

# Markscheme

May 2024

Mathematics

On-screen examination

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

The markscheme abbreviations:

- Bullet notation means award 1 mark – see example below

Example 1  
.1 mark awarded and corresponding notes are aligned

b	<p>.1 Show clear line of reasoning in the method</p> <p>.2 4</p>	<p>.1 45 and 49 seen <b>OE</b></p> <p><i>Ex:</i> <math>49 = 45 + x</math></p> <p>.2</p>	<b>2</b>
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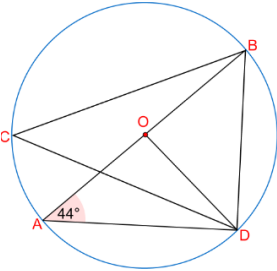
### Error Carried Forward (ECF) marks

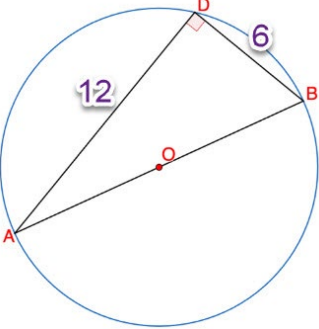
Errors made at any step of a solution affect all working that follows. In general, **Error Carried Forward (ECF)** marks are awarded after an error.

- 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 considered an error that allows ECF afterwards even if the rest of the question requires “the” result and not “their” result.

### General notes

- 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) Unless noted otherwise, ignore further working after a correct answer even if further working is incorrect.
- 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, it indicates what the candidate’s result represents. Ex: if last mark is for the result: (AB)=5; this means we award the mark for seeing 5 as the result of calculating AB without necessarily seeing AB=5, but it does not mean we award the mark for seeing 5 representing another length.
- 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 or the fraction line missing.
- 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) Unless noted otherwise, **ACCEPT** using the correct values or working 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.
- o) For “**show that**” questions, unless otherwise noted, every bullet point has to be seen in order to be awarded.
- p) When a result is written as “their5.7(37...)” it means accept their result if its minimum accuracy is 1 dp. Providing higher accuracy is of course accepted but not required. Rounding their result incorrectly to nearest 1 dp is not accepted.
- q) When there are multiple alternative methods (multiple AM), mark the response using one specific AM. Do not add different marks from different AM.

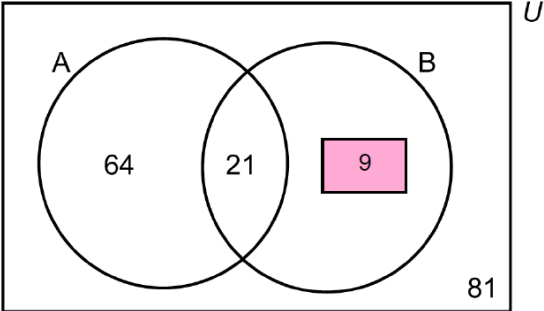
Q1	Answers	Notes	Total
a	Angle AOD 92 Angle DOB 88 Angle DCB 44	Angle AOD <input type="text" value="92"/> ° Angle DOB <input type="text" value="88"/> ° Angle DCB <input type="text" value="44"/> ° 	3
b	The correct reason	<p><b>ACCEPT</b>                      (AB) diameter, passes by the centre, <math>AB=2r</math>                      A, O, and B are on the same line                      semi-circle, half circle                      (angle) ADB is half (angle) AOB WTTE</p> <p><b>DO NOT ACCEPT</b>                      seeing only 90 is half 180                      O is midpoint , OA and OB are radius                      AB doesn't move regardless how we move D                      Triangle inside a circle                      A and B positioned at both ends</p>	1

<p>c</p>	<p>.1 correctly substitute into Pythagoras theorem</p> <p>.2 correctly write <b>the</b> result in simplified surd form</p>	 <p>.1 <math>(AB^2=)12^2 + 6^2</math> or 180 or <math>\sqrt{180}</math> or <math>3\sqrt{20}</math> OE          .1 ACCEPT 13.(416...)</p> <p>.2 <math>6\sqrt{5}</math> ACCEPT <math>6\sqrt{3}</math> only if their bp1 is <math>12^2 - 6^2</math> or 108 or <math>\sqrt{108}</math></p>	<p>2</p>
<p>d</p>	<p>.1 correctly substitute <b>their</b> radius as half their diameter from c) into area of circle formula</p> <p>.2 correctly calculate their area after squaring their radius seen in bp1 and multiplying by <math>\pi</math></p>	<p>.1 <math>\pi \times \left(\frac{\text{their}6\sqrt{5}}{2}\right)^2</math> or <math>\pi \times (\text{their}3\sqrt{5})^2</math> or <math>\pi \times \left(\frac{\text{their}(13.(416...))}{2}\right)^2</math> or <math>\pi \times \text{their}6.5^2</math> OE          .1 ACCEPT using 3.14 or <math>\frac{22}{7}</math> instead of <math>\pi</math></p> <p>.2 their<math>45\pi</math> ACCEPT their<math>141(.37...)</math>          .2 ACCEPT their result using 3.14 or <math>\frac{22}{7}</math> instead of <math>\pi</math></p> <p>(See important examples next page)</p>	<p>2</p>

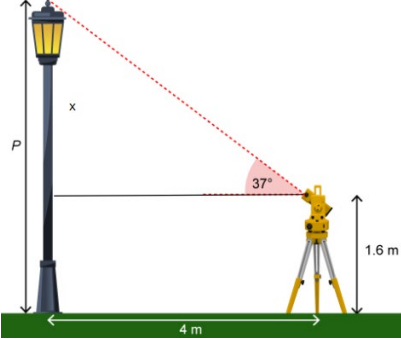
**Important examples showing concepts of marking that can be applied in all your marking**

Part	Student work	Marking
1c	$\sqrt{180} = 6\sqrt{5} = 14$	<b>bp1 awarded</b> because we see $\sqrt{180}$  <b>bp2 awarded</b> because we see $6\sqrt{5}$ and we ignore further working (see point c in general notes)
1d	$\pi 7^2 = 154$	<b>bp1 not awarded</b> because their diameter from c) is $6\sqrt{5}$ (and this is what they were awarded the mark for in their 1c) So only $\pi \times (3\sqrt{5})^2$ or $\pi \times (6.7(08 \dots))^2$ as their radius would be accepted in this case)  <b>bp2 awarded</b> because they correctly calculate their area after squaring their radius seen in bp1 and multiplying by $\pi$ and their result is correct to nearest whole number since we ACCEPT their 141(.37...)

Part	Student work	Marking
1c	$12 + 6 = 18$	<b>bp1 not awarded</b> because they are not adding $12^2$ to $6^2$  <b>bp2 not awarded</b> because the result is not $6\sqrt{5}$
1d	$3.14 \times 9^2 = 255$	<b>bp1 awarded</b> because their diameter from c) is 18 so 9 here is their radius and we accept using 3.14 instead of $\pi$  <b>bp2 not awarded</b> because for their result we accept only 254.34 or 254.3 or 254 since we ACCEPT their 141(.37...)

