Markscheme

November 2017

Mathematics

On-screen examination

21 pages

The following are the annotations available to use when marking responses.

Annotation	Explication	Annotation	Explication	Shortcut
	Unclear		Award 0 marks	Alt+0
	Special case		Award 1 mark	Alt+1
	Misread		Award 2 marks	Alt+2
NWS	No working shown		Award 3 marks	Alt+3
	Error carried forward		Award 4 marks	Alt+4
	Words to that effect		Award 5 marks	Alt+5
	Benefit of the doubt		Award 6 marks	Alt+6
	Answer Given		Award 7 marks	Alt+7
	Highlight tool		Award 8 marks	Alt+8
	Ellipse tool		Award 9 marks	Alt+9
	On page comment tool		Award 10 marks	
	Seen		Award 11 marks	
	Caret - Omission		Award 12 marks	
	Wavy underline tool			

The markscheme may make use of the following abbreviations:

RM Assessor has the following annotations that should be used to award marks:
A0 only use to award a zero mark for an answer that has no merit *eg*, awarded for the candidate that has a wrong answer with no working

NR only use when the candidate has not made any response also stamp the response with SEEN

 Marks awarded by stamping the tick

 Seen; must be stamped on all blank response areas and on concatenated responses

 unclear

ECF Marks that can be awarded as **error carried forward** from previous results in the question
BOD Benefit of the doubt
MR misread
NWS no working shown
SC special case
OE or equivalent
WTTE or words to that effect
AG Answer given

The markscheme makes use of the following abbreviations:
• Bullet notation means award 1 mark – see example below

Example 1
- 1 mark awarded and corresponding notes are aligned

b	•[1] Show clear line of reasoning in the method •[2] 4	•[1] 45 & 49 seen **OE** *eg*, $49 = 45 + x$ •[2] **Accept** $45 + X/10 = 4.9$ **and** Ans 4	**2**

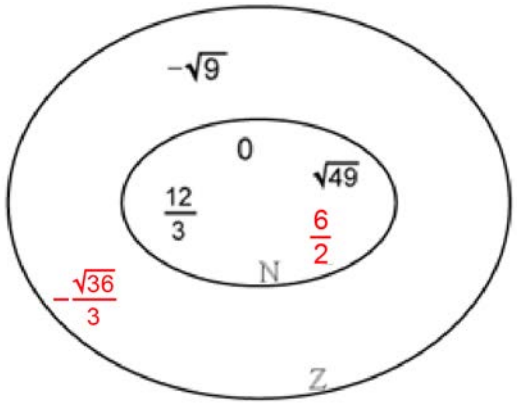
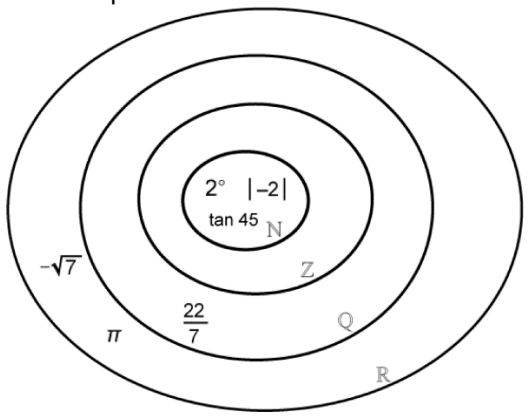
Error Carried Forward (ECF) marks

Errors made at any step of a solution affect all working that follows. In general, **Error Carried Forward (ECF)** marks are awarded after an error.

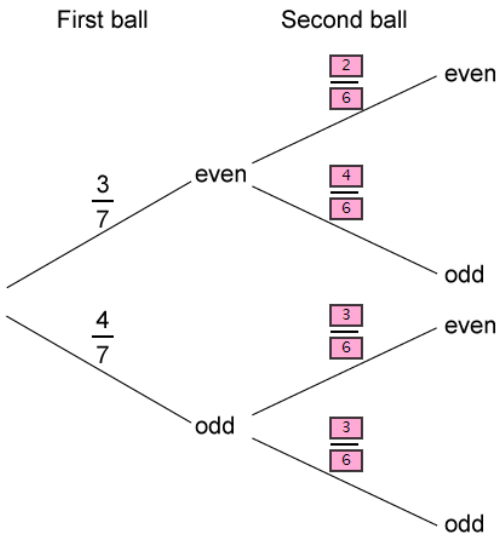
a) **ECF** applies from one part of a question to a subsequent part of the question and also applies within the same part.
b) If an answer resulting from **ECF** is inappropriate (*eg*, negative distances or sin$x$ > 1) then subsequent marks should not be awarded.
c) If a question is transformed by an error into a **simpler question** then **ECF** may not be fully awarded.
d) To award **ECF** marks for a question part, **there must be working present for that part**.
e) **ECF** is only applied to working which is correct. This means that all working subsequent to an error must be checked for accuracy.
f) A misread (**MR**) is an error**. ECF** is normally awarded.

