Markscheme

November 2022

Mathematics

On-screen examination

26 pages

The markscheme abbreviations:

The markscheme may make use of the following abbreviation: **OE** – ‘or equivalent’

• 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 and 49 seen **OE** *Ex:* $49 = 45 + x$ .2	**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.

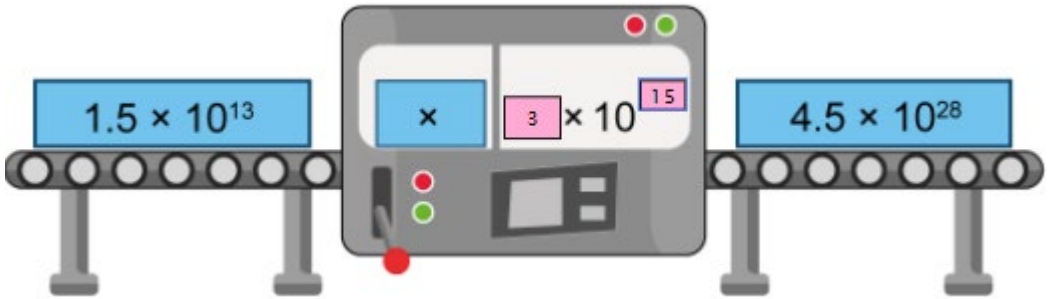
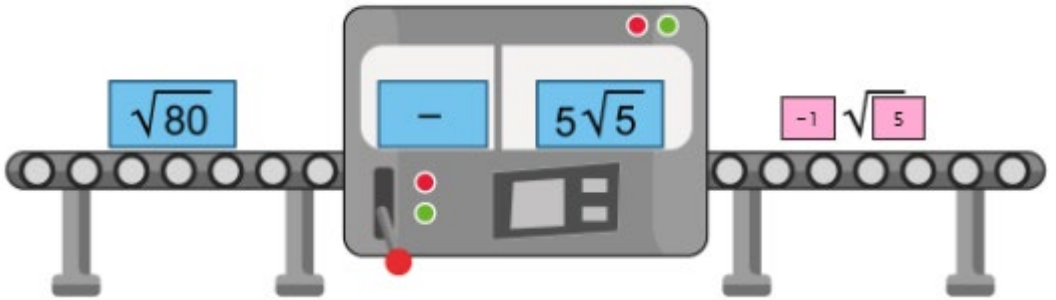
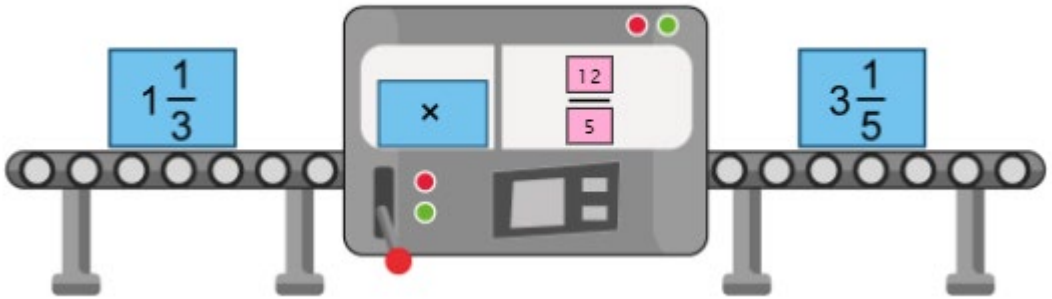
a. **ECF** applies from one part of a question to a subsequent part of the question and also applies within the same part.
b. If an answer resulting from **ECF** is inappropriate (*eg*, negative distances or sin$x$ > 1) then subsequent marks should not be awarded.
c. If a question is transformed by an 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.