Q2	Answers	Notes	Total
a	Correctly write ( $K=$ ) 9 on the diagram	 <p>A Venn diagram with two overlapping circles, A and B, inside a rectangular universal set U. Circle A is on the left and contains the number 64. Circle B is on the right and contains the number 81. The intersection of A and B contains the number 21. A pink rectangular box with the number 9 is placed in the region of circle B that does not overlap with circle A.</p>	1
b	Correct description of $K$ in context	<p><b>ACCEPT</b>  <b>Performer(s)</b> (that are, but, and) <b>not</b> academy/students  <b>Performer(s) excluding</b> academy/students  <b>Performer(s) exclusively</b>  <b>Performer(s) regardless</b> academy/students  <b>Performer(s) only</b> (DO NOT ACCEPT students who perform only)</p> <p><b>ACCEPT</b>          using “present at the show” or “presenter” or “participate in the show” or “artist” instead of Performer</p>	1
c	<p>.1 Correctly write 21 in numerator OR correct denominator from <b>their</b> part a)</p> <p>.2 Correctly write their probability from <b>their</b> part a)</p>	<p>.1 21 in numerator OR 21+their9 in denominator</p> <p>.2 <math>\frac{21}{\text{their}30}</math> or their0.7 OE</p>	2

d	<p>.1 Correct probability of first person from <b>their</b> part a)</p> <p>.2 Correctly write <b>their three</b> probabilities <b>without</b> replacement OR <b>multiply their three</b> probabilities <b>with</b> replacement</p> <p>.3 Correctly multiply <b>their three</b> probabilities <b>without</b> replacement</p>	<p>.1 <math>\frac{21+their9}{175}</math> OE or 0.17(14...)</p> <p>.2 their <math>\frac{30}{175}</math>, their <math>\frac{29}{174}</math>, their <math>\frac{28}{173}</math> OR their <math>\frac{30}{175} \times</math> their <math>\frac{30}{175} \times</math> their <math>\frac{30}{175}</math> OE                  .2 ACCEPT applying without replacement on only numerator or only denominator, <u>only if they multiply</u> their three probabilities                  Ex: their <math>\frac{30}{175} \times</math> their <math>\frac{29}{175} \times</math> their <math>\frac{28}{175}</math></p> <p>.3 their <math>\frac{24360}{5267850}</math> or their <math>\frac{4}{865}</math> or their 0.0046(2...) OE                  .3 ACCEPT 0.005 only if bp2 is awarded without replacement</p>	<p><b>3</b></p>
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Q3	Answers	Notes	Total
a	<p>.1 Correctly substitute into trig ratio</p> <p>.2 Correct value of x</p> <p>.3 Correct result after adding their <u>bp2</u> to 1.6</p>	 <p>.1 <math>\tan 37 = \frac{x}{4}</math> OR <math>(x =) 4 \tan 37</math> OR <math>\tan 53 = \frac{4}{x}</math> OR <math>(x =) \frac{4}{\tan 53}</math> OR</p> <p><math>\frac{x}{\sin 37} = \frac{4}{\sin 53}</math> OR <math>(x =) \frac{4 \sin 37}{\sin 53}</math> OE</p> <p>.1 ACCEPT <math>\left(\frac{4}{\cos 37}\right)^2 - 4^2</math> OE</p> <p>.2 <math>(x =) 3.(0142\dots)</math></p> <p>.2 ACCEPT only if bp1 is awarded</p> <p>.2 ACCEPT not seeing this step</p> <p>.2 ACCEPT value in cm</p> <p>.3 <math>(1.6 + \text{their } 3.0142\dots) = \text{their } 4.6(1\dots)</math></p> <p>.3 ACCEPT only if their 3.(01) is positive</p>	<p><b>3</b></p>

b

**AM1 (using similarity ratio)**

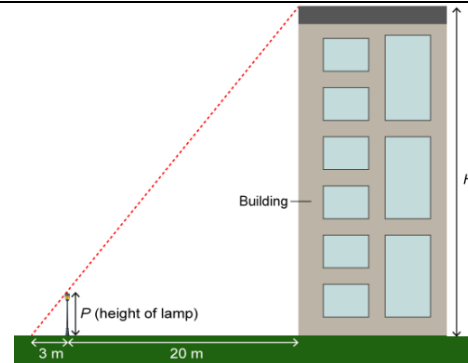
.1 Correct ratio of similarity seen

.2 Correctly apply **their** similarity ratio on their4.6 from a)

.3 Correctly calculate **their** height of building after correctly rearranging **their** similarity ratio

.4 Correctly round **their** height of building to the nearest metre

Next page for AM2 using trigonometry



**AM1 (using similarity ratio)**

.1 ( $\frac{H}{\text{their4.6}} = \frac{23}{3}$ ) OE or ( $\frac{\text{their4.6}}{H} = \frac{3}{23}$ ) ACCEPT seen in the working or implied

.2 ( $H = \text{their4.6} \times \frac{\text{their23}}{3}$ ) OE

.2 ACCEPT applying their ratio correctly on hypotenuse and substitute correctly into Pythagoras. Ex: ( $H^2 = (\frac{\text{their23}}{3} \times \sqrt{\text{their4.6}^2 + 3^2})^2 - 23^2$ ) OE

.3 ( $\text{their4.6} \times \frac{\text{their23}}{3} = \text{their35.3(75...)}$ ) ACCEPT not seeing this step

.3 ACCEPT only if bp1 or bp2 is awarded

.4 their35 (m)