General points

a) As this is an international examination, accept all alternative forms of **notation,** for example 1.9 and 1,9 or 1 000 or 1.000. However **DO NOT ACCEPT** incorrect mathematical notation e.g x^2 for x^2 unless noted otherwise in the MS.
b) Ignore further working after a correct answer **unless** it indicates a lack of mathematical understanding **i.e. if the further working contradicts the correct answer,** then the last mark cannot be awarded.
c) Where candidates have written two solutions to a question, mark the response that deserves more marks.
d) In the markscheme, equivalent examples of **numerical** and **algebraic** forms or **simplified** answers will generally be written in the notes preceded by **OE** (or equivalent) e.g. $\frac{1}{2}$ **OR** 1/2 **OR** $1 \div 2$ and $\frac{x}{2}$ x / 2 **OR** $x \div 2$
e) In the markscheme, information provided in brackets indicate detail that may be seen in a candidate response but is not necessary to award the marks.
f) Special case marks (**SC)** can be allocated instead of but not in addition to the marks prescribed in the markscheme.
g) Accept seeing equation not in-line.
h) Accept notation errors in intermediate steps.
i) When a calculator screenshot is taken, accept not seeing the whole operation.
j) In task 2 and 3 where the markscheme is set out in a table then, unless noted otherwise, awarding the highest mark in a category includes all the lower marks in that category. It is probably best to look for the top category mark answer and if you don't find it look at the next mark down.

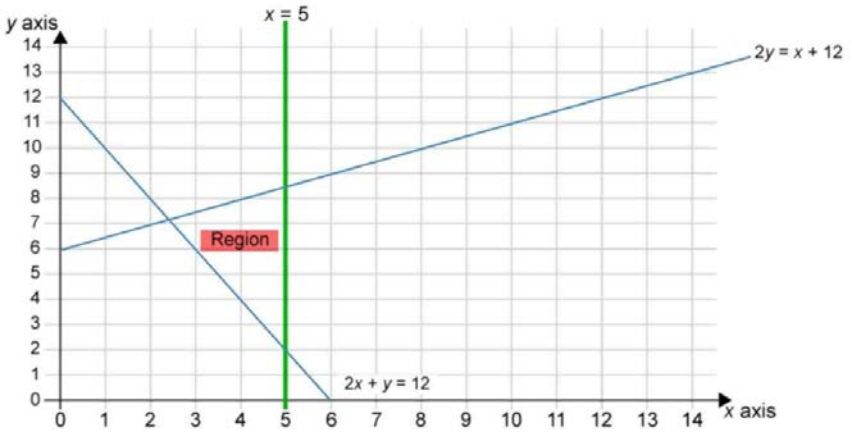
Question		Answers	Notes	Total
1	a	•[1] two correctly placed •[2] the other two correctly placed $\frac{6}{2}$ and $\frac{-\sqrt{36}}{3}$ AG (in red so ignore these in marking)	The correct places are 	2
	b	•[1] two correctly placed •[2] another two correctly placed •[3] another two correctly placed	The correct places are 	3
	c	• $A' \cap B$ **OR** $A \cap B'$		1

