Cambridge Assessment

GCSE

Mathematics

Session: 2000 June
Type: Mark scheme
Code: 1662

Oxford Cambridge and RSA Examinations

OCR

RECOGNISING ACHIEVEMENT

GENERAL CERTIFICATE OF SECONDARY EDUCATION

(former Midland Examining Group syllabus) GCSE 1662

MATHEMATICS (SYLLABUS A)

MARK SCHEME FOR COMPONENTS

TAKEN IN JUNE 2000

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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1662 GCSE Mathematics Syllabus A

Grade Threshold Marks

Candidates' performances were assessed on each component. The minimum level of performance (the threshold mark) was determined for each grade. These thresholds are given below as unscaled marks (i.e. the scale of marks used by the Examiners).

The relevant component thresholds were then related to each other in accordance with the component weightings to fix the overall threshold marks for each option.

Component Threshold Marks										
Component		Max mark	A	B	C	D	E	F	G	U
	1	100				60	46	33	20	
	2	100				61	48	36	24	
	3	100		68	44	32	20			
	4	100		73	45	32	19			
	5	100	51	34	18					
	6	100	57	37	18					
Coursework	7	24	19	16	13	11	9	7	5	

Overall Threshold Marks							Option 1 + 2 + 7(Foundation)			
	Max Mark	A*	A	B	C	D	E	F	G	U
	250					156	122	89	56	
Percentage of Candidates Awarded each Grade							Total Candidature: 13741			
		A*	A	B	C	D	E	F	G	U
Percentage in Grade						13.6	36.1	33.2	14.7	
Cumulative % in Grade						13.6	49.7	82.9	97.6	

Overall Threshold Marks							Option 3 + 4 + 7 (Intermediate)			
	Max Mark	A*	A	B	C	D	E	F	G	U
	250			167	109	77	45			
Percentage of Candidates Awarded each Grade							Total Candidature:			
		A*	A	B	C	D	E	F	G	U
Percentage in Grade				17.6	45.6	24.3	11.3			
Cumulative % in Grade				17.6	63.2	87.5	98.8			

Overall Threshold Marks							Option 5 + 6 + 7 (Higher)			
	Max Mark	A*	A	B	C	D	E	F	G	U
	250	194	143	95	49					
Percentage of Candidates Awarded each Grade							Total Candidature:			
		A*	A	B	C	D	E	F	G	U
Percentage in Grade		15.3	42.3	34.6	7.6					
Cumulative % in Grade		15.3	57.6	92.2	99.8					

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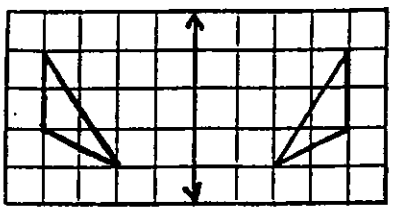
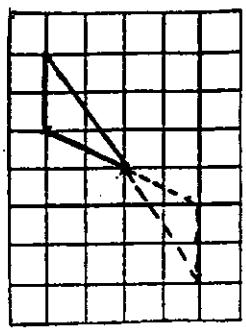
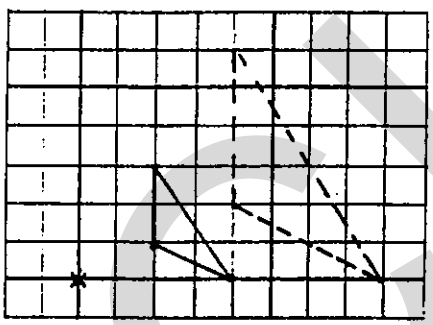
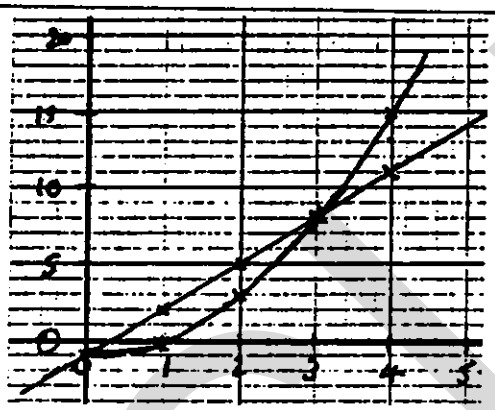
Markscheme 1662/1
June 2000

	Final Marking Scheme Details		
1	(a) 8209 (b) 473 (c) 179 (d) 2360 (e) 2400	1 1 1 1 1	
2	(a) Tangent (b) Arc (c) Diameter or radius (d) Chord	1 1 1 1	MARKING DOWN THE PAGE
3	(a) {(1),2,4,5, 10 (20)} (b)(i) 49 (b)(ii) (±) 9 (c)(i) One of 8, 10, 12, 14, 16, 18 (ii) 12 or 18 (iii) 11, 13 or 17. (iv) 8	2 1 1 1 1 1 1	**B1** for any 2 correct, with no more than one incorrect. Accept x signs.
4	11carnations and 65p change.	3	**B2** for sight of 11. Or **M1** for sight of figs 10 ÷ figs 85 Or for signs of repeated addition Or attempt at multiplying by 85. e.g. 10 carnations + £1.50 implies **M1**

5	(a) The Rolling Stones. (b) 80 (c) Not a large enough sample or Not enough sites. Not a uniform cross-section.	1 2 S1 C1	 M1 for an attempt to add up the readings. At least 4 of 32, 14, 18, 8 ,4, 2, 2.
6	£1150	5	If incorrect, then allow B1 for each of the following seen or implied 130 (or two 65's) 300 (or three 100's) 170 550 If not B4 then also M1 for adding .
7	18 to 20 cm^2	2 U1	B1 for an answer between 17.5 and 22 inclusive.
8	(a)(i) 240000 or 237600 or 232000 or 237000 (ii) More ; Value(s) we have used are over estimates. (b) 22968	2 1 3	M1 for 800 x 30 x 10 seen or implied Or 792 x 30 x 10 or 800 x 29 x 10 Or 790 x 30 x 10 soi. SC1 for figs 24 seen. M1 for showing a desire to multiply 792 by 29 even if also x 10, and M1 for a correct method with only one error.
9	(a) 7 (b) 6	2 3	M1 for placing 8 or 9 of the numbers in order. M1 for attempt to total at least 8 numbers. M1 for ÷ by (their) 9.
10	(a) 1/5 oe (b) 49/100 (c) 31/100	1 1 2	Penalise once only for such as 1 out of 5 1 to 5 , 1 in 5 ,1:5 M1 for sight of 31 or for100 - their total of 20 + 14 + 35

11	(a) 	1	In all parts points must be joined but not ruled.
	(b) 	2	**B1** for 2 points correctly rotated.
	(c) 	3	**B1** for each correct point. Or B2 for correct enlargement ; wrong place. Or M1 for at least 2 correct rays.
12	(a) $\frac{12}{25}$ c.a.o.	1	Mark final answer.
C1	(b) 35 (%) c.a.o.	1	
	(c)(i) (0).375 c.a.o.	2	**M1** for 3 ÷ 8 soi by figs 37(5). Note 0.38 does not imply this.
	(ii) (0).0375	✓1	Their (i) ÷ 10 ; allow truncations.
13	Suitable observation sheet.(A 2 way table or some other way of distinguishing between e.g. blue eyed, black haired pupils and blue eyed blonde haired pupils is needed for full marks.)	3	**B1** Collecting data on eyes. **B1** Collecting data on hair.

14	(a) 24	1	
	(b) 110	2	**M1** for 360 - 100 - 90 – 60
	(c)(i) g (ii) k (iii) d	1 1 1	
15 C2	(a) 31 c.a.o.	1	NOT 264 to 295
	(b) 1, 6, 11, 2.	2	**B1** for two totals correct , or all the tallies correct.
	(c) 281 to 290	1	
	(d) 4 sectors correct ± 2°	4	**B1** for each correct sector, ignore labels. OR after B0 or B1, then **B2** for two of 18, 108, 198, 36° or 5, 30, 55, 10%. OR **M2** for 360 ÷ her 20 x her f Or 100 ÷ her 20 x her f. OR **M1** for 360 ÷ her 20 or 100 ÷ her 20
16 C3	(a) (I) 3.5 or 3½ c.a.o.	1	Not 7/2
	(ii) 6	2	**B1** for 3x = 13 + 5 or better, or B1 for correct embedded as their final answer.
	(iii) 7	2	**B1** for 6x – x = 26 + 9 or better or B1 for correct embedded as their final answer.
	(b)(i) 16q	1	
	(ii) 8n + 4p mark final answer.	2	**B1** for either part seen.
17 C4	(a) 3n	1	Ignore n =..... Allow n3
	(b) 4n + 1	2	**B1** for 4n soi. SC1 for x 4 + 1