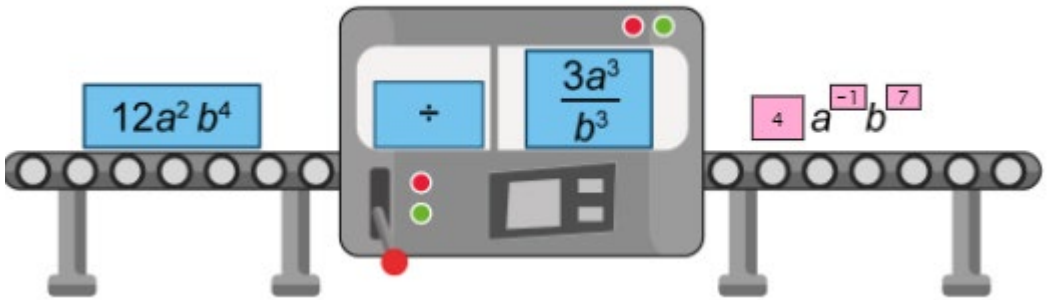
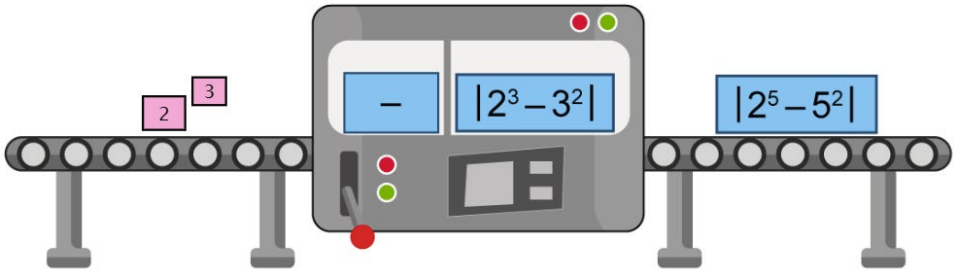
General points

a. As this is an international examination, accept all **alternative forms of notation,** for example 1,9 as 1.9 ; 1,000 or 1.000. However **DO NOT ACCEPT** incorrect mathematical notation x^2 for x^2 unless noted otherwise in the MS
b. Accept notation errors in intermediate steps.
c. Ignore further working after a correct answer **unless** it indicates a lack of mathematical understanding **i.e. if the further working contradict the correct answer,** then that last mark cannot be awarded.
d. In the case when a correct result is obtained using incorrect seen method, do not award the mark for the result.
e. Where candidates have written two solutions to a question, mark the first solution.
f. 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)

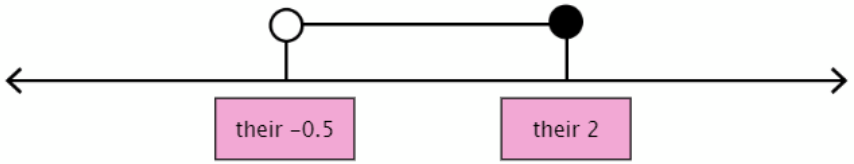
e.g. $\frac{1}{2}$ **OR** 1/2 **OR** 0.5 **OR** $2 \div 4$ **;** $\frac{x}{2}$ **OR** x/2 **OR** $x \div 2$; 0.23 **OR** 23%

g. 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. However, these results need to be seen in the appropriate context to award the mark
h. Special case marks **SC** can be allocated instead of but not in addition to the marks prescribed in the markscheme.
i. Accept seeing equation not in-line.
j. Calculator screenshots are accepted as working steps. And when a calculator screenshot is taken, accept not seeing the whole operation.
k. 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.
l. ACCEPT using the correct values regardless their previous result.
m. Candidates will sometimes use methods other than those in the markscheme. Unless the question specifies a method, other correct methods should be marked in line with the markscheme. If in doubt, contact your team leader for advice.
n. Unless noted otherwise, if a note in a part says to accept the answer without working for 1 mark less than total marks, then seeing the correct answer with any acceptable working step, award full marks. Example: If the note in a part worth 3 marks says “4.3(3…) without working award 2 marks”, then seeing any acceptable working step and seeing 4.3(3…) as the answer award the 3 marks.