Question		Answers	Notes	Total
2	a	(translated horizontally) 3 units to the right (translated vertically) 2 units upwards •1 both translations mentioned without values or with incorrect values **OR** both values correct with incorrect transformations •2 one transformation correctly described (with correct direction and value) •3 second transformation correctly described (with correct direction and value)	•1 Correct descriptions like: Horizontal and vertical shift or movement. ACCEPT down and left. ACCEPT horizontal enlargement 2 and vertical enlargement 3 •2 To the right 3 (units) •3 Upwards 2 (units)	**3**
	b	•1 equating with 11 •2 one correct step to solve for *a* •3 their two values for *a* correct •4 selecting their correct value of *a* within the domain	•1 $11 = (a-3)^2 + 2$. ACCEPT $11 = (x-3)^2 + 2$ •2 $\pm 3 = (a-3)$. ACCEPT $\pm 3 = (x-3)$ OR x(x-6) = 0 •3 (a =) 6 and (or) 0 their equation needs to have two values for a to award **ECF** •4 (Selects)*a* = 6 6 without working award 3 marks 6 with one correct step **or** trial an error statement award 4 marks If they solve incorrectly and obtain two values for *a* outside domain then decide to take none of them award •4 If they solve incorrectly and their solution allows only one value for a do not award •4 If they solve incorrectly and obtain two values for a and select the one within the domain award •4	**4**

Question		Answers	Notes	Total
3	a	•[1] two correct values **OE** •[2] the other two correct values **OE**	Insert image of the tree diagram stimulus  	**2**
	b	•[1] seeing their correct probabilities from (a) •[2] their result after multiplication of probabilities correct	•[1] $\frac{3}{7}$ and their $\frac{2}{6}$ •[2] $\frac{1}{7}$ **OE** 1/7 **OE** without working award 2 marks their answer must be less than 1 to award **ECF**	**2**
	c	•[1] adding multiplied probabilities to their result in part (b) •[2] their calculation correct	•[1] their $\frac{1}{7}+\frac{4}{7}\times$ their $\frac{3}{6}$ •[2] $\frac{3}{7}$ **OE** (ACCEPT $\frac{18}{42}$ **OR** 0.42857… **OR** 43%) 3/7 **OE** without working award 2 marks **SC** calculating only odd-odd correctly ($\frac{4}{7}\times$ their $\frac{3}{6}=\frac{2}{7}$) **OE** award 1 mark	**2**

	d	$\frac{3+b}{2}=5$ or $3+b=10$ AG 7	Accept (3+7)/2=5 Do not accept 3+7/2=5	**1**
	e	•[1] setting equation for range **OR** showing understanding of concept of range •[2] setting equation for mean **OR** showing understanding of concept of mean •[3] simplifying correctly equation for mean •[4] attempt to solve using substitution **OR** elimination •[5] their value for a or c correct •[6] the other value for a or c correct	•[1] c – a = 34 **OR** difference between their a and c is 34 •[2] $\frac{a-12-9+0+3+7+7+10+15+c}{10}=2.7$ •[3] a + c = 6 •[4] Attempt to solve simultaneously, adding **OR** substitution **OR** $2c=40$ **OR** 2*a* = –28 •[5] $c=20$ •[6] $a=-14$ ALLOW ECF from one of their equations (a =) -14 without working award 2 marks (c =) 20 without working award 2 marks (a =) –14 with one correct step award 3 marks (c =) 20 with one correct step award 3 marks	**6**

Question		Answers	Notes	Total
4	a	•1 using Pythagoras correctly •2 correct calculation 693 AG Alternative method •1 using sine rule correctly •2 correct calculation 693 AG Alternative method •1 recognizing that $\angle ABC = 30^\circ$ **and** using tan ratio •2 correct calculation 693 AG	•1 $800^2 = 400^2 + x^2$ **OR** $800^2 - 400^2$ •2 692.8203... **OR** $400\sqrt{3}$ **OR** $\sqrt{480000}$ **OE** Do not award •2 unless their result can be correctly rounded to 693 Alternative method •1 $\frac{x}{\sin 120} = \frac{400}{\sin 30}$ •2 692.8203... **OR** $400\sqrt{3}$ **OR** $\sqrt{480000}$ **OE** Alternative method •1 $\tan 30 = \frac{400}{x}$ •2 692.8203... **OR** $400\sqrt{3}$ **OR** $\sqrt{480000}$ **OE** **SC** Substituting x with 693 in Pythagoras **OR** Sine rule **OR** tan ratio then making correct calculations both sides award 1 mark	**2**
	b	•1 recognizing that triangle OAC is equilateral **OR** substituting 400 correctly into circumference formula •2 correct substitution in Arc length formula •3 their correct calculation	•1 ACCEPT seeing angle 30º, 60º or 120 **OR** $2\pi 400$ **OR** 800π •2 $\frac{\text{their}120}{360} \times 800\pi$ **OR** $\frac{120}{360} \times \text{their}800\pi$ (Accept (800/3) x3.14 **OR** (800/3) x22/7 **OE**) •3 837.758... (838 cm) **OR** $800\pi/3$ •3 award as **ECF** only if •1 **OR** •2 is awarded and the calculation is of similar difficulty	**3**