18 C5	(a) 2 'vertical lines' ± 2mm 3 'horizontal lines' ± 2mm Accurate semi-circle ± 2mm Angles 60 ± 2° (b) 20 cm oe. Or 0.2 ~~s~~m or 1/5 m.	V1 H1 S1 A1 2	Ruled Ruled 'compass' drawn. B1 for 200 seen or 100 ÷ 5
19	 (a)(i) -1, 2, 5, 8, 11. (ii) Correct ruled line. (b) (i) –1, 3, 15 (ii) Correct smooth line.	 1 2 1 3	 B1 for 3 or more correctly ✓ plotted points. B2 Correct points not joined or badly so. B1 Three points correctly plotted. ✓

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RECOGNISING ACHIEVEMENT

Markscheme 1662/2
June 2000

1	(a) 20 (minutes) (b) Britain Today (c) Off the Shelf; World News	1 1 1 + 1	 Not '30 minutes'	 4
2	(a)(i) One quarter, o.e. (ii) Three eighths, o.e. (b) South (c) 90°	1 1 1 1	Words or figures Allow $\frac{1\frac{1}{2}}{4}$. SC1 for $\frac{3}{4}$ and $\frac{5}{8}$	 4
3	(a)(i) Odd (ii) 17, 19 (b)(i) 1 + 3 + 5 + 7 + 9 = 25 1 + 3 + 5 + 7 + 9 + 11 = 36 (ii) Square (numbers)	1 1 1 1 1	 For both SC1 for both LHS or both RHS correct Dep on 25 & 36 not wrong	 5
4	8 11 7	1 1 1		 3

16

5	(a)(i) 40 (ii) 20 (b)(i) (Square) pyramid (ii) 53° (± 2°) (iii) 4 correct lines drawn (iv) 4	1 1 1 1 2 1	 Ignore any units Condone spelling SC1 for two or three correct & none wrong	 7

7

6	(a) 3 points plotted correctly (b)(i) 39°C (ii) −14°C (c) ±53°C (ft) (d) 5°C (±1°) (e) 7 hours	2 1 1 1 1 1	± 1mm SC1 for two within tolerance Condone omission of lines ft provided that (b)(i) is + & (b)(ii) is −	 7
7	(a) $2 \leqslant h \leqslant 3$ metres (b)(i) 9500 cm (ii) 5 (m) w.w.w. (iii) 104, 103.9 or 103.89.. (c)(i) 2 000 000 or 2m (ii) 2 500 000 or $2\frac{1}{2}$m	1 1 2 2 1 1	 M1 for 100 − 95 seen M1 for 95 ÷ 0.9144, implied by digits 103(893) SC1 for 2 and 2.5, or for 2000000m and 2500000m	 8

15

8	(a) Impossible, unlikely, evens, likely, certain (b)(i) 6 (ii) 5 cao (iii) $\frac{5}{40}$, $\frac{1}{8}$, 0.125 or $12\frac{1}{2}\%$	2 2 1 2	SC1 for just one (compensating) error SC1 for 'from 3 to 9' o.e. If a fraction is seen in the answer space, mark it and ignore the rest SC1 for 5 ÷ their 40 (must be ⩾ 32); unlikely; 5 out of 40; 5 in 40; 1 out of 8; 1 in 8.	7
9	(a) £3.04 (b) £58.80 (c) £3.68 (d) 3.6×10^{11} oe	2 2 3 1	M1 for attempt to by 3 & × by 2 or SC1 for 1.52 seen M1 for 0.12 × 490 oe, soi by 58.8 or 431.2 Step by step methods must be complete & convincing to earn the M1 B1 for (0.)46 seen M1 for ÷ 3 & × 8, or clear & complete step by step method 0 if the decimal point in long answer, but condone commas or gaps in the wrong place	8

15

10	(a) 20km/h (b) Horizontal straight line from A Mark made, or that line ends, at (90, 60) (c) Straight line from their B to correct C (d) 'Slowing down' or 'stopping' oe cao	1 1 1 1 1	±1km/h Minimum length 2mm (1 small square) Indep ±1mm Condone C not labelled Not 'going back home', 'going downhill' or 'stopped'	5
11	(a) All values correct (b)(i) $\frac{1}{25}$, 0.04, 4%, cao (ii) 0, $\frac{0}{\text{anything}}$, impossible (iii) $\frac{5}{25}$, $\frac{1}{5}$, 0.2, 20% (ft)	2 1 1 2	B1 for max of 2 errors or omissions All others score 0 ft for 'correct' fraction, decimal or % from their wrong diagram containing at least one 3 and one 4. 1 for numerator 5 soi	6

11

12	(a) 41.28 (francs) (b) (£)2.68 as final answer	3 3	M2 for $25.8 \times \frac{160}{100}$ or B1 for figs 1548 or 4128 seen B2 for 2.67(.) or 2.68 seen, or M1 for $\frac{25.8}{9.63}$ or $\frac{\text{their ()}}{9.63}$	6
13	(a)(i) 52(°) (ii) 32(°) (b) Rhombus	2 2 2	M1 for $180 - 2 \times 64$ B1 for 116 seen, in working or diagram B1 for parallelogram, kite or diamond	6

14	(a) 714 to 714.2 cm^2 (b) 105.8 to 106 (cm)	3 U1 3	M2 for $20^2 + \pi \times 10^2$ or M1 for $\pi \times 10^2$ or for $20^2 + k\pi$ w.w.w. SC2 for 102.8 to 103 or 108.8 to 109 or M2 for $20 + 20 + 3 + 2 \times \pi \times 10$ or M1 for $2 \times \pi \times 10$ or for $20 + 20\ (+ 3) + k\pi$ $(+ 3)$	7
15	(a) $y + 5$ seen (b) $3y + y + 5$ oe (c) $3y + y + 5 = 61$ or *their (b)* = 61 oe seen 14	1 2 B1 B2	'y = …' Ignore units stated throughout question B1 for $3y$ + *their (a)* Equation in y with at least 1 further step to solution M1 for their (b) = 61 & 1 correct step, or, their (b) = 61 implied by $(61 - 5) \div k$	6
16	Figs 91 × 913 Figs 1272 × 619 + 5% × their total of two charges (£) 91.40 or 91.39	M1 M1 M1 A2	soi by figs 83… soi by figs 787… A1 for figs 9138 to 914	5
17	(a) Idea of sampling. Systematic counting Some attempt at ensuring randomness (b) 0.95	W1 V1 R1 3	e.g. use a tally chart M2 for $\frac{(0\times10)+1\times6+2\times1+4\times2+3\times2}{10+6+1+1+2}$ or B1 for either 19 seen or denominator 20	6

TOTAL 100

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RECOGNISING ACHIEVEMENT

Markscheme 1662/3
June 2000

June 2000 — 1662/03 Mathematics Syllabus A

1.	(a) $\frac{12}{25}$ cao	1	Mark final answer
	(b) 35(%) cao	1	
	(c)(i) (0).375 cao	2	**M1** for attempt at 3÷8 soi by figs 37(5) Note : 0.38 does not necessarily imply M1
	(ii) 0.0375	√1	*their* (i) ÷ 10 ; allow truncation or rounding
2.	(a) 31 cao	1	
	(b) 1, 6, 11, 2	2	**B1** for two totals correct or **all** tallies correct
	(c) 281 to 290 cao	1	281 to 290 and/or 11 scores 0
	(d) 4 sectors correct ± 2°	4	**B1** for each correct sector. Ignore labels **After B0 or B1** **B2** for two of 18,108,198,36° or 5,30,55,10% **or M2** for $\frac{360}{\textit{their}\ 20}$ x *their* f or $\frac{100}{\textit{their}20}$ x *their* f seen **or M1** for $\frac{360}{\textit{their}\ 20}$ or $\frac{100}{\textit{their}\ 20}$ seen
	[Note : Mark to the best advantage of the candidate]		
3.	(a)(i) 3.5 or 3½	1	Not 7/2
	(ii) 6	2	**B1** for $3x = 13 + 5$ or better or correct value embedded as final answer
	(iii) 7	2	**B1** for $6x - x = 26 + 9$ or better or correct value embedded as final answer
	(b)(i) 16q cao	1	
	(ii) 8n + 4p cao final answer	2	**B1** for either part seen
	(c) $x^2 + 5x + 4$ final answer (condone = 0 if no further)	2	**B1** for any two of xx (or better) , 4x , 1x , 4 seen from multiplying
4.	(a) 2 'Vertical' lines	V1	Ruled. Within 2 mm of correct posn. top and bottom
	3 'Horiz' lines	H1	Ruled. Within 2 mm of correct posn. both sides
	Semi-circle ±2mm	S1	'compass' drawn
	Angles 60±2°	A1	
	(b) 20(cm) or 0.2**m** or 1/5**m**	2	**B1** for 200 or 100 ÷ 5 seen
5.	(a) (n =) 3n oe	1	Accept n3 etc } Allow marks for unsimplified
	(b) (n =) 4n + 1 oe	2	**B1** for 4n soi } expressions eg. 5n - n + 1 **or SC1** for x4 +1 seen
	condone any letter used		