.4 ACCEPT only if bp1 or bp2 is awarded

.4 ACCEPT only if their result needs rounding

Next page for AM2 using trigonometry

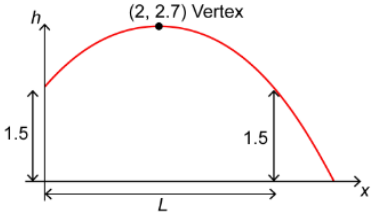
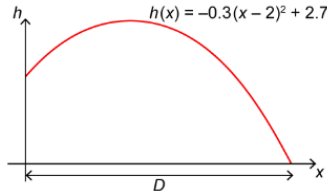
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	<p><b>AM2 (using trigonometry)</b>                  .1 Correctly calculate angle in the triangle using their4.6 from a)                   .2 Correctly substitute <b>their bp1</b> into <b>the</b> correct trig ratio                   .3 Correctly calculate <b>their</b> height of building after correctly rearranging <b>their</b> trig ratio                   .4 Correctly round <b>their</b> height of building to the nearest metre</p>	<p><b>AM2 (using trigonometry)</b>                  .1 <math>(\theta =) \tan^{-1}\left(\frac{\text{their4.6}}{3}\right)</math> or their57                  .1 ACCEPT <math>(\theta =) \tan^{-1}\left(\frac{3}{\text{their4.6}}\right)</math> or 33 ACCEPT [33 , 33.2]                   .2 <math>\tan \text{their57} = \frac{H}{23}</math> or <math>\tan \text{their33} = \frac{23}{H}</math> or <math>\frac{H}{\sin \text{their57}} = \frac{23}{\sin \text{their33}}</math> OE                  .2 ACCEPT <math>(H =) 20 \tan \text{their57} + \text{their4.6}</math>                  .2 DO NOT ACCEPT <math>\tan 37 = \frac{H}{23}</math> or <math>\frac{\sin 37}{\sin 53} = \frac{H}{23}</math> OE or <math>20 \tan 37 + \text{their4.6}</math> OE                   .3 <math>(23 \times \tan \text{their57} =) \text{their35.3(75...)}</math> ACCEPT not seeing this step                  .3 ACCEPT their result using their57 or their33 being correctly rounded to a whole number                  .3 ACCEPT only if their trig ratio is exact or at least 2 dp.                  .3 ACCEPT only if bp1 or bp2 is awarded.                   .4 their35 (m)                  .4 ACCEPT only if bp1 or bp2 is awarded                  .4 ACCEPT only if their result needs rounding</p>	
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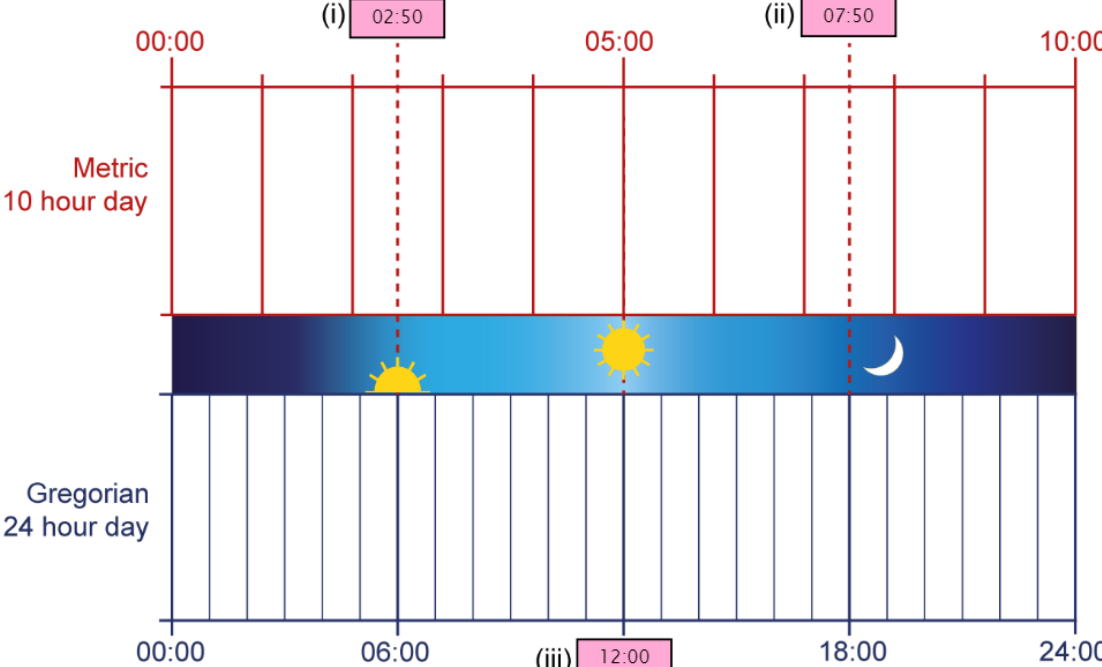
Q4	Answers	Notes	Total
a	<p><b>AM1 (solving quadratic)</b></p> <p>.1 Correctly rearrange and simplify <b>the</b> quadratic on one side</p> <p>.2 Correctly factorize <b>their</b> quadratic from bp1 OR substitute <b>their</b> coefficients into quadratic formula OR correctly write <b>both</b> solutions of <b>their</b> quadratic</p> <p>.3 Correctly identify <b>both</b> of <b>the</b> x values</p> <p>Next page for AM2 numbers trials</p>	<p><math>x^2 + x - 4 = 1 - 3x</math></p> <p><b>AM1 (solving quadratic)</b></p> <p>.1 <math>x^2 + 4x - 5 (= 0)</math> or <math>-x^2 - 4x + 5 (= 0)</math></p> <p>.2 their <math>(x + 5)(x - 1) (= 0)</math> OR their <math>\frac{-4 \pm \sqrt{4^2 - 4 \times 1 \times -5}}{2}</math> OE</p> <p>.2 ACCEPT one notation mistake in substitution</p> <p>Ex: with their coefficients <math>\frac{-4 + \sqrt{4^2 - 4 \times 1 \times -5}}{2}</math> or <math>\frac{-4 \pm \sqrt{4^2 - 4 \times 1 \times 5}}{2}</math> OE</p> <p>.2 ACCEPT their simpler quadratic, <math>ax^2 + c = 0</math> or <math>ax^2 + bx = 0</math>, only if they solve it correctly Ex: if their bp1 is <math>x^2 - 5 = 0</math> and they correctly write solutions <math>(x =) \sqrt{5}</math> and <math>(x =) -\sqrt{5}</math></p> <p>.2 ACCEPT 1.56(...) <u>and</u> -2.56(...)</p> <p>.2 DO NOT ACCEPT their <math>(x + 5)(x - 1) (= 0)</math> OR their <math>\frac{-4 \pm \sqrt{4^2 - 4 \times 1 \times -5}}{2}</math> if we don't see their quadratic</p> <p>.2 The correct bp2 implies bp1: <math>(x + 5)(x - 1) (= 0)</math> or <math>\frac{-4 \pm \sqrt{4^2 - 4 \times 1 \times -5}}{2}</math> OE</p> <p>.3 <math>(x =) - 5</math> and <math>(x =) 1</math></p> <p><b>ACCEPT seeing any part a) bp in their response box of part b) but stamp SC in part a)</b></p> <p>Next page for AM2 numbers trials</p>	<p>3</p>