			837.758... (838 cm) **OR** 800π/3 without working award 2 marks	
	c	adding 693 to their value in part (b)	693 + their 837.758... (838 cm) **OR** 1531 (cm) ACCEPT 692.820... OR 400√3 OR √48000 +their 837.758	**1**
Question		**Answers**	**Notes**	**Total**
5		$x = 5$ given in the question see 1 on diagram •[1] $2x + y = 12$ one intercept correct **OR** the line passes through two correct points •[2] $2x + y = 12$ y-intercept correct **and** crossing the line x = 5 at (5,2) •[3] $2y = x + 12$ y-intercept correct **OR** the line passes through two correct points •[4] $2y = x + 12$ y-intercept correct **and** crossing the line x = 5 at (5,8.5)	 To award the intercept (or intersection with x = 5) mark the line has to be ±0.5 unit accurate Accept equations placed incorrectly	**5**
		•[5] Their correct closed region (Most of the icon "region" has to be in the correct region in order to award the mark)	•[5] **ECF** can be awarded for a region to the left of x = 5 and above their 2x + y = 12 and below their 2y = x + 12	

<table>
<tr><th colspan="2">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>6</td><td>a</td><td>•[1] calculation of tax for 30 % band
•[2] their amount of tax for 30 % band calculated correctly
•[3] calculation of tax for 41 % band
•[4] their amount of tax for 41 % band calculated correctly from a subtraction followed by multiplication
•[5] their amount of total tax paid calculated correctly</td><td>
<table>
<tr><th>Annual income bands in EUR</th><th>Tax rate</th><th>Calculation of tax</th><th>Amount of tax EUR</th></tr>
<tr><td>0 < income ≤ 6000</td><td>0 %</td><td>0</td><td>0</td></tr>
<tr><td>6000 < income ≤ 12 000</td><td>5.5 %</td><td>(12 000 – 6000) x 5.5 %</td><td>330</td></tr>
<tr><td>12 000 < income ≤ 25 000</td><td>14 %</td><td>(25 000 – 12 000) x 14 %</td><td>1820</td></tr>
<tr><td>25 000 < income ≤ 70 000</td><td>30 %</td><td>(70000-25000)x30%</td><td>13500</td></tr>
<tr><td>Above 70 000</td><td>41 %</td><td>(80000-70000)x41%</td><td>4100</td></tr>
<tr><td></td><td></td><td>Total tax paid on 80 000 EUR</td><td>19750</td></tr>
</table>
</td><td>5</td></tr>
</table>

<table>
<tr><th colspan="2">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>6</td><td>b</td><td colspan="2">
<table>
<tr><th></th><th>(1 mark)</th><th>(2 marks)</th></tr>
<tr><td>Identify Factors (F)</td><td>Identify two elements from:
Income, taxes, expenses, the relocation place OR family</td><td>Identify more than two elements from:
Income, taxes, expenses, the relocation place OR family</td></tr>
<tr><td>Calculation Home (H)
For scenario 1</td><td>Attempt to calculate monthly OR yearly net saved value
Example:
Calculate Total Tax correctly:
Tax: 330 + 1820 + 15000 x 0.3(= 6650)
OR
Calculate Total expenses correctly
(400 + 900 + 500)x 12(=21600)
OR
40000-their calculated taxes-their calculated yearly expenses</td><td>Correctly calculating scenario 1 monthly net saved value OR yearly net saved value

(Saved value=40000 – 21600 – 6650 =)11750 OR 979.166… monthly

Accept the result with rounding eg. 12000 yearly OR 1000 monthly</td></tr>
<tr><td>Calculation Relocate (R)
For scenario 2</td><td>Attempt to calculate monthly OR yearly net saved value
Example:
Expenses:
(500+900+80+600)*12+their2x150=24960+300=25260
OR
Calculate correctly total expenses excluding home travel
(500+900+80+600)*12(=24960)
OR
Assuming a certain number of times to visit home but making an error in calculation eg.
(500+900+80+600) +their2x150=2080+300=2380

Accept 2080+150=2230
OR
50000-9650-their yearly incorrect expenses</td><td>Correctly calculating scenario 2 monthly net saved value OR yearly net saved value