6.	0.3 oe	2	**M1** for 1 - (0.35+0.2+0.15) soi or 1 - 0.52 or 0.48 seen
7.	(a)(i) 2400 (ii) *their*(i) ÷ 1000 (b) 5 www	2 √1 3	**M1** for 40x30x2 soi by figs 24 Evaluated. **M2** for 2000/(20x20) **or M1** for 2000 = 20x20xh **or B1** for 400 seen
8.	(a) 'Positive' gradient points 'Tight' oval (b) Scattered Points	1 1 1	4 or more points. Ignore lines drawn. **Indep.** Allow points in a straight line Without correlation
9.	(a) 20 www	3	**M2** for $\frac{480 - 400}{400}$ x 100 oe **or M1** for $\frac{480}{400}$ or $\frac{80}{400}$ or 120 or 4 = 1% or 40 = 10% (these 5 only)
	(b) 1000x(4/5) 800 200x(5/100) *their*(10)x*their*(800) 8000 cao (8000 ww scores **SC3**)	M1 A1 M1 M1 A1	 **or** *their*(800)x(200) **or** *their*(160000)x(5/100)
10.	(a)(i) (6,-5) (ii) $\begin{bmatrix} 4 \\ -6 \end{bmatrix}$	2 √2	**B1** for one correct value in correct place **Follow thro'** $\begin{bmatrix} (i) \end{bmatrix} - \begin{bmatrix} 2 \\ 1 \end{bmatrix}$ Condone fraction line. √**B1** for one 'correct' value in correct place. or for both 'correct' given as a row. eg[4,-6]
	(b)(i) (11,-1) (ii) y = 3 oe	2 2	**B1** for one correct value in correct place **B1** for x = 3 or correct line drawn on grid
11.	4.5 to 5.5 inclusive www	2	**M1** for one or more of 5.8, 6, 36 or 3.2, 3, 9 seen in rounding or 27 seen
12.	(a) 60 (b) 80 (c) $\frac{f - 32}{0.6}$ oe	2 2 2	**M1** for 68 - 32 = 0.6d or better oe **M1** for d - 0.6d = 32 or f - 0.6f = 32 or better oe **M1** for f - 32 = 0.6d oe or for f - 32 ÷ 0.6 **SC1** for $\frac{32 - f}{0.6}$

13.	6 www	4	**M1** for mid-values used (max 1 slip) - 3, 8, 13, 18 **and M1** for Σfs with three s in relevant class and f correct, rounded or truncated **and M1** for (a number) ÷ 30 indep
14.	(a) 720 , 480 correct order	3	**M1** for 1200/5 soi by 240 or a correct value **and A1** for one value correct seen
	(b) 1/8	2	**M1** for 150/1200 with attempt to cancel or 12½% or 0.125
15.	(a) Volume	1	
	(b) Area	1	
	(c) Length	1	
16.	68	2	**B1** for 21.5 or 12.5 seen and used
17.	(a) Correct diagram	2	**B1** for one of 1/20 , 3/20 , 0.05 , 0.15 , 5% , 15% $\frac{5}{100}$, $\frac{15}{100}$ correctly placed once . These only.
	(b)(i) $\frac{1}{400}$ oe	√2	**M1** for *their*(1/20 x 1/20)
	(ii) *their* (i) x 2000	√1	Evaluated as integer, up or down if decimal answer
	(c) $\frac{12}{400}$ oe cao www	3	**M2** for *their*(1/20x3/20 + 3/20x3/20) oe **or M1** for either product √ correct
18.	(a) 12, 8, 6, 4, 3, (2.4), 2	1	
	(b) 7 Points correct	√P1	Points within ½ small square horiz. or vert. of correct.
	Reasonable curve	√C1	Curve within ½ small square of their points or the correct points. Ignore to left of 10 and right of 60.
	(c) 3.1 to 3.4 cao	1	Allow 3 hr 6 min to 3 hr 24 min } All marks dependent
	(d) 26 to 28 cao	2	**M1** for using y = 4.5 } on a graph drawn
19.	(a) $\frac{1}{9}$ or 0.11 or better	1	
	(b) 2^{-6} or $1/2^6$	1	
	(c)(i) 1.8×10^{10}	1	
	(ii) 4×10^{3}	2	**B1** for 0.4×10^4 or 4000 or $\frac{2}{5} \times 10^4$ seen

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Markscheme 1662/4
June 2000

1.	(Costsave) : 1500 (g) 182 (p) or (£)1.82 (Pricewell): 1500(g) cost 185(p) or (£)1.85	1 1 1	 Both values stated **SC3** for consistent multiples **3**
2.	(a) All values correct (b)(i) $\frac{1}{25}$, 0.04, 4% cao (ii) 0, $\frac{0}{anything}$, impossible (iii) $\frac{5}{25}$, $\frac{1}{5}$, 0.2, 20%	2 1 1 2 ft	**B1** for max of 2 errors or omissions ft for 'correct' fraction, decimal or percentage from their wrong diagram containing at least one 3 and one 4. **SC1** for numerator 5 soi (denominator > 5) **6**
3.	(a) 41.28 (francs) (b) Final answer (£) 2.68	3 3	**M2** for $25.8 \times \frac{160}{100}$ or **B1** for figs 1548 or figs 4128 seen **B2** for 2.67(.) or 2.68 seen or **M1** for $\frac{25.8}{9.63}$ or $\frac{their(a)}{9.63}$ **6**
4.	(a)(i) 52(°) (ii) 32(°) (b) Rhombus	2 2 2	**M1** for $180 - 2 \times 64$ **B1** for 116 seen in working or diagram **B1** for parallelogram, kite or diamond **6**
5.	(a) 714 to 714.2 cm^2 (b) 105.8 to 106 (cm)	3 U1 3	**M2** for $20^2 + \pi \times 10^2$ or **M1** for $\pi \times 10^2$ or for $20^2 + k\pi$ **SC2** for 102.8 to 103(www) or 108.8 to 109 or **M2** for $20 + 20 + 3 + 2 \times \pi \times 10$ or **M1** for $2 \times \pi \times 10$ or for $20 + 20(+3)(+3) + k\pi$ **7**

6.	(a) $y + 5$ seen	**1**	Ignore units stated throughout question
	(b) $3y + y + 5$ oe	**2**	**B1** for $3y +$ *their (a)*
	(c) $3y + y + 5 = 61$	**B1**	Equation in y with at least 1 further step to solution
	or *their (b)* = 61 oe seen		
	14	**B2**	**M1** for their (b) =61 and 1 correct step or their(b)=61 implied by $\frac{61-5}{k}$
			6
7.	(a)(i) n^3	**1**	
	(ii) 6ab or 6ba	**1**	
	(b) Final answer $12x - 18$	**1**	
			3
8.	figs 91 × 913	**M1**	soi by figs 83...
	figs 1272 × 619	**M1**	soi by figs 787...
	+ 5 % × their total of two charges	**M1**	
	(£) 91.39 or 91.40	**A2**	**A1** for figs 9138 to 914 **SC2** for 91.39 or 91.40 with no working or **SC1** for figs 9138 to 914 with no working
			5
9.	(a) **Two-way table** with boys/girls	**T1**	gender column
	Columns for WP, SS, both,neither oe	**C2**	Must allow for negative in order to score C2 **C1** for three of these
	One way table or questionnaire		
	Gender column or box	**T1**	
	Columns or boxes for WP & SS	**C1**	dep on T1 or name or number column soi
	(b) 0.95, $\frac{19}{20}$	**3**	**M2** for $\frac{(0\times10)+1\times6+2\times1+3\times1+4\times2}{10+6+1+1+2}$ or **B1** for either 19 seen or denom 20
			6
10.	(a) 8.04	**1**	
	(b)(i) 7.6149(0.)	**1**	
	(ii) 7.61	**1 ft**	ft their (b)(i) which must be at least 3dp
	(iii) $\frac{4^2+(0.5)}{4\times0.5}$, $\frac{4^2+0.53}{4\times0.5}$	**1**	**SC1** for $\frac{4^2+1}{4(\times1)}$ or $\frac{4^2+1}{4\times0.5}$
	8 to 8.3	**1**	dep on rounding seen in numerator and denominator
			5