	<p><b>AM2 (numbers trials)</b></p> <p>.1 Correctly substitute 1 into <math>f(x)</math> <b>and</b> <math>g(x)</math></p> <p>.2 Correctly substitute -5 into <math>f(x)</math> <b>and</b> <math>g(x)</math></p> <p>.3 Correctly identify <b>both</b> of <b>the</b> <math>x</math> values</p>	<p><b>AM2 (numbers trials)</b></p> <p>.1 <math>1^2 + 1 - 4</math> and <math>1 - 3 \times 1</math></p> <p>.2 <math>-5^2 - 5 - 4</math> and <math>1 - 3 \times -5</math></p> <p>.3 <math>(x =) - 5</math> and <math>(x =)1</math></p> <p><b>ACCEPT seeing any part a) bp in their response box of part b) but stamp SC in part a)</b></p>	
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	<p>b</p> <p>.1 Correctly substitute their -5 or their 1 from part a) into <b>the <math>f(x)</math> or the <math>g(x)</math></b></p> <p>.2 Correctly calculate <b>their</b> y-coordinate for A after substituting their -5 from part a) into <b>the <math>f(x)</math> or the <math>g(x)</math></b></p> <p>.3 Correctly calculate their y-coordinate for B after substituting their 1 from part a) into <b>the <math>f(x)</math> or the <math>g(x)</math></b></p>	<p>.1 <math>1 - 3(\text{their} - 5)</math> or <math>1 - 3(\text{their}1)</math> OR <math>(\text{their} - 5)^2 + (\text{their} - 5) - 4</math> or <math>(\text{their}1)^2 + (\text{their}1) - 4</math></p> <p>.1 DO NOT ACCEPT just a sentence "by substituting the x values in f(x) or g(x)"</p> <p>.1 ACCEPT substituting 1.56... or -2.56... into <math>f(x) = 1 - 3x</math> but <b>not</b> into <math>g(x) = x^2 + x - 4</math></p> <p>.1 ACCEPT substituting 1/3 OE into <math>g(x) = x^2 + x - 4</math> but <b>not</b> into <math>f(x) = 1 - 3x</math></p> <p>.1 DO NOT ACCEPT seeing this substitution in their response box of part a)</p> <p>.2 their16 ACCEPT only if positive</p> <p>.2 DO NOT ACCEPT their16 without working</p> <p>.2 DO NOT ACCEPT if it is the result of substituting 1.56... or -2.56... or 1/3 OE</p> <p>.2 ACCEPT seeing bp2 in their response box for part a) only if they identify it is y-coordinate of A</p> <p>.3 their -2 ACCEPT only if negative</p> <p>.3 DO NOT ACCEPT their-2 without working</p> <p>.3 DO NOT ACCEPT if it is the result of substituting 1.56... or -2.56... or 1/3 OE</p> <p>.3 ACCEPT seeing bp3 in their response box for part a) only if they identify it is y-coordinate of B</p>	<p>3</p>
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Q5	Answers	Notes	Total
a	<p>Correct value of <math>L</math></p>	 <p><math>(L=)4</math> (m)</p>	1
b	<p>.1 Correctly substitute <math>h = 1.5</math> and <math>x = 0</math> or <math>4</math></p> <p>.2 Correctly rearrange for <math>a</math> on one side</p> <p>AG -0.3</p>	<p>.1 <math>1.5 = a(0 - 2)^2 + 2.7</math> or <math>1.5 = a(-2)^2 + 2.7</math> or <math>1.5 = a(4 - 2)^2 + 2.7</math></p> <p>.2 <math>(a =) \frac{-1.2}{4}</math></p> <p>.2 ACCEPT <math>(a =) \frac{1.5-2.7}{4}</math> or <math>4a = 1.5 - 2.7</math></p> <p>.2 ACCEPT <math>-1.2 = 4a</math></p>	2
c	<p><b>AM1</b></p> <p>.1 Correctly substitute 0 into the equation</p> <p>.2 Correct rearrangement for <math>(D - 2)^2</math> on one side</p> <p>.3 Correctly square root their both sides of <b>their</b> quadratic in bp2</p> <p>.4 Correctly identify the value of <math>D</math> as 5</p>	<p><b>ACCEPT using <math>x</math> or any symbol instead of <math>D</math></b></p>  <p><b>AM1</b></p> <p>.1 <math>0 = -0.3(D - 2)^2 + 2.7</math> or <math>0.3(D - 2)^2 - 2.7 = 0</math></p> <p>.2 <math>(D - 2)^2 = \frac{2.7}{0.3}</math> OE</p> <p>.3 <math>D - 2 = \pm 3</math> ACCEPT <math>D - 2 = 3</math></p> <p>.4 <math>(D =) 5</math></p>	4

<p><b>AM2</b></p> <p>.1 Correctly substitute 0 into the equation</p> <p>.2 Correctly write <b>the</b> quadratic in the form <math>ax^2+ bx + c(= 0)</math></p> <p>.3 Correctly factorise <b>their</b> quadratic or substitute correctly the coefficients of <b>their</b> quadratic into quadratic formula or correctly write the solution(s) of <b>their</b> quadratic</p> <p>.4 Correctly identify the value of <math>D</math> as 5</p> <p><b>AM3</b> (using numbers)</p> <p>.1 Correctly substitute a number <math>D \neq 5</math> and correctly calculate corresponding <math>h</math></p> <p>.2 Correctly substitute 5 and equate to 0</p> <p>.3 Correctly substitute another number <math>D \neq 5</math> and correctly calculate corresponding <math>h</math></p> <p>.4 Correctly identify the value of <math>D</math> as 5</p>	<p><b>AM2</b></p> <p>.1 <math>-0.3(D - 2)^2 + 2.7 = 0</math> or <math>0.3(D - 2)^2 - 2.7 = 0</math></p> <p>.2 <math>-0.3D^2 + 1.2D + 1.5(= 0)</math> or <math>D^2 - 4D - 5(= 0)</math> OE</p> <p>.3 <math>(D-5)(D+1)</math> OR their coefficients in <math>\frac{-1.2 \pm \sqrt{1.2^2 - 4 \times -0.3 \times 1.5}}{2(-0.3)}</math> OE</p> <p>.3 ACCEPT one notation mistake in substitution</p> <p>Ex with their coefficients: <math>\frac{-1.2 \pm \sqrt{1.2^2 - 4 \times -0.3 \times 1.5}}{2(0.3)}</math> or <math>\frac{-1.2 \pm \sqrt{1.2^2 - 4 \times -0.3 \times 1.5}}{2(-0.3)}</math></p> <p>.3 ACCEPT their simpler quadratic, <math>ax^2 + c = 0</math> or <math>ax^2 + bx = 0</math>, only if they solve it correctly at least for the positive value Ex: if their bp2 is <math>0.3D^2 - 2.7 = 0</math> and <math>D = 3</math> (and/or -3)</p> <p>.4 <math>(D=) 5</math></p> <p><b>AM3</b> (using numbers, ignore additional incorrect substitutions/calculations)</p> <p>.1 Ex: <math>-0.3(4 - 2)^2 + 2.7 = 1.5</math></p> <p>.2 <math>-0.3(5 - 2)^2 + 2.7 = 0</math></p> <p>.3 Ex: <math>-0.3(1 - 2)^2 + 2.7 = 2.4</math></p> <p>.4 <math>(D=)5</math></p> <p><b><u>For any AM: bp2 implies bp1</u></b></p>	
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Q6	Answers	Notes	Total
6a	<p>.1 Correctly write one time</p> <p>.2 Correctly write another two times</p>	<p>ACCEPT 2:50 or 2h50 or 250 or 2.50 or 2.5 2.5:00 OE DO NOT ACCEPT 2:5 or 25 or 2:30 OE            ACCEPT 7:50 or 7h50 or 750 or 7.50 or 7.5 7.5:00 OE DO NOT ACCEPT 7:5 or 75 or 7:30 OE            ACCEPT 12:00 or 12h00 or 1200 or 12.00 or 12 or 12pm OE</p>  <p>The diagram illustrates the difference between a 10-hour Metric day and a 24-hour Gregorian day. The Metric day is represented by a horizontal bar from 00:00 to 10:00, with a blue background and sun icons. The Gregorian day is represented by a horizontal bar from 00:00 to 24:00, with a blue background and sun/moon icons. Vertical lines mark specific times: (i) 02:50, (ii) 07:50, and (iii) 12:00.</p>	2
6b	<p>.1 Correct number of hours in the hours box</p> <p>.2 Correct number of minutes in the minutes box</p>	<p>.1 <b>2 in the hours box</b></p> <p>.1 ACCEPT <math>\frac{24}{10}</math> or 2.4 OE in the hours box</p> <p>.1 ACCEPT 2 or 2.4 hours in the response box <u>only if the hours box is empty</u></p> <p>.2 <b>24 OE in the minutes box</b></p> <p>.2 ACCEPT 24 minutes in the response box <u>only if the minutes box is empty</u></p>	2