Q1	Answers	Notes	Total
	3×10^{15}		1
	$-\sqrt{5}$ or $-1\sqrt{5}$		1
	$\frac{12}{5}$ OE DO NOT ACCEPT decimals in numerator or denominator		1 1

		$4a^{-1}b^{7}$		**1**
		2^3 ACCEPT 8^1 or 8		

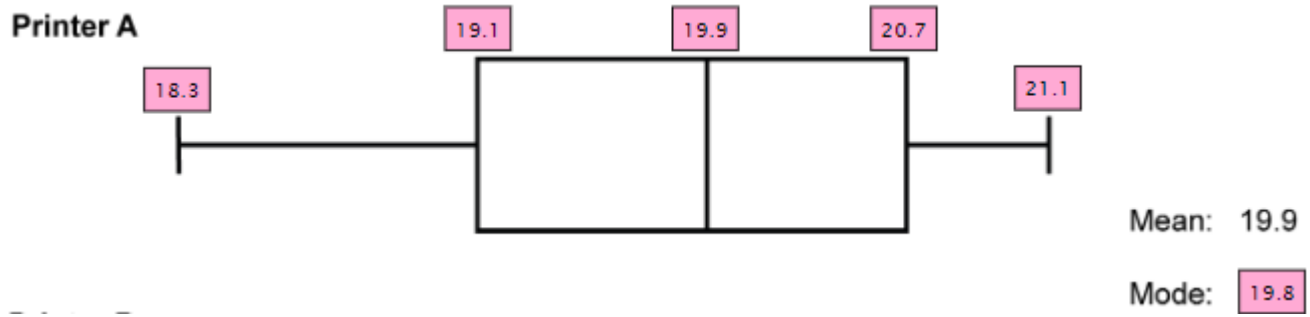
Q2		Answers	Notes	Total
	a	.1 Correctly write two missing values .2 Correctly write the third missing value		**2**
	b	.1 Correct number of students who travel by bus or car .2 Correctly divide their86 by their total number of students in part (a)	.1 86 .2 $(\frac{their86}{their150})$ or $\frac{43}{75}$ or 0.57(333...) OE	**2**
	c	$\frac{15}{56}$ or 0.267(857...) OE		**1**
	d	.1 Correct initial probability .2 Multiply three probabilities without OR with replacement .3 Correctly multiply their three probabilities without replacement	.1 $\frac{12}{their150}$ OE ACCEPT their150 being their total seen in their part b) .2 $their(\frac{12}{150}\times\frac{11}{149}\times\frac{10}{148})$ OR $(their\frac{12}{150})^3$ or 0.0000512 .3 $their\frac{1320}{3307800}$ or $their\frac{11}{27565}$ or their0.0000399(0...) OE ACCEPT 0.00004	**3**

Q3		Answers	Notes	Total
	a	.1 Correctly rearrange the inequality to have x on one side .2 Correctly write their inequality after dividing by 5	.1 $5x \leq 10$ or $5x = 10$ or $x = \frac{10}{5}$ OE .2 $x \leq \frac{their 10}{5}$ OE ACCEPT their 10 being 11-1 .2 ACCEPT x less than or equal 2 $x \leq \frac{10}{5}$ OE without working award 2 marks $x = 2$ with or without working award 1 mark ACCEPT strict and not strict inequalities	**2**
	b	.1 Correctly expand .2 Correctly rearrange the inequality to have x on one side .3 Correctly write their inequality after dividing their -7 by their 14	.1 $-9x - 6 < 5x + 1$ ACCEPT $-9x - 6 = 5x + 1$ or $-9x - 6 - 5x - 1 = 0$ OE .2 $-7 < 14x$ or $-14x < 7$ ACCEPT $-7 = 14x$ OE .3 $x > their \frac{-7}{14}$ OE $x > \frac{-7}{14}$ OE without working award 2 marks $x = -0.5$ OE without working award 1 mark ACCEPT strict and not strict inequalities	**3**
	c	.1 Correctly place two items .2 Correctly place the rest of the five items	ACCEPT ECF from their previous results  	**2**