11.	Correct trial for $4 \le x \le 5$	**1**	All trials evaluated correctly to the first 2 figs (rounded or truncated)
	Improved correct trial for $4 < x < 5$	**1**	
	Trial for $4.2 < x \le 4.25$	**1**	
	(or trials for both 4.2 and 4.3 with conclusion)		
	Answer 4.2	**1**	
			4
12.	(a) (£) 535.95 or 535.96	**3**	**M2** for 450×1.06^3 soi or **B1** for 477 seen
	(b) (£) 376	**3**	**M2** for $\frac{319.6}{85}(\times 100)$ soi by figs 376 or **M1** for 85% = 319.6 or **M1** for $k - k \times \frac{15}{100} \approx 319.6$, $k > 368$
			6
13.	Multiplication and subtraction or substitution	**M1**	
	$x = 3$	**A1**	
	$y = -\frac{1}{2}$	**A1**	**SC2** for both correct but with no valid algebraic manipulation
			3
14.	(a) 8.9 to 8.94	**3**	**M2** for $\sqrt{(12.4^2 - 8.6^2)}$ or **M1** for $x^2 + 8.6^2 = 12.4^2$
	(b) 7.7 to 7.75	**3**	**M2** for 8.6tan(180-138) or equiv. trig method **M1** for tan(180-138) = $\frac{DC}{8.6}$ or equiv. trig
			6

15.	(a) Final answer $10x - 22$	**2**	**B1** for $4x - 20 + 6x - 2$ condoning I error
	(b) 1,2,3,4	**2**	**B1** for $0 < n < 14/3$ (soi by 4.6(.)) or0,1,2,3,4 or 1 - 4 or 1 to 4 or $0 < n \leq 4$ or $0 \leq n \leq 4$
	(c) Final answer $3x\ (2x - 3y)$ or $-3x\ (-2x + 3y)$	**2**	Condone missing final bracket **B1** for $x(6x - 9y)$ or $3(2x^2 - 3xy)$ or $6x(x - 1.5y)$ or $3x\ (2x - 3y)$ or $-3x\ (-2x + 3y)$ seen
	(d)(i) $(x - 6)(x - 2)$	**2**	**SC1** for $(x \pm 6)(x \pm 2)$
	(ii) 2, 6	**1 ft**	ft from their two bracket factors or for both correct values however obtained
			9
16.	(a) 83.6 to 84 (°)	**4**	**B3** for 41.8 to 42 or **M3** for $2 \sin^{-1} \frac{0.8}{1.2}$ or **M2** for $\sin^{-1} \frac{0.8}{1.2}$ or **M1** for $\sin = \frac{0.8}{1.2}$ (M marks available for equivalent trig)
	(b) 1.125 (m)	**2**	**M1** for $\frac{x}{1.8} = \frac{1}{1.6}$ oe
			6
17.	(a)(i) 0.72	**2**	**M1** for 0.9×0.8
	(ii) 0.02	**2**	**B1** for both 0.1 and 0.2 seen In (b) & (c) ½ small square accuracy for plots and joins
	(b) Plots at 10,30,50,70,90	**P1**	Horizontal time axis with correct linear scale
	Plots at correct heights	**H1**	
	Ruled joins (at least 4 plots)	**J1**	Ignore joins to left of 10 and right of 90
	(c)(i) 4,23,53,71,80	**1**	
	(ii) Correct ft plots at 20,40,60,80,100	**P1 ft**	ft if ogive shape
	Curve or ruled joins (at least 4 plots)	**C1**	Ogive shape
	(d)(i) 50 to 54 (minutes)	**1 ft**	ft if ogive shape
	(ii) 27 to 32 (minutes)	**2**	**M1** for evidence of reading from y= 20 and 60 (both **2** and **M1** dep on ogive shape)
			13
	TOTAL	**100**	

OCR

RECOGNISING ACHIEVEMENT

Markscheme 1662/5
June 2000

1	Line parallel to house wall 2 cm away 'Circular' ends radius 2cm Circle centre * Radius 2.5 cm Correct shading	 B1 M1 A1 M1 A1 √1	Accuracy ± 2mm, accept dotted lines At least as long as width of house by eye Intention Accurate Intention Accurate, must reach line ft only If M1 gained for circle and there is a line parallel to house Good freehand can score B0,M1,A0,M1,A0,1√	6
2	(a) 24 000 (b) 22098.1 (c) 15.5 or 15.49̇ , 14.5	2 2√ 2	**M1** for 40 or 30 or 20 **SC1** for 43x29x18=22446 with working shown Ft from figs 24 only, 24 → 22.1, 240 → 221.0 etc **B1**√(ft from figs 24) for 22098.096 **B1** for one correct in correct place or for two correct in wrong places	
3	(a) Correct Sample Space with scores or list of ordered pairs 5/36 (b) 30/36 oe or (n – 6) / n WWW (c) 6/36 oe or 6/n WWW	 M2 A1 2√ 1√	-1 once for 5 in 36 etc, ISW for cancelling / decimal errors **B1** for one or two errors **M1** for sample space with points only + **A1** for scores of 6 ringed **SC2** for 5/36 Without list of outcomes Where n = number of outcomes in (a) **B1**√ for 6/36 or 6/n seen	12
4	(a) t^6 (b)(i) x = 3.5 oe (ii) x > 2.5 oe ($2^4/_8$ or better) (c) (2x + 5)(2x - 5) (d)(i) (x + 1)(x + 6) oe (ii) -1 and - 6	1 3 2 2 2 1√	 **M1** for 3x - 3 = x + 4 + **M1** for 3x - x = 4 + 3 **M1** for x > 20/8 soi **SC1** for (x =) 2.5, x < 2.5, x ≥ 2.5, x ≤ 2.5 **B1** for (ax + b)(ax - b) seen **B1** for factors which would give 2 of the 3 terms Ft from their factors	11

5	(a) (3) 10 21 49 73 90 98 100	1		
	(b) 9 points plotted correctly	√P2	± ½ small sq, P1√ for 7 or 8 correct	
	Curve or straight lines	√G1	± ½ small sq ft only if no number in table is less than previous one	
	(c) 78 to 82	1√	whole number only	
	(d) 1.7 to 2.2	2	M1 for attempt to read off both quartiles onto height axis.	
6	Ruled line through (0, 0) and (2, 6)	1	condone dotted lines ± 1 small square at those points	
	Ruled line through (0, 6) and (4, 0)	2	± 1 small square at those points SC1 for line through either (not y = 6 or x = 4)	
	Correct region, including some in –ve x region	1√	Ft provided first line has positive gradient and second has negative gradient.	11
7	20 and 16 seen	B1		
	2 complete correct corresponding ratios / fractions	M1	e.g. 2lengths, 2 widths or length & width and length & width	
	reducing these to comparable forms	A1		
	not same, not similar	A1	dep on M1 only (condone not congruent)	
			SC2 for complete correct argument using 1 border only Area scale factor + l.s.f + w.s.f.: M1,A0,A1 Area scale factor + l.s.f (or w.s.f.) only: M0,A0,A0	
8	(a) 8	1		
	(b) 2	1		
	(c) 6	1		7
9	(a) x > -3 or – 3 < x	3	M1 for 2x - 5x < 12 - 3 oe + A1 for - 9 < 3x or - 3x < 9 or SC1 for -3, x = -3, x < -3, x ≥ -3, x ≤ -3	
	(b)(i) - 1½ or 1	3	M2 for (2x + 3) (x - 1) (= 0) or (–1 ± √25) / 4 Or x + ¼ = ± √(25/16) SC1 for x = 1½ or –1 or one correct answer	
	(ii) U shaped Parabola crossing x axis twice	M1	SC1 for inverted parabola with intersections at their -1½ and 1.	
	Intersections indicated at their -1½ and 1	A1√	Labelled or good scale	

10	(a)(i) 18000π	**2**	**M1** for $(4/3) \times \pi \times 30^3 \div 2$ or better, $\div 2$ can come later. 30^3 can be implied by figs 27	
	(ii) 45	**2√**	ft is for their 18000 (single number)÷400 (2sf) **M1** for $\pi \times 20^2 \times h$ = their (a)(i)	
	(b) 24	**3**	**B1** for 18 seen + **M1** for $\sqrt{(30^2 - \text{their } 18^2)}$ or mention of 3,4,5 triangle.	**15**
11			-1 once for 5 in 36 etc, ISW for cancelling / decimal errors	
	(a) 42/380 oe	**3**	**M2** for 7/20 x 6/19 **SC1** for 49/400	
	(b) 226/380 oe	**4**	**M2** for 11/20 x 7/19 + 11/20x 2/19 + 7/20 x 2/19 soi by 113/380 + **M1** for x2 or **M3** for complete alternative methods Or **B2** for 154/380 seen Or **SC1** for 226/400 oe Or if 0 or 1 scored for whole question give **M2** for correct tree diagram with probabilities (conditional / unconditional) (NOT + M2)	
12	35.55 or 35.549 (m) or 3555 cm or 35m 55 (cm)	**2**	**M1** for $m - n$ where $50 < m \leq 50.5$ and $14.5 \leq n < 15$ Or **SC1** for 15.05 or 14.95 seen	
13			Condone eg $6 \times \sqrt{2}$	
	(a)(i) $6\sqrt{2}$	**1**		
	(ii) $10\sqrt{3}$	**2**	**B1** for $\sqrt{300}$ or $2\sqrt{5} \times \sqrt{5}.\sqrt{3}$ or $5\sqrt{4} \times \sqrt{3}$ seen	
	(iii) $5\sqrt{3}$	**2**	**B1** for any two of $5\sqrt{2}$, $3\sqrt{3}$, $3\sqrt{2}$ or for $\sqrt{75}$ seen. Condone $5\sqrt{3}/1$	**16**
	(b) a = 32, b = 10	**2**	**B1** for either, **SC1** for $32 + 10\sqrt{7}$ seen	