6c		School event	Metric time	Metric seconds in standard form
		Examination	90 minutes	$9 \times 10^3$
		School day	2 hours and 40 minutes	$2.4 \times 10^4$
		Time to run 10 kilometres	53 minutes	$5.3 \times 10^3$
		Climbing mount Kilimanjaro	4 days, 2 hours and 5 minutes	$4.205 \times 10^5$

.1 Correctly write first row	.1 $9 \times 10^3$ ACCEPT $9.0 \times 10^3$
.2 Correctly write second row	.2 $2.4 \times 10^4$ ACCEPT $2.40 \times 10^4$
.3 Correctly write third row	.3 53 min .3 ACCEPT 53.00 mins or half hour and 3 mins or 50 minutes and 300 sec OE .3 DO NOT ACCEPT without units Ex: 53
.4 Correctly write fourth row	.4 $4.205 \times 10^5$

**For bp1, bp2, and bp4**  
ACCEPT if the value in seconds is correct but written in incorrect standard form, and **deduct only one mark from the total**  
Do not deduct if the value incorrectly written in standard form is already 0 marks (incorrect value of seconds)

Examples:  
 $90 \times 10^2$ ,  $24 \times 10^3$ , 53 minutes,  $4205 \times 10^2 \rightarrow$  Award  $(1 + 1 + 1 + 1) - 1 = 3$  marks  
 $90 \times 10^3$ ,  $2.4 \times 10^4$ , 5 hours and 3 minutes,  $4205 \times 10^2 \rightarrow$  Award  $(0 + 1 + 0 + 1) - 1 = 1$  mark  
 $9 \times 10^3$ ,  $24 \times 10^4$ , 53 mins,  $4.2 \times 10^5 \rightarrow$  Award  $(1 + 0 + 1 + 0) - 0 = 2$  marks

4



Equation
S + D = 160
20S + 40D = 4000

e)

6e	<p>.1 Correct step towards solving their equations</p> <p>.2 Correct equation in one unknown</p> <p>.3 Correctly solve for S or D</p> <p>.4 Correctly write <b>their</b> corresponding value of the other unknown satisfying one of <b>the</b> equations</p>	<p style="color: red;"><b>ACCEPT using x and y instead of S and D</b></p> <p>.1 correct step for elimination. Example: <math>20S+20D=3200</math> or <math>40S +40D = 6400</math> or <math>S+2D=200</math> or correct step for substitution. Example <math>S= 160 - D</math> or <math>D=160-S</math> or <math>S = 200 - 2D</math> or <math>D = 100 - 0.5S</math></p> <p>.2 Example: <math>20S+40(160-S)=4000</math> or <math>20(160-D)+40D=4000</math> OR <math>20D=800</math> or <math>20S=2400</math> OR <math>S = 200 - 2(160 - S)</math> or <math>D = 100 - 0.5(160 - D)</math>OE</p> <p>.2 ACCEPT <math>D = \frac{800}{20}</math>OE or <math>S = \frac{2400}{20}</math>OE only if there is evidence of using elimination method</p> <p>.2 DO NOT ACCEPT substituting the separated unknown into the same equation Ex: <math>20 \times (200 - 2D) + 40D = 4000</math> or <math>20S + 40(100 - 0.5S) = 4000</math> OE</p> <p><b>.2 bp2 implies bp1</b></p> <p>.3 (S =) 120 OE OR (D=) 40 OE</p> <p>.4 (S =) their120 for their (D=)their40 OR (D=) their40 for their (S=)120</p> <p>.4 ACCEPT only if <u>both</u> of their120 and their40, are positive integers</p> <p><b>For bp3 and bp4 ACCEPT</b> seeing values directly substituted into equations. Examples <math>120+40=160</math> or <math>20 \times 120 + 40 \times 40 = 4000</math> is accepted for bp3 and bp4 <math>130+30=160</math> or <math>20 \times 100 + 40 \times 50 = 4000</math> is accepted for bp4</p>	4
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The MYP 5 chemistry class is creating copper sulphate crystals from a solution.

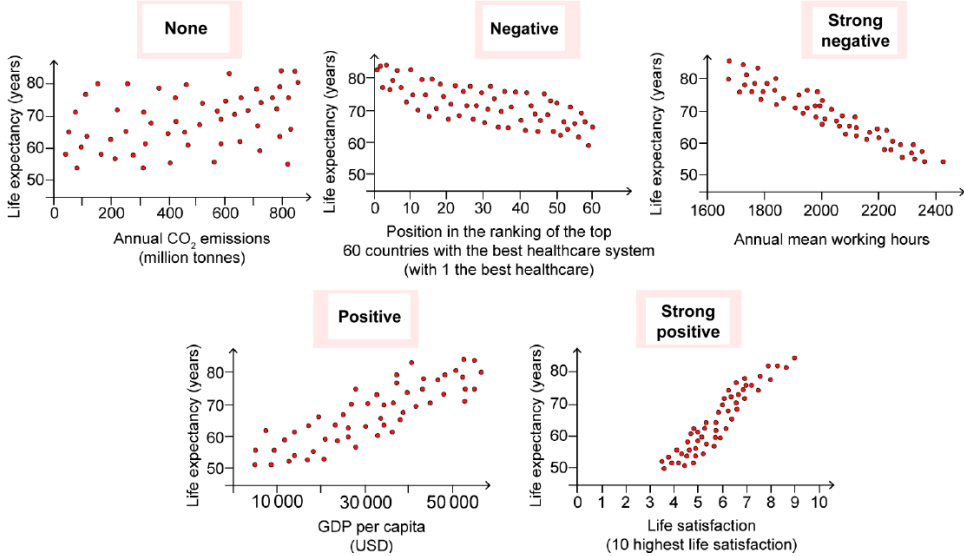
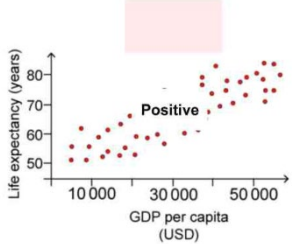
It takes **one** metric day for the solution to form 2.987 grams of copper sulphate crystal.

