0 if curve goes back to (0, 0) no double lines, no turning back on itself
(c)(i)	75 to 85	B2	2	70 to 90 gets B1 B1 for setting up equation $v^2 / 4000 = 10000 / v^2$
(ii)	$P = 0.0004 \times 200^2$ $D = 640000 \div v^2$	B1 B1	2	16
<b>Total</b>			<b>10</b>	
<b>TOTAL</b>			<b>60</b>	