14	(a) Strata identified Method within strata 10% clear (b) Ensures all streets, areas etc represented (c) people not on telephone, ex directory, includes businesses etc Or may mean streets / areas etc not represented	M1 A1 A1 1 1	streets, areas etc Must be obtainable without visiting houses accept random or systematic Must refer back to their strata Must refer back to their strata	
15	(a) $\frac{540}{x} + \frac{300}{x+1} = 90$ $\div 30$ oe (b) x = 9 and -2/3 Final answer 9	1 1 6 1	Dep. Must include some indication of method e.g. intermediate stage with 10 cancelled Accept working in part (a) **M2** for $18(x+1) + 10x = 3x(x + 1)$ soi or **M1** for common denominator $x(x + 1)$ + **B1** for $28x + 18$ soi or $3x^2 + 3x$ seen (indep) + **A1** for $3x^2 - 25x - 18 (= 0)$ or $-3x^2 + 25x + 18$ + **A1** for $(3x + 2)(x - 9)$ oe or subst in formula Answer without working gets final mark only. Independent	14
16	(a) 2**a** (b)(i) $\overrightarrow{AB}$ = **b - a** (ii) $\overrightarrow{CD}$ = 2**b** - 2**a** A further step indicating CD parallel to AB (iii) CD is twice as long as AB (c) $\overrightarrow{AE} = \overrightarrow{AC} + \frac{1}{2}\overrightarrow{CD}$ oe = **b** WWW	1 1 2 1 1 M1 A1	Condone omission of vector marks Condone **a** + **a** **B1** for $\overrightarrow{OD}$ = 2**b** soi e.g. $\overrightarrow{CD} = 2\overrightarrow{AB}$, $\overrightarrow{CD} = 2$ (**b** – **a**), $\overrightarrow{CD}$ is a multiple of $\overrightarrow{AB}$ Indep, Accept CD = 2AB e.g. $\overrightarrow{AE}$ = **a** + ½ (2**b** - 2**a**) , $\overrightarrow{AE}$ = **a** + **b** - **a** Accept equivalent method finding $\overrightarrow{BE}$ = **a** If $\overrightarrow{AE}$ and $\overrightarrow{BE}$ found both must be correct for A mark	8

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RECOGNISING ACHIEVEMENT

Markscheme 1662/6
June 2000

1	(a) Negative (b) Line ruled (c) (i) 9.9 to 10.1 (ii) Time may not continue to decrease with age oe	1 1 1 1	Ignore embellishments Must have at least 3 points on each side and when $x = 9$, $13.5 < y < 14$ Must indicate why the trend changes or the correlation could change at 18
2	(a) (i) 7.6149(0…) (ii) 7.61 (b) Rounds to $\frac{4^2(+0.5)}{4\times0.5}$ o.e. or $\frac{4^2+0.53}{4\times0.5}$ 8 to 8.3	1 1 ft 1 1	Ft from (a)(i) which must be at least 3 d.p. SC1 for $\frac{4^2+1}{4(\times1)}$ or $\frac{4^2+1}{4\times0.5}$ dep. on rounding seen in num and denom
3	Correct trial for $4 \leqslant x \leqslant 5$ Improved correct trial for $4 < x < 5$ Trial $4.2 < x \leqslant 4.25$ or trials for both 4.2 and 4.3 with a conclusion Answer 4.2	1 1 1 1	All trials evaluated correctly to the first 2 figs rounded or truncated
4	(a) 8.9 to 8.94 (b) 7.7 to 7.75 (Answer of 6.67 implies M2 as has used grads)	3 3	M2 for $\sqrt{(12.4^2 - 8.6^2)}$ or M1 for $x^2 + 8.6^2 = 12.4^2$ M2 for $8.6\tan(180 - 138)$ or M1 for $\tan(180 - 138) = \frac{DC}{8.6}$ oe. } Or equivalent trig
5	(a) (i) 0.72 oe (ii) 0.02 oe (b) (i) 52.25 not $40 < t \leqslant 60$ 20.97 to 21 (c) (i) 4, 23, 53, 71, 80 (ii) correct points ft at 20, 40, 60, 80, 100 curve or ruled joins for at least 4 plots (iii) $\frac{13\pm1}{80}$ oe or 0.15 to 0.175	2 2 2 3 1 P1ft C1ft 2ft	M1 for 0.9×0.8 B1 for both 0.1 and 0.2 seen M1 for Σfx midpoints (= 4180) or 4140 or 4220 (condone 1 error seen) M1 for oe 35195 or 253600/80 And M1 dep for ÷ 80 and root or $-(\bar{x})^2$ and $\sqrt{}$ Ogive shape Ogive shape ignore blocks } ½ sm sq accuracy B1 for 13 ± 1 ft from ogive
6	(a) $n^2 + 1$ seen (b) $4n^2$ or $(2n)^2$ oe unsimplified seen without further error	2 2	B1 for $n^2 + k$ seen – condone other variable B1 for kn^2 soi or $2n$ seen – condone other variable for $k \neq 1$ After 0, 0 SC1 if quadratic expression seen in (a) or (b).
7	(a) 83.6° to 84° (b) 1.125 cao	4 2	B3 for 41.8° to 42° or M3 for $2\sin^{-1}\left(\frac{0.8}{1.2}\right)$ implied by 92.9(1…) or M2 for $\sin^{-1}\left(\frac{0.8}{1.2}\right)$ implied by 46.4(5…) or M1 for $\sin x = \frac{0.8}{1.2}$ All M marks available for equivalent trig eg cos rule M1 for $\frac{x}{1.8} = \frac{1}{1.6}$ oe implied by 1.12 or 1.13

8	(a) $3x(2x - 3y)$ or $-3x(-2x + 3y)$ as final answer	2	Condone missing final bracket B1 for $x(6x - 9y)$ or $3(2x^2 - 3xy)$ Or $6x(x - 1.5y)$ or $3x(2x - 3y)$ Or $-3x(-2x + 3y)$ seen
	(b) 0.44(3…) and –1.69(3…) or –1.7	3	M1 for $\frac{-5 \pm \sqrt{p}}{8}$ seen and M1 for $\sqrt{73}$ seen – only one correct answer implies M0 M1
9	(a) 376	3	M2 for $\frac{319.6}{0.85}$ (× 100) soi by figs 376 or M1 for 85% = 319.6 or M1 for $k - k \times \frac{15}{100} \approx 319.6$ for $k > 368$
	(b) 5 www	2	M1 for 10×1.15^n $n > 1$ or any one of 13.225, 15.20875, 17.490063, 20.113572 rounded or truncated
10	(a) multiplication and subtraction or substitution $x = 3$ $y = -½$	M1 A1 A1	SC2 for both correct but no valid algebraic manipulation
	(b) $y = -6x + 2$ www	4	Either M1 rise ÷ run A1 $a = -6$ M1 sub coord or attempt at y intercept A1 $b = 2$ OR $8 = -1a + b$ M1 $-10 = 2a + b$ M1 $a = -6$ A1 $b = 2$ A1
11	(a) (i) 55 (ii) 35 (iii) 80 (b) (i) 54° (ii) 22°	1 1 1ft 1 2	If ans space blank all marks can be earned for diagram if clear ft for 180 – (65 + their 35) B1 for OXT (or OYT) = 90 seen, can be in diagram
12	(a) $\frac{4y-3x}{4x}$ oe Accept $\frac{5y-3x-y}{4x}$	3	M1 for $4ax = 4y - 3x$ oe and M1 for division by $4x$
	(b) $\frac{4y}{4a+3}$ oe Accept $\frac{5y-y}{4a+3}$ Mark final answers	3	M1 for $4ax + 3x = 4y$ oe and M1 for $x(4a + 3) = 4y$ oe
13	(a) $\frac{35}{99}$ o.e. (b) Numbers must be between 1 and 10 eg $\sqrt{2}$ and $\sqrt{8}$; π and $\frac{6}{\pi}$	2 2	M1 for complete correct method B1 for *any* two different irrationals eg π and $\frac{3}{\pi}$
14	(a) $\frac{3}{10}$ oe www	2	M1 for $\frac{3}{5} \times \frac{2}{4}$ M marks lost if further incorrect method
	(b) $\frac{1}{20}$ oe www	2	M1 for $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3} \times \frac{1}{2}$
	(c) $\frac{1}{10}$ oe www	3	M2 for $\frac{3}{5} \times \frac{1}{4} \times \frac{2}{3} \times \frac{1}{2} \left(\times \frac{1}{1}\right) \times 2$ or $\frac{2}{5} \times \frac{1}{4}$ Or $\frac{3}{5} \times \frac{2}{4} \times \frac{2}{3} \times \frac{1}{2} \left(\times \frac{1}{1}\right)$ Or M1 for $\frac{3}{5} \times \frac{1}{4} \times \frac{2}{3} \times \frac{1}{2} \left(\times \frac{1}{1}\right)$ oe OR M1 for $\frac{1}{5} \times \frac{1}{4}$ or SC1 for KNKNK only selection