Q4		Answers	Notes	Total
	a	.1 Identify the transformation type .2 Identify the value of the transformation 60°	.1 Rotation anti-clockwise or counter clockwise .2 60 (degrees) ACCEPT -60 (degrees)	**2**
	b	.1 Correct use of Pythagoras .2 Correct value of height .3 Correct comparison of their 230.48... and 230 Storage unit cannot be lifted into place AG	.1 $50^2 + 225^2 = h^2$ *OE* or 53125 .2 (h =) 230.4(886…) ACCEPT [230.4, 230.5] .3 their230.4(886…) > 230 or anything that WTTE Ex: "230.48 is greater than height of ceiling" or "and height of ceiling is 230" .3 DO NOT ACCEPT unless .1 or .2 is awarded	**3**
	c	.1 Correctly substitute h, x and 230 into the Pythagoras's theorem .2 Correctly rearrange the formula to have h on one side	.1 $h^2 + x^2 = 230^2$ OE .2 (h =) $\sqrt{52900 - x^2}$ OE	**2**
	d	Correctly calculate their h using x=50 and 230 into their formula for h provided that their formula for h is of similar complexity	Their 224(.4994432) ACCEPT in the working ex: $50^2 + 224.(499)^2 = hyp^2$	**1**
	e	Selects storage unit with height 220		**1**
	f	.1 Correctly substitute 50 and their 220 into volume of cuboid .2 Correct calculate their volume for their height	.1 50 × 50 × their 220 .2 their 550 000 (cm^3)	**2**

Q5		Answers	Notes	Total
	a	.1 A correct reason for a pair of congruent angles .2 A correct reason for another pair of congruent angles (AA) $\Delta ABC \sim \Delta ADE$ AG	**Examples of correct reasons for pair of congruent angles:** - Angle BAC = Angle DAE or Angle A is common angle or same angle A or share angle A WTTE. (They have to mention the angle A). ACCEPT angle A = angle A DO NOT ACCEPT they share same angle or they have a common angle - Angle ABC= Angle ADE with reason Ex: BC parallel to DE or parallel lines or corresponding angles ACCEPT Angle B = Angle D instead of Angle ABC= Angle ADE - Angle ACB= Angle AED with reason Ex: BC parallel to DE or parallel lines or corresponding angles ACCEPT Angle C = Angle E instead of Angle ACB= Angle AED DO NOT ACCEPT Angle ABC and Angle ADE are similar or Angle ACB and AED are similar DO NOT ACCEPT seeing only Angle ABC= Angle ADE or Angle ACB= Angle AED without correct reasoning	**2**
	b	.1 Correct ratio	.1 (3/(3 + 4) =) 3:7 or $\frac{3}{7}$ or 0.428(57…) OE ACCEPT 0.43 OE	**1**

	c	.1 Squaring their length ratio .2 Multiply their ratio of area by 9 .3 Correctly subtract 9 from their area of triangle ADE	.1 $(\text{their}\frac{7}{3})^2$ OE ACCEPT $(\text{their}\frac{3}{7})^2$ OE .2 $\text{their}(\frac{7}{3})^2 \times 9$ or 49 .2 ACCEPT seeing $\text{their}\frac{7}{3}\times 9$ or 21 BUT DO NOT ACCEPT *their* $\frac{3}{7}\times 9$ .3 (their49-9=) their 40 (cm^2) ACCEPT only if positive	**3**

Q6		Answers	Notes	Total
	a	Correct mass of phone case	(1.25 x 29 =) 36(.25) (g)	**1**
	b	.1 Divide 1000 by their mass .2 Correctly round their answer to nearest whole number	.1 $\frac{1000}{their\,36.25}$ or 27.586.. .2 their27 ACCEPT only if $\frac{1000}{their\,36.25}$ is not a whole number	**2**
	c	.1 Correct method to calculate the mean .2 Correct value of mean before rounding 19.9 AG	.1 $\frac{18.3 + 18.5 + 19.1 + \ldots + 21.1}{11}$ or $\frac{218.7}{11}$ ACCEPT 18.3 + 18.5 + 19.1 +…+ 21.1 /11 .1 ACCEPT if they divide at least sum of eight values by 10 or 11 .2 19.88(18….) DO NOT ACCEPT 19.89	**2**
	d	.1 two correct values .2 another two correct values .3 another two correct values	 Min 18.3, Q1 19.1, Median 19.9, Q3 20.7, Max 21.1 and Mode 19.8	**3**