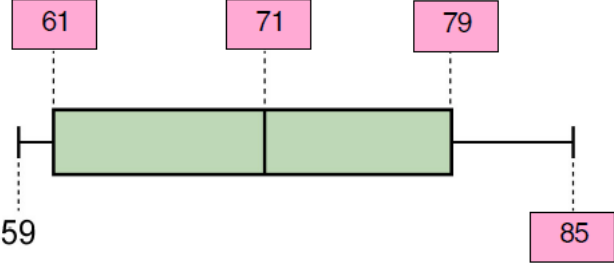
**Show that** the rate of production is 2.987 milligrams per minute.

f)

6f	<p>Correctly apply on 2.987 g per day both conversions: from g to mg and from day to minutes</p> <p>AG 2.987 (mg/min)</p>	<p>Conversions with correct mass units mentioned <b>and</b> divide by 1000. Example: 2987 mg (per day) <b>and</b> 2987/1000 OR Conversions with correct time units mentioned <b>and</b> multiply by 1000. Example: 0.002987 (grams) per min <b>and</b> 0.002987x1000</p> <p>ACCEPT</p> <p>Multiply 2.987 by 1000 and divide by 1000. Ex: <math>2.987 \times \frac{1000}{1000}</math></p> <p>DO NOT ACCEPT any of the following to replace any part from the accepted above 2.987 mg per minute (it is the required AG) 2.987 g per day 1 day=10 hours or 1000 mins 1g=1000mg</p> <p>DO NOT ACCEPT (in any order): <math>\frac{2.987}{1000} = 0.002987</math> g/min <b>and</b> 0.002987g/min=2.987mg/min (because the second part is 2.987 mg per minute AG)</p>	1
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•	Answers	Notes	Total
a	<p>.1 Correctly identify 3 scatter plots</p> <p>.2 Correctly identify another 2 scatter plots</p>	<p>Notes</p> <div></div> <p>ACCEPT identifying on the graph instead of the box above it. Ex:</p> <div></div>	2

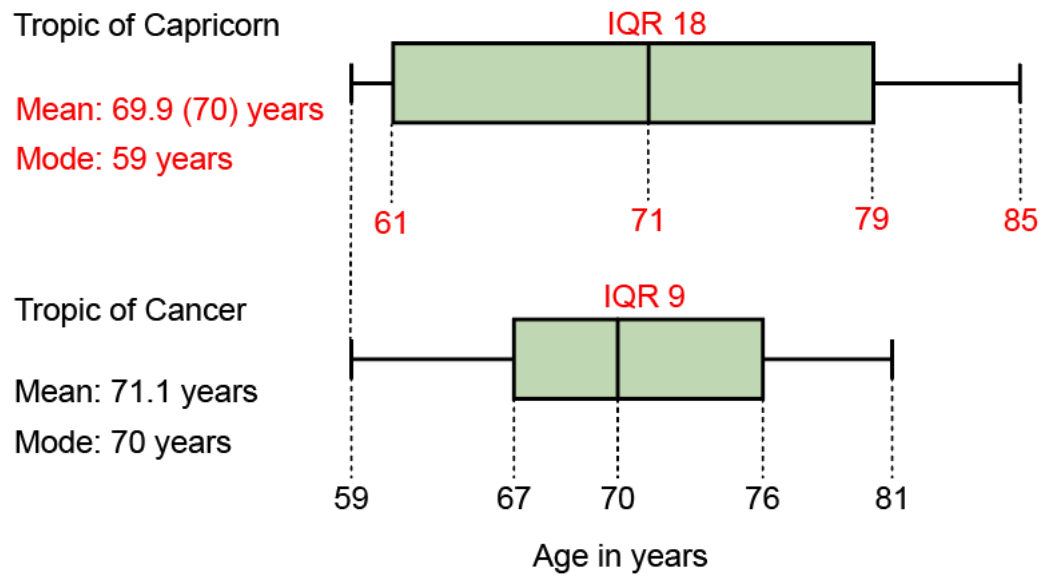
<p>b</p>	<p>.1 Two correct .2 Third correct .3 fourth and fifth correct</p>	<p>Mode 59 LQ 61 Median 71 UQ79 Max 85 Tropic of Capricorn</p>  <p>Mode: 59</p>	<p>3</p>
<p>c</p>	<p><b>Range:</b> .1 Correctly subtract 59 from 85</p> <p><b>Interquartile range (IQR):</b> .2 Correctly subtract 61 from 79</p>	<p><b>Range:</b> .1 26 .1 ACCEPT correctly subtracting 59 from their max in their box plot in part b) i.e (their85-59=) their26</p> <p><b>Interquartile range (IQR):</b> .2 18 .2 ACCEPT correctly subtracting their LQ from their UQ on their box plot in part b) i.e (their79-their61=) their18</p>	<p>2</p>

7	d		10
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Mark	1	2
<b>Identify factors (F)</b>	<p><b>Note: Award F1 automatically if C3 is achieved</b></p> <p style="text-align: center;"><b>OR</b></p> <p>Identify <b>two</b> from the elements below <u>in the elements box</u> (ACCEPT WTTE):</p> <ol style="list-style-type: none"> <li>1) Mean or Mode or Median</li> <li>2) Range or IQR</li> <li>3) Trend over the years or line of best fit or any description for the graph</li> <li>4) Max or Min or UQ or LQ or quartiles</li> <li>5) Health care or mean working hours or GDP or life satisfaction or the correlation</li> </ol> <p><b>DO NOT ACCEPT</b>                      General terms like: Measures of central tendency or measures of dispersion or statistics or Box and whisker or the graph for life expectancy or the scatter graph                      Number of countries in each tropic (11 countries on Capricorn and 17 on Cancer)                      Location of countries                      Annual CO<sub>2</sub> emissions                      Just values for the elements</p>	<p>Identify <b>three</b> from the elements below <u>in the elements box</u> (ACCEPT WTTE):</p> <ol style="list-style-type: none"> <li>1) Mean or Mode or Median</li> <li>2) Range or IQR</li> <li>3) Trend over the years or line of best fit or any description for the graph</li> </ol> <p><b>DO NOT ACCEPT Any element from 4) or 5) (mentioned for F1)</b></p>

