Version 1.0 0611

General Certificate of Education
June 2011

AS Level Use of Mathematics UOM4/2

Applying Mathematics

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 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 candidates' 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 candidates' 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.

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.

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

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX.

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

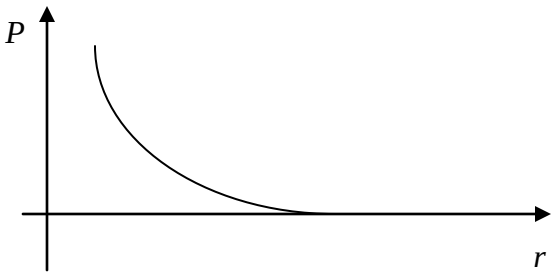
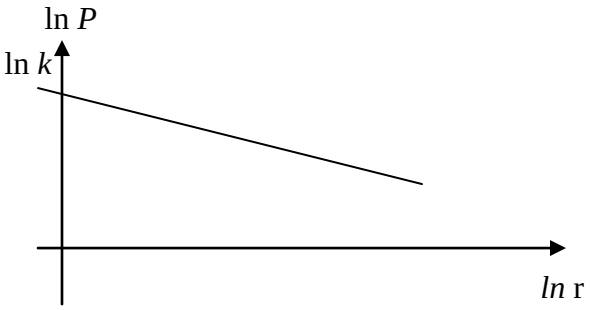
No method shown:	
Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise
More than one method / choice of solution:	
2 or more complete attempts, neither/none crossed out	mark both/all fully and award the mean mark rounded down
1 complete 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

General Certificate of Education
AS Level – Applying Mathematics UOM 4/2
Answers and Marking Scheme – June 2011

Question 1

(a)	$d^2 = 24^2 + \left(\frac{16}{9}\times 24\right)^2$ $d^2 = 2396$ $d = \sqrt{2396} = 48.95 = 49$	 **M1** **A1**	
(b)	$32^2 = h^2 + \left(\frac{16}{9}h\right)^2$ $1024 = h^2 + 3.16h^2$ $h^2 = \frac{1024}{4.16} = 246$ $h = 15.7$ $w = \frac{16}{9}h = \frac{16}{9}\times 15.7 = 27.9$	**M1** **M1** **A1** **A1**	Alternative $15.7^2 + \left(\frac{16}{9}\times 15.7\right)^2$ M1 A1 Or $15.7^2 + 27.9 = 1025$ $h = \sqrt{1025}$, = 32 M1 A1
(c)	$x = 3\times 15.7$ inches = 47.1 inches	**B1**	ft from any mistake in (b)
(d)	$32^2 = h^2 + \left(\frac{4}{3}h\right)^2$ $32^2 = h^2 + \frac{16}{9}h^2 = \frac{25}{9}h^2$ $h = \sqrt{\frac{32^2\times 9}{25}} = 19.2$ $19.2\times 6 = 115.2$ inches	**M1** **M1** **A1** **A1 ft**	 (their $h \times 6$)
(e)	$x = 6h$ $h^2 + \frac{16}{9}h^2 = \frac{25}{9}h^2 = d^2$ $h = \sqrt{\frac{9}{25}}d \quad \left(=\frac{3}{5}d\right)$ $x = 6\times\sqrt{\frac{9}{25}}d = \frac{18}{5}d = 3.6d$	 **M1** **A1** **M1** **A1**	
	TOTAL	**15**	

Question 2

<table>
<tr><td>(a)</td><td> 
</td><td>B1
B1</td><td>General Shape
No intercept with axes</td></tr>
<tr><td>(b)(i)</td><td>$P = \frac{k}{r^n} = kr^{-n}$
$\ln P = \ln\ kr^{-n}$
$\ln P = \ln k + \ln r^{-n}$
$\ln P = \ln k - n \ln r$</td><td>
M1
M1
A1</td><td></td></tr>
<tr><td>(b)(ii)</td><td> 
</td><td>B1
B1</td><td>Straight line with negative gradient
Intercept on vertical axis</td></tr>
<tr><td>(c)(i)</td><td>
<table>
<tr><th></th><th>rank, r</th><th>population, P</th><th>lnr</th><th>lnP</th></tr>
<tr><td>Antwerp</td><td>1</td><td>470 000</td><td>0.000</td><td>13.060</td></tr>
<tr><td>Ghent</td><td>2</td><td>231 000</td><td>0.693</td><td>12.350</td></tr>
<tr><td>Charleroi</td><td>3</td><td>207 000</td><td>1.099</td><td>12.240</td></tr>
<tr><td>Liège</td><td>4</td><td>197 000</td><td>1.386</td><td>12.191</td></tr>
<tr><td>Brussels</td><td>5</td><td>136 000</td><td>1.609</td><td>11.820</td></tr>
<tr><td>Brugge</td><td>6</td><td>117 000</td><td>1.792</td><td>11.670</td></tr>
<tr><td>Namur</td><td>7</td><td>104 000</td><td>1.946</td><td>11.552</td></tr>
<tr><td>Mons</td><td>8</td><td>92 000</td><td>2.079</td><td>11.430</td></tr>
<tr><td>La Louvière</td><td>9</td><td>76 000</td><td>2.197</td><td>11.238</td></tr>
<tr><td>Kortrijk</td><td>10</td><td>75 000</td><td>2.303</td><td>11.225</td></tr>
</table>
</td><td>B1

B1

B1
B1</td><td>B1 for each row

Allow 11.429

Allow 2.302
Allow SC2 for one column completely correct with other incorrect</td></tr>
</table>