15	605 ÷ their 15 15.25 or 15.249̇ seen 39 or 40 www	M1 M1 A1	 If 0 scored SC1 for 615 ÷ 14.75 or 614.9̇ ÷ 14.75
16	 ½ × 61 × 76sinA = 2300 or sinA = 60.526316 ÷ 61 A = 82.85 to 83 $61^2 + 76^2 - 2 \times 76 \times 61\cos(\text{their A})$ for square root but not $\sqrt{k\cos A}$ 91.3 to 91.5 91 *can be earned if A is not calculated	 M1 A1 *M1 *M1 dep A1 B1ft	*Alternative method* AN = $\sqrt{61^2 - H^2}$ where N is foot of perpendicular from B AN = 7.5 to 7.6 76 – their AN $\sqrt{(76 - \text{their AN})^2 + H^2}$ Rounding to nearest whole number or 2 sf
17	(a) 18.8 to 19.6 … (b) 55 to 95 or 0.9 to 1.6 km/h^2 oe or km/h/min oe	M1 M1 M1 A1 M1 M1 dep A1 1	For width of 0.25 soi possibly from graph For 5.5 to 6.5, 18, 18.5, 17 to 17.5, 16.5 to 17 and final s = 0 to 1.5. Condone one minor error if answer in range. For completely correct method with their heights and w = 0.25 After 0 scored allow SC1 for one correct trapezium For tangent at t = 0.25 drawn Rise ÷ run attempted with correct scales Must be consistent with their acceleration. If no acceleration accept km/h^2.

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RECOGNISING ACHIEVEMENT

Markscheme 1662/7
June 2000

MARKING GUIDE This guide gives examples of the evidence that candidates may produce.
MILLENNIUM PARTIES

MARK FOR EACH STRAND	Strategy	Communication	Reasoning
1	• **Candidates try different approaches and find ways of overcoming difficulties that arise when they are solving problems. They are beginning to organise their work and check results.** eg Draws correct arrangement of two square tables to achieve 8 and 6 people.	• **Candidates discuss their mathematical work and are beginning to explain their thinking. They use and interpret mathematical symbols and diagrams.** Diagrams are clear and convey meaning well [using two tables.]	• **Candidates show that they understand a general statement by finding particular examples that match it.** eg. Provides more than one answer to the number of people who can sit at a set number of tables.
2	• **Candidates are developing their own strategies for solving problems and are using these strategies both in working within mathematics and applying mathematics to practical contexts.** Draws a number of different arrangements of three tables and correctly counts the number of people in most cases.	• **Candidates present information and results in a clear way, explaining the reasons for their presentation.** Diagrams are clear and convey meaning well [using three tables.] Number of people sitting are recorded. *i.e. C1 + Number of people.*	• **Candidates search for a pattern by trying out ideas of their own.** Provides at least three different results for any chosen situation. eg three results for people sitting at three tables.
3	• **In order to carry through tasks and solve mathematical problems, candidates identify and obtain necessary information; they check their results, considering whether these are sensible.** eg Draws at least three, correct, different arrangements of tables that will seat 16 people.	• **Candidates show understanding of situations by describing them mathematically using symbols, words and diagrams.** Tabulates results from diagrams but provides only limited text. *i.e. section headings, "I have found...", or "I predict ...." statements.*	• **Candidates make general statements of their own, based on evidence they have produced, and give an explanation of their reasoning.** eg. States that a maximum number of people increases by two or equivalent of 2n + 2 OR any "correct" generalisation that follows from their results.
4	• **Candidates carry through substantial tasks and solve quite complex problems by breaking them down into smaller, more manageable tasks.** eg Gathers adequate correct data by drawing systematic table arrangements and makes any correct general statement to answer the "Maximum number of people" problem.	• **Candidates interpret, discuss and synthesise information presented in a variety of mathematical forms. Their writing explains and informs their use of diagrams.** Presents a comprehensive record of work involving clear diagrams, tabulated results, and a linking commentary.	• **Candidates are beginning to give a mathematical justification for their generalisations; they test them by checking particular cases.** eg states 2n + 2and tests this on **a new case, or the equivalent.** [The test must be supported by a new diagram and not have been used to obtain the formula originally.]

5	• **Starting from problems or contexts that have been presented to them, candidates introduce questions of their own, which generate fuller solutions.** eg Begins to examine: number of people on arrangements of tables which are not square, OR conditions where numbers of people are minimised etc *and generates sufficient data from which a generalisation could be made.*	• **Candidates examine critically and justify their choice of mathematical presentation, considering alternative approaches and explaining improvements they have made.** eg Uses a graphical representation , giving a reason for doing so OR produces C4 with a formula and evidence of use. *This allows a movement into algebra as an improved communication means,* ***with justification implicit,*** *and this secured by showing use.*	• **Candidates justify their generalisations or solutions, showing some insight into the mathematical structure of the situation being investigated. They appreciate the difference between mathematical explanation and experimental evidence.** eg States 2n + 2 and explains why this applies, with reference to 2 people on either side of teach table and 1 at each end.
6	• **Candidates develop and follow alternative approaches. They reflect on their own lines of enquiry when exploring mathematical tasks; in doing so they introduce and use a range of mathematical techniques.** eg applies difference method algebraically [to solve 2n + 2] and **must** start from ax + b.	• **Candidates convey mathematical meaning through consistent use of symbols.** **eg Produces a formula for the maximum number of people which links number of edges of table to number of tables. i.e. e(n - 2) + 2. (oe.)** *[e = number of edges on a table, n = number of tables.]*	• **Candidates examine generalisations or solutions reached in an activity, commenting constructively on the reasoning and logic employed, and make further progress in the activity as a result.** eg Collates results for tables with different numbers of sides and generates a composite formula, explaining how the multipliers of "n" are related.
7	• **Candidates analyse alternative approaches to problems involving a number of features or variables. They give detailed reasons for following or rejecting particular lines of enquiry.**	• **Candidates use mathematical language and symbols accurately in presenting a convincing reasoned argument.**	• **Candidates' reports include mathematical justifications, explaining their solutions to problems involving a number of features or variables.**
8	• **Candidates consider and evaluate a number of approaches to a substantial task. They explore extensively a context or area of mathematics with which they are unfamiliar. They apply independently a range of appropriate mathematical techniques.**	• **Candidates use mathematical language and symbols efficiently in presenting a concise reasoned argument.**	• **Candidates provide a mathematically rigorous justification or proof of their solution to a complex problem, considering the conditions under which it remains valid.**

GRAZING LAND MARKING GUIDE This guide gives examples of the evidence that candidates may produce. **TASK A**