In 2021	Mean	Mode	IQR	Range	Min	LQ	Median	UQ	Max
Capricorn	69.9.. (or 70)	59	18	26	59	61	71	79	85
Cancer	71	70	9	22	59	67	70	76	81

Image 2



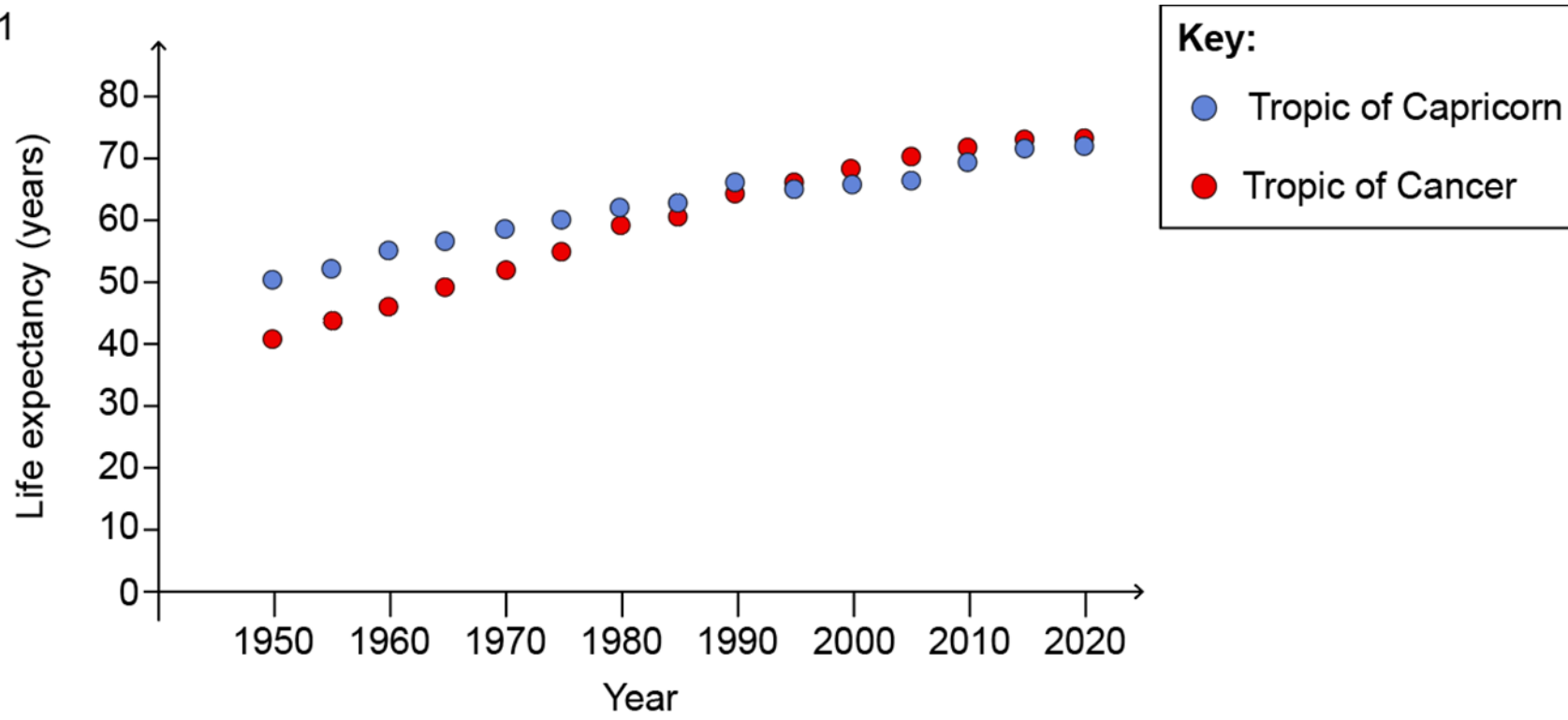
**In 2021**

Capricorn has bigger/larger: Median, IQR and Range

Cancer has bigger/larger: Mean and Mode

Mark	1	2	3	4
<p><b>Comparative calculations (C)</b></p> <p><b>ACCEPT seeing in the elements response box or under any title in their response box</b></p>	<p>Correctly compare any <b>two</b> from <b>their</b> statistics:  <b>Their</b> Mean  <b>Their</b> Mode  <b>Their</b> Median  <b>Their</b> Range  <b>Their</b> IQR  <b>Their</b> Max or Min or LQ or UQ                      Example:                      They have similar mean and median                      Highest value in Capricorn is 85 while Cancer 81                      Cancer mode is 70 and compared to Capricorn 59                      Capricorn less Q1 but higher median</p>	<p>Correctly compare any <b>three</b> from <b>their</b> statistics:  <b>Their</b> Mean  <b>Their</b> Mode  <b>Their</b> Median  <b>Their</b> Range  <b>Their</b> IQR  <b>Their</b> Max or Min or LQ or UQ                      Example:                      Capricorn higher median and IQR but same min</p>	<p><b>Values must be seen</b></p> <p>Correctly compare:   <b>The Mean: 69.9 or 70</b></p> <p style="text-align: center;"><b>AND</b></p> <p><b>One from Their Range or Their IQR</b></p> <p>Note: When comparing their range or their IQR <b>ACCEPT</b> seeing only their values for cancer (their22 or their9)</p>	<p><b>Values must be seen</b></p> <p>Correctly compare:   <b>The Mean: 69.9 or 70</b></p> <p style="text-align: center;"><b>AND</b></p> <p><b>One from The Range or The IQR</b></p> <p style="text-align: center;"><b>AND</b></p> <p><b>One from The Mode or The Median</b></p>
	<p style="text-align: center;"><b>OR</b></p> <p>Attempt to calculate the mean for the tropic of Capricorn</p> <p>Ex: adding the values incorrectly and divide by 11 their769/11</p>	<p style="text-align: center;"><b>OR</b></p> <p>Correctly calculate <b>The</b> mean for the tropic of Capricorn</p> <p>(769/11=)69.9 or 70</p>	<p style="text-align: center;"><b>OR</b></p> <p>Correctly compare:  <b>The Mean</b></p> <p style="text-align: center;"><b>AND</b></p> <p><b>The Mode and The Median</b>  <b>ACCEPT</b> only one with their value but not both</p>	<p>Note: When comparing the range or the IQR <b>ACCEPT</b> seeing only the values for cancer (22 or 9)</p> <p>Note: If they compare by writing directly the difference then it has to be correct (4 for range or 9 for IQR)</p>
	<b>ACCEPT</b>			
<p>Spelling mistakes Ex: “medium” instead of “median”                      “similar” WTTE when comparing Mean or Median                      Q1 instead of LQ, Q3 instead of UQ, “Middle” age or “Q2” instead of “median”                      “most common” instead of “mode”                      “lowest” or “smallest” OE instead of “minimum, “highest” or “largest” OE instead of “Maximum”                      IQR “more concentrated” instead of smaller</p>				
<b>DO NOT ACCEPT</b>				
<p><b>Cancer is higher WTTE when comparing their median, their IQR, or their range</b>                      Using “central tendency” or “average” instead of “mean or mode or median”                      Using “measures of dispersion” or “spread” instead of “range or IQR”</p>				