Question 2 (conitnued)

(c)(ii)	Two points plotted correctly Two points plotted correctly	**B1** **B1**	
(c)(iii)	Intercept = ln k = 13.05 So k = 465000 Gradient = $n = -0.78$ $P = \frac{465000}{r^{0.78}}$	**M1** **A1ft** **M1A1** **B1ft**	
	TOTAL	**18**	

Question 3

(a)	$d = 1.4 - 0.7\sin 25°$ d = 1.10	**M1** **A1**	
(b)(i)	2.1 metres	**B1**	
(b)(ii)	0.7 metres	**B1**	
(b)(iii)	1.4 metres	**B1**	
(c)	$\frac{360}{25} = 14.4$ days	**M1 A1**	
(d)	wave generally correct maxima and minima values of d indicated indication of correct period	**B1** **B1** **B1**	
(e)	$1.4 - 0.7\sin 25n^\circ = 1.5$ $-0.7\sin 25n^\circ = 0.1$ $\sin 25n^\circ = \frac{-0.1}{0.7} = -0.143$ $25n = -8.21$ $25n = 180 + 8.2132$ n = 7.5 (28) 7th/8th October or 7th/8th day	**M1** **M1** **M1** **A1** **A1**	
	TOTAL	**15**	

Question 4

(a)	$\frac{2}{10} = \frac{1}{5} = 0.2$	**B1**	
	There are two randomly generated integers out of 10	**B1**	

(b)

Worker		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Won
A	Random Number	1	0	2	5	6	3	5	7	5	2	8	8	£50
	Token	R	R	R	W	W	R	W	W	W	R	Y	Y	
B	Random Number	1	4	7	5	9	8	4	8	8	3	2	6	£0
	Token	R	R	W	W	Y	Y	R	Y	Y	R	R	W	
C	Random Number	7	3	8	7	8	3	4	6	0	2	8	8	£100
	Token	W	R	Y	W	Y	R	R	W	R	R	Y	Y	
D	Random Number	8	6	1	8	8	1	7	3	7	6	9	7	£100
	Token	Y	W	R	Y	Y	R	W	R	W	W	Y	W	
E	Random Number	0	6	0	5	6	4	0	2	4	2	1	0	£0
	Token	R	W	R	W	W	R	R	R	R	R	R	R	
F	Random Number	8	9	1	0	3	1	3	8	8	8	6	9	£0
	Token	Y	Y	R	R	R	R	R	Y	Y	Y	W	Y	
G	Random Number	7	0	5	5	1	5	8	7	7	8	1	0	£100
	Token	W	R	W	W	R	W	Y	W	W	Y	R	R	
H	Random Number	6	9	5	3	7	9	1	3	7	0	5	8	£150
	Token	W	Y	W	R	W	Y	R	R	W	R	W	Y	
I	Random Number	8	8	8	8	4	8	8	7	8	0	7	2	£50
	Token	Y	Y	Y	Y	R	Y	Y	W	Y	R	W	R	
J	Random Number	2	5	5	6	4	5	8	4	7	4	2	9	£50
	Token	R	W	W	W	R	W	Y	R	W	R	R	Y	

		B1/2/3	B1 each row correct

Question 4 continued

(c)	$\frac{£600}{10} = £60$	**M1** **A1 ft**	
(d)	Adding the additional colour can block out the possibility of a run of three winning colours so that you have to start again. Reducing the probabilities of getting a "white" and "yellow" token makes it less likely to a winning run	**B1** **B1**	

Question 4 continued

(e)

Worker		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Won
A	Random Number	2	5	9	5	4	7	0	1	3	7	0	3	£0
	Token	R	R	Y	R	R	W	P	P	R	W	P	R	
B	Random Number	4	3	7	5	1	9	4	7	7	9	4	2	£100
	Token	R	R	W	R	P	Y	R	W	W	Y	R	R	
C	Random Number	4	6	2	9	1	4	6	4	0	9	2	8	£50
	Token	R	R	R	Y	P	R	R	R	P	Y	R	W	
D	Random Number	6	3	7	5	8	6	7	4	2	3	8	2	£0
	Token	R	R	W	R	W	R	W	R	R	R	W	R	
E	Random Number	0	1	1	0	3	6	0	6	4	5	1	4	£0
	Token	P	P	P	P	R	R	P	R	R	R	P	R	
F	Random Number	8	4	0	1	0	5	0	7	0	3	6	8	£0
	Token	W	R	P	P	P	R	P	W	P	R	R	W	
G	Random Number	8	9	2	2	1	3	3	9	9	5	5	2	£50
	Token	W	Y	R	R	P	R	R	Y	Y	R	R	R	
H	Random Number	3	7	3	7	7	6	3	9	6	8	5	7	£50
	Token	R	W	R	W	W	R	R	Y	R	W	R	W	
I	Random Number	3	3	4	3	5	5	1	6	9	6	9	1	£0
	Token	R	R	R	R	R	R	P	R	Y	R	Y	P	
J	Random Number	9	7	7	0	2	6	4	3	1	7	3	3	£0
	Token	Y	W	W	P	R	R	R	R	P	W	R	R	

		B1/2/3	B1 each row correct
(f)	$\frac{£250}{10} = £25$	**M1 A1ft**	

(g)	Introduce a random number to determine whether or not a worker drove to work in any given month	**B2**	Or other sensible
	TOTAL	**16**	

+ 3 marks for mathematical argument

+ 3 marks for mathematical notation

	TOTAL MARK FOR UNIT	**70**	