

FSMQ

MATHEMATICS

6991/2 – Working with Algebraic and Graphical Techniques
Mark scheme

6991
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Version/Stage: v1.0 Final

Mark schemes are prepared by the Lead Assessment Writer 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 associates 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 associate understands and applies it in the same correct way. As preparation for standardisation each associate 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, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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.

Further copies of this Mark Scheme are available from aqa.org.uk

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.

Question	Solution	Marks	Total	Comments
1(a)	$m = 80$ $80 - n(2^2) = 60$ $n = 5$	B1 M1 A1	3	M1 for attempt to show $n = 5$
(b)	79.2, 76.8, 72.8, 67.2 3 correct	B1		allow to nearest integer
	correct all	B1	2	
(c)	4 points correct [from their table] all points correct [from their table] smooth curve through their points	B1 B1 B1	3	1 square straight line B0
(d)(i)	tangent drawn and attempt to find gradient gradient = -10	M1 A1		allow $[-12, -8]$
(ii)	metres per second or m/s or ms^{-1}	B1		
(iii)	she is descending/falling at 10 m/s (after 1 second)	E1	4	allow "speed of descent/falling" or similar, but not "average speed"
(e)	$5 = 80 - 5t^2$ $5t^2 = 75$ $t^2 = 15$ $t = \sqrt{15}$ or 3.87 or 3.9 (seconds)	M1ft M1 ft A1 cao	3	
	Total		15	

Question	Solution	Marks	Total	Comments
2(a)	32.1	B1	1	
(b)	10	B1	1	
(c)	$\frac{360}{42.9}$ = 8.39	M1 A1	2	or 8.4
(d)	10.1, 20.5, 42.4 correct	2 B1		
	all correct	B1	2	
(e)	5 points correct [from their table] all points correct [from their table] smooth curve through points	B1 B1 B1	3	1 square
(f)	$37.1 - 40 = -2.9$ $-\frac{2.9}{40} \times 100$ = -7.25(%)	M1 M1 ft A1	3	allow 2.9; allow [39.7, 40] allow 7.25
	Total		12	

Question	Solution	Marks	Total	Comments
3(a)(i)	$y_{\max} = 64.1$	B1		
(ii)	$t = 8.7$	B1	2	
(b)	$y = 64.1 - 5(t - 8.7)^2$ $y = 64.1 - 5(t^2 - 17.4t + 75.69)$ $y = -5t^2 + 87t - 314.35$	M1 M1 A1	3	for squaring correctly For expanding correctly allow 314 or 314.4
(c)	1 st method: $62 = -5t^2 + 87t - 314.35$ $5t^2 - 87t + 376.35 = 0$ $t = \frac{87 \pm \sqrt{42}}{10}$ $t = 9.35$ or 8.05	M1ft M1ft A1	3	2 nd method: $62 = 64.1 - 5(t - 8.7)^2$ $5(t - 8.7)^2 = 2.1$ M1 $t - 8.7 = \pm\sqrt{0.42}$ $t = 8.7 \pm \sqrt{0.42}$ M1 $t = 9.35$ or 8.05 A1 M2A1 if both answers seen correct to 3 s.f.
	Total		8	

Question	Solution	Marks	Total	Comments
4(a)	$y = Ak^T$ $\log_{10} y = \log_{10} A + \log_{10} (k^T)$ $\log_{10} y = \log_{10} A + T \log_{10} k$	B1	1	
(b)	2.78, 2.58, 2.30, 2.08 3 correct all correct	B1 B1	2	
(c)	6 correct all correct line of best fit	B1 B1 B1	3	1 square
(d)	$\log_{10} A = \text{intercept} = 3.6$ $A = 4000$ $\log_{10} k = \text{gradient} = -\frac{1.15}{50} = -0.023$ $k = 10^{-0.023} = 0.95$ $y = 4000(0.95^T)$	M1 A1 M1 A1	4	allow [3.5, 3.7] allow [3160, 5012] allow [-0.025, -0.02] allow [0.94, 0.96]
(e)	$1000 = 4000(0.95^T)$ $0.95^T = 0.25$ $T \log_{10} 0.95 = \log_{10} 0.25$ $T = 27$	M1ft M1ft A1ft	3	If $k > 0$ and $A > 0$
(f)	$y = 4000(0.95^{80})$ $= 66$ $\text{RPM} = 66 + 2000 = 2066$	M1ft A1ft	2	If $k > 0$ and $A > 0$ or 2070 2000 + 0: A0
Total			15	

Question	Solution	Marks	Total	Comments
5(a)	$2 \times 0.4^{\frac{1}{2}} = 1.26$ (seconds)	B1	1	
(b)	$l^{\frac{1}{2}} = \frac{T}{2}$ $l = \left(\frac{T}{2}\right)^2$ or $l = \frac{T^2}{4}$	M1 A1	2	$T^2 = 4l$ M1 Not $\frac{\frac{1}{2}\sqrt{T}}{\sqrt{2}}$
(c)	$2 = 2l^{\frac{1}{2}}$ $l = 1$ (metre)	B1	1	
(d)	graph has correct curvature through the origin	B1 B1	2	
(e)(i)	$4.4 = k(0.8^{\frac{1}{2}})$ $k = 4.92$ $T = 4.92l^{\frac{1}{2}}$	M1 A1	2	allow 4.9
(e)(ii)	$2 = 4.92l^{\frac{1}{2}}$ $l = \left(\frac{2}{4.92}\right)^2 = 0.165$ (m)	M1 A1 cao	2	allow ft from (e)(i) allow [0.16, 0.17]
	Total		10	
	TOTAL		60	