	e	One fully correct reason for Printer A referring to a measure of dispersion or mode Printer A is better AG .	Examples (WTTE): has smaller IQR has smaller range less spread Mode is less ACCEPT most recurring time or most common or most frequent ACCEPT Printer A is better because it is more reliable or more consistent ACCEPT using the descriptor 'better' for 'less/lower/smaller' WTTE DO NOT ACCEPT comments about skewness ex: less skewed DO NOT ACCEPT the length of the box is smaller DO NOT ACCEPT comments just about the maximum Ex: The maximum is less	**1**
	f	One fully correct reason for Printer B referring to a measure of central tendency Printer B is better AG	Examples (WTTE): has a lower median has smaller average ACCEPT using the descriptor 'better' for 'less/lower/smaller' WTTE ACCEPT "smaller Q1 and Q3" DO NOT ACCEPT smaller Q1 only or smaller Q3 only DO NOT ACCEPT comments just about the minimum Ex: The minimum is less	**1**

Q7	Answers	Notes	Total
a	.1 b = 2.5 OE ACCEPT [2, 2.5] OE .2 c = 50 OE	ACCEPT using capital letters ACCEPT seeing values replaced in the equation	**2**
b	**AM1** .1 Correctly substitute n = 2 into the F equation .2 Correctly calculate F=42 **AM2** .1 Correctly substitute F= 42 into the F equation .2 Correctly calculate n=2 **AM3** .1 Correctly substitute (2,42) into the F equation .2 Correctly square the –6 and multiply by 1.5	**AM1** .1 (F =) $-1.5(2-8)^2+96$ ACCEPT 8-2 instead of 2-8 .2 (F =) $-54+96$ (= 42) **AM2** .1 $42=-1.5(n-8)^2+96$ .2 $(n-8)^2=36$, n=2 **AM3** .1 $42=-1.5(2-8)^2+96$ ACCEPT 8-2 instead of 2-8 .2 $42=-54+96$ ACCEPT any evidence of equality Ex: 96=96	**2**

c	**AM1 (Solving)** .1 Equate their E with $-1.5(n-8)^2+96$ .2 Correctly expand $(n-8)^2$ and multiply by -1.5 .3 Correctly rearrange their quadratic equation on one side = 0 .4 Correctly substitute into quadratic formula .5 Correctly calculate their *n* **AM2 (substitution trials)** .1 Correctly substitute in their E and the F same value of *n*, accept decimal **within domain** .2 Correctly calculate their value of E and the value of F for their value of *n* .3 Correctly calculate their value of E and the value of F for another value of *n* .4 Compare value of E and F .5 Correctly identify their *n* **within the given domain**	**AM1 (Solving)** .1 their $2.5n+50=-1.5(n-8)^2+96$ ACCEPT using < instead of = .1 ACCEPT their E to be 70 .2 $-1.5n^2+24n-96$ OE SEEN .3 their $1.5n^2-21.5n+50=0$ ACCEPT using < instead of = .4 their $\frac{21.5\pm\sqrt{21.5^2-4\times1.5\times50}}{2\times1.5}$ .5 (*n*=) Their 2.92 or 3 **AM2 (substitution trials)** .1 Ex: $2.5(2)+50$ and $-1.5(2-8)^2+96$ .2 Ex: their55 and 42 when *n*=2 ACCEPT values from graph not exact .3 Ex: their60 and 72 when *n*=4 ACCEPT values from graph not exact .4 evidence of comparing values of their E and F at same value of *n* Ex: 72>their60 ACCEPT argument based on the graph .5 (*n*=)their3 .5 DO NOT ACCEPT if *n*>8 .5 DO NOT ACCEPT their3 if they use only values from graph	**5**

d	.1 Correct value of h .2 Correct value of k .3 Substitute point (2,50) into L .4 Correct value of a	.1 h=8 .2 k=86 .3 $50 = a(2-h)^2 + k$ ACCEPT substituting n=2 and any values for a,f, and k that gives 50 Ex: $4(2-5)^2+14=50$ .4 $a = -1$ ACCEPT seeing –1 in the expression $(L =) -(n-h)^2 + k$	**4**