MARK FOR EACH STRAND	Strategy	Communication	Reasoning
1	• **Candidates try different approaches and find ways of overcoming difficulties that arise when they are solving problems. They are beginning to organise their work and check results.** eg Candidate draws a circle, even freehand, and shows the position of the peg at the centre.	• **Candidates discuss their mathematical work and are beginning to explain their thinking. They use and interpret mathematical symbols and diagrams.** eg Candidate records work showing at least one circle with the pegs correctly positioned.	• **Candidates show that they understand a general statement by finding particular examples that match it.** eg Candidate compares their working to the required $100m^2$ and answers appropriately. OR states the land grazed will be a circle (, or a semi circle.)
2	• **Candidates are developing their own strategies for solving problems and are using these strategies both in working within mathematics and applying mathematics to practical contexts.** eg Candidate draws "circles" with flattened edges as they approach the fence, OR obtains the area of one circle, by any valid method.	• **Candidates present information and results in a clear way, explaining the reasons for their presentation.** eg Candidate shows clearly how shapes are changed as they approach the boundaries, OR Shows how areas have been obtained, (possibly by using Πr^2 and substitutions for r.)	• **Candidates search for a pattern by trying out ideas of their own.** Candidate alters the position of the peg or radius to show at least three different positions, OR collects at least three areas of different circles, *hopefully stating the intent of finding an area of* $100m^2$.
3	• **In order to carry through tasks and solve mathematical problems, candidates identify and obtain necessary information; they check their results, considering whether these are sensible.** eg Finds more than two areas using any valid method.	• **Candidates show understanding of situations by describing them mathematically using symbols, words and diagrams.** eg Candidate uses diagrams and calculations with some comments, such as section headings, table headings or "I have found ..." statements.	• **Candidates make general statements of their own, based on evidence they have produced, and give an explanation of their reasoning.** eg Candidate observes that if the rope length is doubled the area is not doubled oe OR describes accurately the shape of the grazed land at limiting conditions eg quarter circles, semicircles.
4	• **Candidates carry through substantial tasks and solve quite complex problems by breaking them down into smaller, more manageable tasks.** Candidate produces clear evidence for relevant areas to include non integer lengths to solve circle and/or semicircle case(s). *Allows sol^n to* $\Pi r^2=100$ *oe.* (r > 5.64m r>9.77m)	• **Candidates interpret, discuss and synthesise information presented in a variety of mathematical forms. Their writing explains and informs their use of diagrams.** Candidate clearly explains, using diagrams and calculations which are linked with a commentary, how they have solved the circle or semicircle	• **Candidates are beginning to give a mathematical justification for their generalisations; they test them by checking particular cases.** eg Candidate justifies their generalisations by checking with **new** calculations (Area Just above and just below r = 5.64 oe)

5	• **Starting from problems or contexts that have been presented to them, candidates introduce questions of their own, which generate fuller solutions.** Candidate changes one new variable eg tether point on barn OR length of barn, OR shape of barn etc and generates sufficient evidence that some conclusion could be made. OR moves into 3D, calculating some volumes of spheres towards a stated aim.	• **Candidates examine critically and justify their choice of mathematical presentation, considering alternative approaches and explaining improvements they have made.** Candidate improves their presentation and justifies the improvement eg colour codes diagrams or produces spreadsheet printout in tables. OR Begins to work **using** algebra beyond a simple substitution into $A = \Pi r^2$ such as $A = \Pi(r - 10)^2$ or uses a rearrangement of $A = \Pi r2$.	• **Candidates justify their generalisations or solutions, showing some insight into the mathematical structure of the situation being investigated. They appreciate the difference between mathematical explanation and experimental evidence.** eg describes loci that result from their set condition(s), OR solves $\Pi r^2 = 100$ **oe**, with clear explanation of reasoning.
6	• **Candidates develop and follow alternative approaches. They reflect on their own lines of enquiry when exploring mathematical tasks; in doing so they introduce and use a range of mathematical techniques.** Candidate allows tether to increase in length and sums series of semi and quarter circles up to but not exceeding the overlap point, OR extends 3D work to include ¼ and/or ¾ of spheres towards a stated aim.	• **Candidates convey mathematical meaning through consistent use of symbols.** Candidate shows competence with algebra and adapts complex formulae involving two variables eg involving the length of the rope (r) and the length of the barn (l) into one formula OR spreadsheet formulae are explained showing a clear understanding of how the spreadsheet was constructed.	• **Candidates examine generalisations or solutions reached in an activity, commenting constructively on the reasoning and logic employed, and make further progress in the activity as a result.** eg Candidate explains why a corner tether will give a larger grazing area for a given rope length than a central tether and supports this with evidence.
7	• **Candidates analyse alternative approaches to problems involving a number of features or variables. They give detailed reasons for following or rejecting particular lines of enquiry.** eg Candidate uses, with explanation, a method that gives an (approximate) area of an overlap, (which goes beyond counting squares, such as trigonometry.) OR uses algebra to express a compound area that requires the use of three variables .. rope, barn length and width, OR Begins work on a problem involving a sphere cut by a plane and calculates volumes.	• **Candidates use mathematical language and symbols accurately in presenting a convincing reasoned argument.** eg Applies trigonometry to the overlap problem and annotates their solution, OR Uses symbols, all correctly defined, to link three variables with a correct argument to support the construction of the formula.	• **Candidates' reports include mathematical justifications, explaining their solutions to problems involving a number of features or variables.** eg Explains their solution to an overlap case. OR The writing clearly explains how the formula in S7 has been obtained. *in either case this will probably involve the use of clearly annotated diagrams.*

8	• **Candidates consider and evaluate a number of approaches to a substantial task. They explore extensively a context or area of mathematics with which they are unfamiliar. They apply independently a range of appropriate mathematical techniques.** Candidate attempts a general solution to calculating overlaps which goes beyond S7 OR Uses purely algebraic methods to solve problems in which areas are the same for different shaped regions, OR Makes significant progress on 3D work in S7.	• **Candidates use mathematical language and symbols efficiently in presenting a concise reasoned argument.** eg Quadratic equations used to solve problems in S* with elegant method and annotation, OR Constructs formulae for regions other than circles limited by rectangles that require at least three variables .. triangular barns etc	• **Candidates provide a mathematically rigorous justification or proof of their solution to a complex problem, considering the conditions under which it remains valid.** eg Explains the construction and use of formulae in the case dealt with in S8.

Some Evidence that may be produced in Response to Grazing Land

These calculations may result from the initial problem, in the first case **the circle (F/I)** and in the second, the **semi circle (I/H)**.

Length of rope	Area	Step	Length of rope	Area	Step	Length of rope	Area	Step
1	3.14	1	5	78.54	0.1	5.6	98.52	0.01
2	12.57		5.1	81.71		5.61	98.87	
3	28.27		5.2	84.95		5.62	99.23	
4	50.27		5.3	88.25		5.63	99.58	
5	78.54		5.4	91.61		5.64	99.93	
6	113.10		5.5	95.03		5.65	100.29	
7	153.94		5.6	98.52		5.66	100.64	
8	201.06		5.7	102.07		5.67	101.00	
9	254.47		5.8	105.68		5.68	101.36	
10	314.16		5.9	109.36		5.69	101.71	
11	380.13		6	113.10		5.7	102.07	

Length of rope	Area	Step	Length of rope	Area	Step	Length of rope	Area	Step
1	1.57	1	9.3	135.86	0.1	9.7	147.80	0.01
2	6.28		9.4	138.80		9.71	148.10	
3	14.14		9.5	141.76		9.72	148.41	
4	25.13		9.6	144.76		9.73	148.71	
5	39.27		9.7	147.80		9.74	149.02	
6	56.55		9.8	150.86		9.75	149.32	
7	76.97		9.9	153.95		9.76	149.63	
8	100.53		10	157.08		9.77	149.94	
9	127.23		10.1	160.24		9.78	150.24	
10	157.08		10.2	163.43		9.79	150.55	
11	190.07		10.3	166.65		9.8	150.86	

This evidence may result from extending the length of the rope from the centre point of the barn.

Rope Length	Area	Step
1	1.57	1
2	6.28	
3	14.14	
4	25.13	
5	39.27	
6	56.55	
7	76.97	
8	100.53	
9	127.23	
10	157.08	
11	191.64	
12	232.48	
13	279.60	
14	333.01	
15	392.70	
16	458.67	

Rope Length	Area	Step
17	530.93	1
18	609.47	
19	694.29	
20	786.97	
21	882.79	
22	986.46	
23	1096.42	
24	1212.65	
25	1335.18	
26	1463.98	
27	1599.07	
28	1740.44	
29	1888.10	
30	2042.04	

This evidence may result from moving the tether to points 2m apart along the longest side of the barn, up to the point of overlap.
The tables are for 2m, 4m, 6m, 8m and the corner of the barn

Rope Length	Area
1	1.57
2	6.28
3	14.14
4	25.13
5	39.27
6	56.55
7	76.97
8	100.53
9	128.02
10	160.22
11	197.13
12	238.76
13	285.88
14	339.29
15	398.98
16	464.96
17	537.21
18	615.75
19	701.36
20	794.82
21	896.14
22	1005.31
23	1123.12
24	1250.35
25	1387.01
26	1533.10
27	1688.61
28	1853.54
29	2027.90
30	2211.68

Rope Length	Area
1	1.57
2	6.28
3	14.14
4	25.13
5	39.27
6	56.55
7	77.75
8	103.67
9	134.3
10	169.65
11	209.7
12	254.47
13	303.95
14	358.14
15	417.83
16	483.81
17	556.85
18	637.74
19	726.49
20	823.1
21	927.56
22	1039.87
23	1160.03
24	1288.05
25	1424.71
26	1570.8
27	1726.31
28	1891.24
29	2065.6
30	2249.38