(Saved value=50000 – their25260 – 9650=)15090 yearly OR 15090/12=1257.5 monthly

Accept the result with rounding eg. 15000 yearly OR 1250 monthly

Accept any number of trips home for example 15090 + 150 = 15240 (Allow for candidates that confuse ‘return’ for ‘one way’ only)</td></tr>
<tr><td>Justify accuracy of calculations (J)</td><td>Weak unsupported justification
OR
Sensible rounding used
OR
Recognizing that these are approximate calculations and not accurate

Do not accept: My calculations are accurate with any justification</td><td>Recognizing the calculation is not accurate with good reasoning:
because many of the monthly expenses are estimates
because medical expenses can vary
because the number of journeys home vary</td></tr>
</table>
</td><td>10</td></tr>
</table>

		Decision (D)	Relocate **OR** do not relocate with weak supporting justification Examples: I will relocate because I will make more money I will not relocate because I don't want to move Relocate **or** do not relocate without justification **OR** with irrelevant justification award 0 marks	Relocate **or** do not relocate with good supporting justification (balanced reflection) Examples: I will relocate because I will make more money even if I come to visit home once a month I will not relocate because even though I will be making xxx more money, it is not much compared to staying with family. I will relocate because I will make more money and I will gain new experiences by moving		

<table>
<tr><th colspan="2">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td rowspan="3">7</td><td>a</td><td>•1 any correct area
•2 the corresponding other correct area
•3 show appropriate operation either adding OR subtracting
800 AG</td><td>SC seeing only:
1800 – 1000 = 800 award 2 marks
OR
600 + 200 = 800 award 2 marks
60x10+30x8-40=800 award 1 mark for 60x10</td><td rowspan="2">3</td></tr>
<tr><td></td><td colspan="3"><table><tr><td>Example method 1
• 30 x 60 (= 1800)
• 4 x 10 x 25 = (1000)
• (30 x 60) – 4 x 10 x 25
Total 800 AG</td><td>Example method 2
• 60 x 10 (= 600)
• 10 x 10 x 2(= 200)
• 60 x 10 + 10 x 10 x 2
Total 800 AG</td><td>Example method 3
• 10 x 25 (= 250) and 10 x 25 (= 250)
• 10 x 30 (=300)
• 250 + 250 + 300
Total 800 AG</td><td>Example method 4
• 10 x 10 x 3 (= 300)
• 10 x 25 x 2 (= 500)
• 300 + 500
Total 800 AG</td></tr></table></td></tr>
<tr><td>b</td><td>$\tan\theta = \frac{30}{60}$</td><td>Accept $(\tan\theta =)\frac{15}{30}$</td><td>1</td></tr>
<tr><td>c</td><td>•1 using tan ratio to determine correct value of θ
•2 using correct ratio to set equation in x
•3 rearranging x on one side correctly
•4 the correct value of x
•5 rounding their result correctly to 1 dp</td><td>•1 $(\arctan\frac{1}{2} =)$ 26.565...deg
•2 $\sin(\text{their}\,\theta) = \frac{3}{x}$ OR $\frac{3}{\sin(\text{their}\theta)} = \frac{x}{\sin 90}$ OR $\frac{3}{x} = \text{their } 0.447...$
•3 $x = \frac{3}{\sin(\text{their}\theta)}$ OR $x = \frac{3}{\text{their}0.447...}$
•4 $(x =)\ 3\sqrt{5}$ OR 6.708… (cm)
•5 (x =) 6.7 (cm) 1 dp
$(x =)\ 3\sqrt{5}$ OR 6.708… (cm) without working award 3 marks</td><td>5</td></tr>
</table>