7	e		10

Mark	1	2	3	4	5
Identify factors (F)	State one factor from: - Number of observations - The y-intercept Ignore additional irrelevant factors				
Calculation (C)	Equate their L with $-1.5(n-8)^2+96$ OR Correctly substitute in their L and the F same value of n	Correctly Expand both quadratics Ex: $-n^2+16n-64+86=-1.5n^2+24n$ OR Correctly calculate their value of L and the value of F for a certain value of n	Correctly rearrange their quadratics on one side = 0 Ex: $0.5n^2-8n+22=0$ OR Correctly calculate their value of L and the value of F for another value of n	Correctly substitute into quadratic formula OR Compare value of L and F	Correctly calculate their value of n Ex: (n =)3.53 OR Correctly identify their n within the given domain Accept their correctly calculated n only if between 2 and 5
Accuracy (A)	Recognizing it is not accurate with weak justification Examples: (WTTE) these are approximate calculations and not accurate Inaccurate because of rounding Inaccurate because equations not accurate **OR** Sensible rounding used in calculations without a comment ex: 2.55 is 3 DO NOT ACCEPT: my results are accurate WTTE	Recognizing it is not accurate with acceptable justification Examples: (WTTE) The equations we are using are not exactly the models that represent the data OR Accurate with strong justification Ex: Regardless of the equation I use the intersection between both will still be in the range 2 to 3			

Justify (J)	Weak Justification Appropriate comment on one of the methods Examples: (WTTE) - Correct comment on the graphical behaviour of a method -The success rate of E is 50% even with zero observations OR Attempt to comment on two or more methods Examples: (WTTE) - The Fisherface is most accurate (or highest success rate) - The maximum success rate for F is 96% while for L only 86%	Good Justification Appropriate comment/comparison on at least two methods Examples: (WTTE) - Fisherface is better than LBPH in the long run - When n = 2 or less use LBPH and when n = 4 or more use Fisherface - The maximum success rate for F is 96% while for L only 86% for the maximum n (or at n=8) -The success rate of E is 50% even with zero observations while for others it is less ACCEPT: The Fisherface is most accurate (or highest success rate) for the maximum n (or at n=8) DO NOT ACCEPT if they do not have a choice of method			

<table>
<tr><th colspan="2">Question 8</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td></td><td>a</td><td>AM1
.1 correctly substitute 2 into correct equation
.2 correctly substitute –2 into correct equation

9 AG

AM2
.1 substitute f(x)=9 and get x=2

.2 substitute g(x)=9 and get x=-2</td><td>AM1
.1 $(y =) (2 – 5)^2$
.2 $(y =) (–2 + 5)^2$

AM2
.1 $9 = (x – 5)^2$, $x – 5 = \pm 3$, $x = 2$ or $x = 8$ ACCEPT if they expand and factorise
.2 $9 = (x + 5)^2$, $x + 5 = \pm 3$, $x = –2$ or $x = –8$ ACCEPT if they expand and factorise

DO NOT ACCEPT describing how squares are added</td><td>2</td></tr>
<tr><td></td><td>b</td><td>Correctly place 36 and 44</td><td><table><tr><th>Stage (n)</th><th>Number of new squares added (S)</th></tr><tr><td>1</td><td>4</td></tr><tr><td>2</td><td>12</td></tr><tr><td>3</td><td>20</td></tr><tr><td>4</td><td>28</td></tr><tr><td>5</td><td>36</td></tr><tr><td>6</td><td>44</td></tr></table></td><td>1</td></tr>
<tr><td></td><td>c</td><td>.1 correctly describe one pattern for S in words

.2 correctly describe a second pattern for S in words</td><td>Examples of accepted terminology:
- Even numbers
- Multiples of 4, divisible by 4
- Increasing by 8, adds 8 every time, goes up by 8, moves up by 8
- Difference 8, linear with difference 8, arithmetic d= 8
- Second difference is zero
- product of 4 and odd number

DO NOT ACCEPT incomplete terminology, for example:
Arithmetic, linear, increasing by a constant, constant difference, the even numbers or the multiples of 4

DO NOT ACCEPT the rule in words, for example:
8 times n minus 4, n multiplied by 8 minus 4, 8 times stage number minus 4, the difference between 8n and 4</td><td>2</td></tr>
</table>