Rope Length	Area
1	1.57
2	6.28
3	14.14
4	25.13
5	40.06
6	59.69
7	84.04
8	113.10
9	146.87
10	185.35
11	228.55
12	276.46
13	329.08
14	386.42
15	449.25
16	518.36
17	594.55
18	678.58
19	770.48
20	870.22
21	977.82
22	1093.27
23	1216.58
24	1347.74
25	1486.76
26	1633.63
27	1789.14
28	1954.07
29	2128.43
30	2312.21

Rope Length	Area
1	1.57
2	6.28
3	14.92
4	28.27
5	46.34
6	69.12
7	96.60
8	128.81
9	165.72
10	207.35
11	253.68
12	304.73
13	361.28
14	424.12
15	493.23
16	568.63
17	650.31
18	738.27
19	833.31
20	936.19
21	1046.94
22	1165.53
23	1291.98
24	1426.28
25	1568.44
26	1718.45
27	1876.32
28	2042.04
29	2216.39
30	2400.18

Rope Length	Area
1	2.36
2	9.42
3	21.21
4	37.70
5	58.90
6	84.82
7	115.45
8	150.80
9	190.85
10	235.62
11	285.88
12	342.43
13	405.27
14	474.38
15	549.78
16	631.46
17	719.42
18	813.67
19	914.20
20	1021.02
21	1134.90
22	1256.64
23	1386.23
24	1523.67
25	1668.97
26	1822.12
27	1983.13
28	2151.99
29	2328.71
30	2513.27

Formulas that might result from an algebraic analysis of the problem.

From the centre of the barn

$A = \frac{\pi r^2}{2} \quad r \leq 10$

$A = \frac{\pi(r - 10)^2}{2} \quad 10 \leq r \leq 20$

$A = \frac{\pi(r - 20)^2}{2} \quad 20 \leq r \leq 30$

From the centre of any barn, length L, width W

$A = \frac{\pi(r - L/2)^2}{2}$

$A = \frac{\pi(r - L/2 - W)^2}{2}$

Further formulae may well result from the proportional division of L (and W) as the tether point is moved.

These are the areas of the overlap created when the rope extends from 30m to 40m, and the tether is in the middle of the barn. (Areas in m^2)

Rope Length	Area of Overlap (using an approximation to a triangle)	Area of Overlap (Calculated using a sector of a circle)
31	4.58	6.17
32	13.27	18.01
33	24.92	34.08
34	39.19	53.96
35	55.90	77.44
36	74.94	104.39
37	96.23	134.74
38	119.73	168.43
39	145.40	205.41
40	173.21	245.67

Formulae developed from researching the overlap might be:

$$A = \frac{\sqrt{[(r - 20)^2 - 100]} \times (r - 30)}{2}$$ *Given that* $30 \leq r \leq 40$

$$A = \frac{\sqrt{[(r - L/2 - W)^2 - 100]} \times (r - (L + W))}{2}$$ *Given that* $L/2 + W \leq r \leq \frac{3L}{2} + W$

$\theta = \cos^{-1}(10/(r - 20))$

$A = 2[\ \Pi(r - 20)^2\theta)/360 - 5(r - 20)\sin\theta]$

$\theta = \cos^{-1}(10/(r - L/2 - W))$

$A = 2[\ \Pi(r - L/2 - W)^2\theta)/360 - 5(r - L/2 - W)\sin\theta]$

BAKER'S DOZEN - MARKING GUIDE This guide gives examples of the evidence that candidates may produce.

MARK FOR EACH STRAND	Strategy	Communication	Reasoning
1	• **Candidates try different approaches and find ways of overcoming difficulties that arise when they are solving problems. They are beginning to organise their work and check results.** Attempts to solve the initial problem.	• **Candidates discuss their mathematical work and are beginning to explain their thinking. They use and interpret mathematical symbols and diagrams.** Shows some record of work done.	• **Candidates show that they understand a general statement by finding particular examples that match it.** Shows another swap or draws, correctly, an initial arrangement of buns not shown in the task.
2	• **Candidates are developing their own strategies for solving problems and are using these strategies both in working within mathematics and applying mathematics to practical contexts.** Correctly solves the first problem, i.e. rearranges the array to give an answer of 3 moves.	• **Candidates present information and results in a clear way, explaining the reasons for their presentation.** eg Shows an organised record of swaps needed to solve the first problem	• **Candidates search for a pattern by trying out ideas of their own.** eg Tries at least three sequences of moves to solve an arrangement, or lists at least three moves to look for a pattern.
3	• **In order to carry through tasks and solve mathematical problems, candidates identify and obtain necessary information; they check their results, considering whether these are sensible.** Correctly applies swapping method to another case.	• **Candidates show understanding of situations by describing them mathematically using symbols, words and diagrams.** eg From diagrams [or moves with counters] produces a table of numbers of moves for different numbers of buns and provides some text. *i.e. Section headings, "I have found ..." or "I predict ...." statements.*	• **Candidates make general statements of their own, based on evidence they have produced, and give an explanation of their reasoning.** eg States that the number of moves increases by one extra each time OR states Triangular Numbers OR shows difference pattern OR $\frac{n(n-1)}{2}$ or $\frac{n(n+1)}{2}$
4	• **Candidates carry through substantial tasks and solve quite complex problems by breaking them down into smaller, more manageable tasks.** Obtains sufficient correct results to solve the initial problem and makes a general statement. eg 3, 6, 10, 15, ... hence, "Goes up by 1 more each time " or "Triangular Numbers are generated" [oe]	• **Candidates interpret, discuss and synthesise information presented in a variety of mathematical forms. Their writing explains and informs their use of diagrams.** Commentary explains how buns move and how the diagrams are tables of results are related. i.e. C3 with linking commentary.	• **Candidates are beginning to give a mathematical justification for their generalisations; they test them by checking particular cases.** States that the number of moves is the pattern of Triangular Numbers, or equivalent formula, and tests this on a new number of buns . This test must be supported by result obtained through arranging.

5	• **Starting from problems or contexts that have been presented to them, candidates introduce questions of their own, which generate fuller solutions.** States conditions for a personal line of research and obtains sufficient correct results from which a further generalisation could be made. eg Works with three types of bun or moves buns to the "other end" or changes the arrangement AABB.	• **Candidates examine critically and justify their choice of mathematical presentation, considering alternative approaches and explaining improvements they have made.** Produces evidence for C4 **and** states an algebraic formula n(n - 1)/2 with evidence of use. *(The meaning of n can be implicit from the usage.)*	• **Candidates justify their generalisations or solutions, showing some insight into the mathematical structure of the situation being investigated. They appreciate the difference between mathematical explanation and experimental evidence.** Explains WHY the number of swaps is a Triangular Number showing that buns move 1, 2, 3, ... swaps, hence 1 + 2 + 3 + ... = Triangular Numbers.
6	• **Candidates develop and follow alternative approaches. They reflect on their own lines of enquiry when exploring mathematical tasks; in doing so they introduce and use a range of mathematical techniques.** Begins to apply the "Difference Method" algebraically i.e. uses differences to determine a coefficient in $an^2 + bn + c$ *(must be stated)*for their new development. OR Tabulates together previous results with new ones and seeks linkages i.e. Common Factors	• **Candidates convey mathematical meaning through consistent use of symbols.** **eg produces a variant of n(n - 1)/2 to satisfy their chosen development.** *(The meaning of n can be implicit from the usage.)*	• **Candidates examine generalisations or solutions reached in an activity, commenting constructively on the reasoning and logic employed, and make further progress in the activity as a result.** **Derives a new formula i.e. 3n(n - 1)/2 by examining new and old results and deducing a common multiple.**
7	• **Candidates analyse alternative approaches to problems involving a number of features or variables. They give detailed reasons for following or rejecting particular lines of enquiry.** **Correctly completes Difference Method (fromS6)***The resulting formula is evidence for* ***R6.*** OR Continues to link old and new results, spots linkages and generates further formulae.	• **Candidates use mathematical language and symbols accurately in presenting a convincing reasoned argument.** eg Correctly annotates Difference Method which must begin $an^2 + bn + c$. OR Examines a sequence of formulae for different sets of numbers and argues for the R7 case.	• **Candidates' reports include mathematical justifications, explaining their solutions to problems involving a number of features or variables.** Derives formula involving three variables eg $\frac{t(t-1)}{2}\frac{n(n-1)}{2}$ oe.

8	• **Candidates consider and evaluate a number of approaches to a substantial task. They explore extensively a context or area of mathematics with which they are unfamiliar. They apply independently a range of appropriate mathematical techniques.** **Attempts, with some success, a proof for their chosen development.**	• **Candidates use mathematical language and symbols efficiently in presenting a concise reasoned argument.** Uses efficient language and symbols linked to S8 and to facilitate R8.	• **Candidates provide a mathematically rigorous justification or proof of their solution to a complex problem, considering the conditions under which it remains valid.** eg Proof of formula being the product of two triangular numbers, **oe** depending on the development chosen. eg Proof by Induction.