		Alternative method •1 using Pythagoras to determine correct value of $\sin\theta$ •2 using correct ratio to set equation in x •3 rearranging *x* on one side correctly •4 the correct value of *x* •5 rounding their result correctly to 1 dp	Alternative method •1 $\sin\theta = \frac{1}{\sqrt{5}}$ **OR** 0.447…. •2 $\frac{3}{x} = \text{their}\,\frac{1}{\sqrt{5}}$ **OR** $\frac{3}{\text{their}\sin\theta} = \frac{x}{\sin 90}$ **OR** $\frac{3}{x} = \text{their}\ 0.447...$ •3 $x = \frac{3}{\text{their}\sin\theta}$ **OR** $x = \frac{3}{\text{their}\ 0.447...}$ •4 (x =) $3\sqrt{5}$ **OR** 6.708… (cm) •5 (x =) 6.7 (cm) 1 dp Seeing only $\frac{3}{\sin 26.565..} = 6.708..$ award 4 marks Seeing only $\frac{3}{\sin\text{their}\theta} =$ their value not rounded **OR** exact value that doesn't need rounding award 3 marks	
	d	•1 calculating their base of the triangle correctly •2 using trigonometric ratio correctly to set equation involving H •3 rearranging their equation correctly to have H on one side •4 calculating correctly the area of triangle using their height of triangle and their base of triangle	•1 (Base of triangle = 25-their 6.7 =) 18.3 •2 $\frac{1}{2} = \frac{H}{25-3\sqrt{5}}\text{or}\frac{H}{\text{their}\ 18.3}$ **OR** $\frac{H}{\sin(\text{their}\ 26.565...)} = \frac{\text{their}\ 18.3}{\sin(90-\text{their}\ 26.565...)}$ •3 $(H=)\frac{1}{2}\times\text{their}18.3$ OR $\frac{25-3\sqrt{5}}{2}$ OR 9.146... •2 has to be seen in order to award •3. To award •4 their H without working has to be in the range of [9.1 , 9.2]	**4**

		84 AG	$\bullet^4$ $(T_1 =)\frac{1}{2}\times$ their $18.3\times$ their $9.146... = 83.6...$ Accept 83.7… Do not award $\bullet^4$ unless their result can be correctly rounded to 84 Do not award $\bullet^4$ if their answer is exactly 84	
	e	$\bullet^1$ seeing 4 x 44 **and** 4 x 84 $\bullet^2$ Adding correctly their multiplied values	$\bullet^2$ 512 (cm^2) 512 without working award 2 marks	**2**
	f	$\bullet^1$ dividing by total area of flag $\bullet^2$ calculating their percentage correctly	$\bullet^1$ Seeing 60 x 30 **OR** 1800 in denominator $\bullet^2$ $(\%\text{ represented} = \frac{\text{their } 512}{\text{their } 1800}\times 100 =) 28.444...(\%)$ 28.444... **OR** 28 % without working award 2 marks	**2**

Question		Answers	Notes	Total
8	a	•1 one suitable pattern •2 another suitable pattern	Examples of suitable patterns: Differences are 2,4,6 All even numbers Difference increasing Difference is even Second difference constant Number of female times the previous number of female f multiplied by f-1 **SC** 2 marks: Second difference is 2 The differences are two step different **OE** Double of triangular numbers Do not accept Number of kisses increases as the number of females increases **OE**	**2**
	b	•1 correct general rule with poor notation •2 correct general rule with correct notation	•1 (*k =)f*(f–1)* ***OR*** *f^2–f* ***OR*** *ff–f* ***OR*** *f*f–f* •2 (*k =) f(f–1)* ***OR*** *(k=)f^2–f* ***OR*** *fxf–f* ***OR*** *fx(f–1)* ***OR*** *(f)(f–1)* Do not accept description in words Do not accept notation that reads incorrect general rule eg. f x f–1	**2**
	c	•1 substitute $f \geq 6$ into their rule •2 correctly calculate their value of k after substitution $f \geq 6$ •3 recognise that their result is the same as their predicted value	•3 ACCEPT seeing the 30 in the table and seeing k = 30 from their calculation **SC** if "tested" correctly award 1 mark Tested correctly is when they apply the steps of verification mentioned in the left column on a value of $f \leq 6$	**3**