			DO NOT ACCEPT *n* goes up by 1 It is increasing general rules in terms of *n*, example: S = 8*n*-4 More than two different patterns, all correct award **(2 marks)** Ex: adds 8 and Second difference is zero and it is 8 times n minus 4 More than two different patterns, with any incorrect award **(1 mark)** Ex: adds 8 and Second difference is zero and it is 8 times n	
	d	.1 the correct general rule .2 the correct simplified general rule with correct notation	.1 (S =) 8*n*-4 or (S=) 4(2*n*–1) or $S = 8 \times n - 4$ or $S = 8 * n - 4$ or S=8x-4 or S=4+8(*n*-1) .2 S = 8*n*–4 or S = 4(2*n*–1) ACCEPT S=(8*n*-4) ACCEPT using S_n instead of S DO NOT ACCEPT description in words	**2**
	e	·1 Correctly substitute n ≥ 5 into their general rule ·2 Correctly calculate their value of S after substituting n ≥ 5 ·3 Recognize that their result is the same as the correctly predicted value	.1 Ex: $8 \times 5 - 4$ ·2 Ex: 52 (for the *n* = 7) .3 “the same as when we continue the pattern” WTTE and states how Ex: For n=7, 52 is obtained from pattern of adding 8 to 44 ·3 ACCEPT if their value from .2 is the same as their value in the table in part b) or seen here in part e)	**3**

8	f		20

Mark	1	2	3	4
Predictions (P)	Correctly predict two terms for T ACCEPT whether in the table or in the response box			
Description (D)	Correctly describe a pattern in words or recursive rule for *T* (Ignore additional incorrect patterns) Ex: Even numbers Square numbers Divisible by 4, multiples of 4, part of 4 timetable The increase increases by 8 first difference increases by 8 second difference 8 It is quadratic or the recursive rule for *T* $T_n = T_{n-1} + S_n$ DO NOT ACCEPT descriptions of how squares are added DO NOT ACCEPT goes up by 12,20,28,… DO NOT ACCEPT descriptions using n or S DO NOT ACCEPT recursive rule in words OR Valid attempt to write down a general rule for *T* Ex: $T= n^2+4$	Correctly describe two patterns in words or recursive rule for *T* (Ignore additional incorrect patterns) OR Correctly describe a pattern in words or recursive rule for *T* AND valid attempt to write a general rule for *T*. OR Correctly write down the general rule for *T* $T=4n^2$ ACCEPT the general rule in words but penalise in notation Ex: The square of 2n (for Notation see N)	Correctly describe two patterns in words or recursive rule for *T* (Ignore additional incorrect patterns) AND valid attempt to write down general rule for *T* OR Correctly describe one pattern in words or recursive rule for *T* AND correctly write down the general rule for *T* ACCEPT the general rule in words but penalise in notation Ex: The square of 2n (for Notation see N)	Correctly describe two patterns in words or recursive rule for *T* (Ignore additional incorrect patterns) AND Correctly write down the general rule for *T* ACCEPT the general rule in words but penalise in notation Ex: The square of 2n (for Notation see N)

Testing (T)	Attempt to test their general rule for T using $n \leq 4$ Correctly substitute in their general rule for T value of $n \leq 4$ **OR** Correctly test their rule for T or described pattern or recursive rule	Correctly test their general rule for T using $n \leq 4$ Correctly calculate their value for T in their general rule using $n \leq 4$ **AND** Recognize that their correctly calculated value for T is the same as the given value. ACCEPT seeing their correctly calculated value for T and the given value in the table being equal		
Verifying (V)	Attempt to verify their general rule for T using $n \geq 5$ Correctly substitute in their general rule for T value of $n \geq 5$ **OR** Correctly verify their rule for T or described pattern or recursive rule	Correctly calculate their value for T in their general rule using $n \geq 5$	Correctly calculate their value for T in their general rule using $n \geq 5$ **AND** Recognise that their correctly calculated value for T is the same as their predicted value obtained by continuing the pattern ACCEPT seeing their correctly calculated value for T and their predicted value in the table being equal	