8	d	Mark	Predictions (P)	Description (D)	Testing (T)	Verifying (V)	Justify/proof (J)	Notation and terminology (N)	Communication (C)		24
		1	Correctly predict one term for any two sets of data *s* or *b* or *k* or *G* (when $m \geq 6$)	Attempt to describe a pattern Ex: they are all increasing or Recognize that pattern for *s* and *b* are the same	Attempted to test their described pattern or general rule of *b* or *s* or *G* for $m \leq 5$ ex: substitutes in their rule value of $m \leq 5$	Attempt to verify their general rule of *b* or *s* or *G* for $m \geq 6$ ex: substitute in their rule value of $m \geq 6$	Attempt to justify any of their described patterns or general rules Ex: refer to difference between terms or test at least two values for *s* and say it works or after stating the rule they say every time it is male times male	The notation or terminology is correct **OR** The notation and terminology have significant errors	Lines of reasoning are incomplete **OR** incoherent. Ex: Only two lines of calculations **or** algebraic steps		
		2	Correctly predict one row for the four sets of data (when $m \geq 6$) **OR** Correctly predict four values in the columns of *s* or *b* or *k* or *G* (when $m \geq 6$)	Recognize that pattern for *s* and *b* are the same **and** Attempt to describe a pattern for *s* Ex: the number is multiplied by itself or the number increases in 3,5,7,..	Correctly calculating their value of *b* or *s* or *G* using their value of $m \leq 5$ and recognizing that their result is the same as the table value (ACCEPT seeing their calculated value and their predicted value in the table being equal)	Correctly calculate their value of *b* or *s* or *G* using their value of $m \geq 6$	Justify any of the general rules correctly Ex: The second difference is constant Ex: The *s* (or *b*) are the square numbers **OR** Attempt to justify the general rule for Greeting (*G*) Ex: Attempt to add any of their rules for *b*, *s* or *k* together or test at least two values for *G* and say it works	The notation of a general rule and terminology describing pattern is correct **OR** Correct general rule in correct notation but not simplified Ex: G=m(2m+m-1)	Lines of reasoning are coherent **OR** answer is organised using a logical structure.		

Mark	Predictions (P)	Description (D)	Testing (T)	Verifying (V)	Justify/proof (J)	Notation and terminology (N)	Communication (C)
3	Correctly predict two rows for the four sets of data (when $m \geq 6$) **OR** Correctly predict eight values in the columns of s or b or k or G (when $m \geq 6$)	Correctly describe pattern in words for smiles (s) Ex: They are the square numbers or the second difference is constant or it is quadratic or second degree or $s = m \times f$		Recognise that their result for G is the same as their predicted value (ACCEPT seeing their calculated value and their predicted value in the table being equal) Allow V3 only if they verify their rule for G correctly	Justify any of the general rules correctly Ex: The second difference is constant Ex: The s (or b) are the square numbers **AND** Attempt to justify the general rule for Greeting (G) Ex: Attempt to add any of the rules for b, s or k together or test at least two values for s and say it works **OR** Justify correctly the general rule for Greeting (G) Ex: Add correctly their rules for b, s and k together	The notation of their general rule for G and terminology used are correct and their general rule is simplified as $G = 3m^2-m$ or $G = m(3m-1)$ Award only if D5 is achieved	Lines of reasoning are coherent **AND** answer is organised using a logical structure Award only if J2 is achieved
4		Correctly describe pattern as general rule for smiles (s) **AND** recognise it is the same as for bows (b) $s = m^2$ and b the same writing only $s = m^2$ award D3			Justify any of the general rules correctly Ex: The second difference is constant Ex: The s (or b) are the square numbers **AND** Justify correctly the general rule for Greeting (G) Ex: Add correctly the rules for b, s and k together		

		Mark	Predictions (P)	Description (D)	Testing (T)	Verifying (V)	Justify/proof (J)	Notation and terminology (N)	Communication (C)		
		5		Attempt to describe pattern as general rule for G Ex: the rule is $3m^2$-m or $m(3m$-1) **OR** adding correct rules incorrectly $G=2m^2-m+m^2=2m^2$							
		6		Correctly describe the pattern for G as a general rule $G = m(m$-1) + m^2 + m^2 **OR** $G = 3m^2 - m$							

Predictions

Table Object

Number of males (m)	Number of females (f)	Number of kisses (k)	Number of bows (b)	Number of smiles (s)	Total number of greetings (G)
1	**1**	**0**	**1**	**1**	**2**
2	**2**	**2**	**4**	**4**	**10**
3	**3**	**6**	**9**	**9**	**24**
4	**4**	**12**	**16**	**16**	**44**
5	**5**	**20**	**25**	**25**	**70**
6	6	30	36	36	102
7	7	42	49	49	140
8	8	56	64	64	184
9	9	70	81	81	232
10	10	86	100	100	286
11	11	110	121	121	352
12	12	132	144	144	420
13	13	156	169	169	494
14	14	182	196	196	574
15	15	210	225	225	660

Rules:

$k = m(m$-1) $s = m^2$ $b = m^2$ $G = m(m - 1) + m^2 + m^2 = 3\,m^2 - m$