Justify/ proof (J)	Weak attempt to justify their general rule for *T* or described pattern or rule or recursive rule Examples: trying at least two more values and arguing as justification that they are the same or rule works or Attempt to find coefficients of quadratic using any method DO NOT ACCEPT if D1 not achieved	Justify their general rule arithmetically Ex: Correctly finding the coefficients using the second difference **OR** Attempt to justify their general rule geometrically Ex: Try to calculate area rectangle DO NOT ACCEPT if D2 not achieved	Good attempt to justify the general rule for *T* in relation to geometry by using incorrect equations or information DO NOT ACCEPT if $T=4n^2$ not reached	Correctly justify the general rule for T in relation to geometry by using area of rectangle with base 4 and functions for the height. Total number of squares is the area of a rectangle with base 4 and height of $y=(x-a)^2$ $x = 2$ (because of base 4 symmetrical) $a = n + 2$ starting at $(x – 3)$ for stage $n = 1$. $A = b*h$ $A = 4*(2–(n+2)^2$ $A= 4*(2-n-2)^2$ $A= 4*(-n)^2$ $A= 4n^2$ DO NOT ACCEPT if $T=4n^2$ not reached

Communication criteria

Mark	1	2	3
Notation and terminology (N)	Correct notation of their general rule for T **OR** The notation of the general rule for T includes errors, ex: $T=4xn^2$ or the square of 2n or non-simplified general rule Ex: $(n+n)^2$ **OR** Correctly describe at least one pattern in words for T DO NOT ACCEPT if they don't have any rules and they don't describe any patterns	Correct notation of the general rule for T $T=4n^2$ or $T_n=4n^2$ ACCEPT $T=(2n)^2$ or $T=4(n)^2$ **OR** The notation of the general rule includes errors (see examples in N1) **AND** Correctly describe at least one pattern in words for T ACCEPT using U_n instead of T only if they mention that $T=U_n$ DO NOT ACCEPT using * for multiplication using / for division using ^ for power Using x instead of n DO NOT ACCEPT if they don't have the general rule for T	Correct notation of the general rule for T (see examples in N2) **AND** Correctly describe at least one pattern in words for T ACCEPT using U_n instead of T only if they mention that $T=U_n$ DO NOT ACCEPT using * for multiplication using / for division using ^ for power Using x instead of n DO NOT ACCEPT if they don't have the general rule for T

Continued on next page

Mark	1	2	3
Communication (L) Organisation and coherence Can be awarded even if there are errors Describing pattern and writing rule can be considered an item even if D0 awarded Test, verify, and justify may include errors but cannot be considered item (or identified for coherence) if they are zeros	**At least three** from the following items are seen: • describe a pattern in words • write a rule • test their general rule or rule or recursive rule or pattern (at least T1) • verify their general rule or rule or recursive rule or pattern (at least V1) • justify their general rule or rule or recursive rule or pattern (at least J1)	DO NOT ACCEPT if they don't have a general rule **At least four** of the following items are seen: • describe a pattern in words • write a general rule • test their general rule (at least T1) • verify their general rule (at least V1) • justify their general rule (at least J1) **AND** For coherence, they identify the processes correctly. **At least one** from the following: • test (at least T1) • verify (at least V1) • justify (at least J1) Ex: • **For test:** they say "test" and they test using value(s) of $n \leq 4$ only • **For verify:** they say "verify" and they verify using value(s) of $n \geq 5$ only • **For test and for verify:** they say 'test **and** verify' and they test using value(s) of $n \leq 4$ **and** then verify using value(s) of $n \geq 5$ • **For justify:** At least J1 awarded	**The following two items must be seen** : • write the general rule for T • justify the general rule (at least J2) **AND** **At least two** of the following items are seen: • describe a pattern or rule in words • test the general rule (at least T1) • verify the general rule (at least V1) **AND** For coherence, they identify the processes correctly. **At least one** from the following: • test (at least T1) • verify (at least V1) Ex: • **For test:** they say "test" and they test using value(s) of $n \leq 4$ only • **For verify:** they say "verify" and they verify using value(s) of $n \geq 5$ only • **For test and for verify:** they say 'test **and** verify' and they test using value(s) of $n \leq 4$ **and** then verify using value(s) of $n \geq 5$

Stage (n)	Number of new squares (S)	Total number of squares (T)
1	4	4
2	12	16
3	20	36
4	28	64
5	36	100
6	44	144
7	52	196