Image 1



Mark	1	2
<p><b>Comment on the Headline (H)</b></p> <p><b>ACCEPT seeing in the elements response box or under any title in their response box</b></p>	<p>Correct comment on the headline referring to the trend over the years with <u>specific years</u> (based on the graph in image 1)</p> <p>Ex: WTTE            Correct up to [1980 , 2000]            Incorrect after [1980 , 2000]            After 1950 Capricorn higher for [30,50] years            In the last [20,40] years cancer increased further            There was a gap but it narrowed in [1980 , 2000]            There was a gap for [30,50] years after 1950 then it narrowed            The headline was written in the [1980 , 2000]            It was true up to [1980 , 2000] but after that the opposite            Capricorn had higher life expectancy until [1980 , 2000]</p> <p style="text-align: center;"><b>OR</b></p> <p><b>C1 is achieved AND</b> Correct comment on the headline referring to <u>general</u> trend over the years (based on the graph in image 1)</p> <p>Ex: WTTE            Correct in the past            Incorrect recently            Somehow correct but they are becoming closer            Over the years the gap has narrowed            The Headline is outdated            Cancer has higher slope (or steeper)            Capricorn has lower slope            Cancer was lower but increased more            Recently Capricorn became closer to Cancer and expected to increase</p>	<p><b>C3 is achieved AND</b> Correct comment on the headline referring to trend over the years with <u>specific years</u> (based on the graph in image 1)</p>

Mark	1	2
	<b>ACCEPT only if C1 is achieved</b>	<b>ACCEPT only if C3 is achieved</b>
<b>Justify (J)</b>  <b>ACCEPT seeing in the elements response box or under any title in their response box</b>	<b>One reason</b> Implying accurate or Inaccurate related to the data given WTTE  1) Inaccurate as Capricorn only 11 countries or (tropics) don't have same number of countries or (tropics) don't have same number of people or we don't know the number of people  2) Accurate as the data given in the graph "starts from 1950" or "is until 2020" or "until 2021" OR as they are based on [70,73] years of data  3) Accurate as I compared <u>both</u> measures of central tendency and measures of dispersion OR mean (or median or mode) and range (or IQR)  4) Inaccurate as life expectancies were rounded OR accurate/inaccurate as some (accept all) data is given to nearest 1 decimal place  5) Inaccurate as image 1 (or the graph) does not indicate which average is graphed. e.g. image 1 does not show mean or median for life expectancy  <b>DO NOT ACCEPT</b> other reasoning Ex: Inaccurate because diseases (or pandemic or storm or, wars...etc) Accurate/Inaccurate as data is from a (given) graph Inaccurate because image 2 is only about one year (2021) Inaccurate as we don't know the source of data Inaccurate as I am not sure of my calculations Accurate as I am sure of what I calculated or I used the right formula Inaccurate as I had to guess values Accurate as the data is provided	<b>Two reasons</b> from the list (1 to 5) in J1   <p style="text-align: center;"><b>OR</b></p> Implying inaccurate with <b>the reason</b> related to <b>population of each country</b> WTTE  <b>Ex:</b> Inaccurate as we do not know the number of people <u>in each country</u> Inaccurate as the population of <u>each country</u> is different Inaccurate as <u>countries</u> don't have same number of people

**Task 3 QIG 8 & QIG 9**

Glossary for task 3

Term used	Clarification
General rule	Rule in terms of only $n$ (if they use $x$ , it is still general rule but penalise in notation)
The general rule	The correct general rule in terms of only $n$ (if they use $x$ , it is still the general rule but penalise in notation)
Their general rule	valid attempt for the general rule but in terms of only $n$ (if they use $x$ , it is still their general rule but penalise in notation)
Their rule	Correct rule not in terms of only $n$
Recursive rule	$U_n = \frac{2}{U_{n-1}+d}$ or $U_{n+1} = \frac{2}{U_n+d}$ or $U_n = \frac{2}{U_{n-1}+1}$

We accept subsequent use of their general rule provided it is of similar complexity. In general, the complexity of the rule depends on its form. The table below shows examples.

The general rule	ACCEPT for their general rule	DO NOT ACCEPT for their general rule
$G = \frac{2}{n}$	$\frac{2}{\text{Linear}}$ or exponential or $\frac{2}{\text{Quadratic}}$	(G=) Linear
$L = \sqrt{\left(\frac{n^2 + 4}{4}\right)}$	Quadratic or exponential or (L =) $\sqrt{\text{quadratic}}$	(L=) Linear or (L =) $\sqrt{\text{linear}}$

**Question 8 (Remember from the general notes that we ACCEPT seeing equations not inline or the fraction line missing)**

Q8	Answers	Notes	Total												
a	Correctly write $\frac{6-5}{4-2}$ or $\frac{5-6}{2-4}$  $= \frac{1}{2}$ AG	ACCEPT inappropriate notations. Ex: 6-5 over 4-2 6-5 in numerator and 4-2 in denominator 6-5=1 and 4-2=2 6-5/4-2  DO NOT ACCEPT Using any other values. Ex: $\frac{6-5}{3-1}$ Rise 1 over run 2 It moves 1 unit up and 2 units to the right $\frac{2}{4}$ $\frac{6}{4} - \frac{5}{2}$	<b>1</b>												
b	.1 Correctly write at least one value for G  .2 Correctly write the other value for G and the four values for M and N	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th><i>n</i></th> <th>M</th> <th>N</th> <th>Gradient <i>MN</i> (<i>G</i>)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">(2.5 , 5)</td> <td style="text-align: center;">(5,6)</td> <td style="text-align: center;"><math>\frac{2}{5}</math></td> </tr> <tr> <td style="text-align: center;">6</td> <td style="text-align: center;">(3 , 5)</td> <td style="text-align: center;">(6,6)</td> <td style="text-align: center;"><math>\frac{2}{6}</math></td> </tr> </tbody> </table> <p style="margin-left: 20px;">ACCEPT equivalent values for all ACCEPT incorrect notation, example: 2/5 and 2/6</p>	<i>n</i>	M	N	Gradient <i>MN</i> ( <i>G</i> )	5	(2.5 , 5)	(5,6)	$\frac{2}{5}$	6	(3 , 5)	(6,6)	$\frac{2}{6}$	<b>2</b>
<i>n</i>	M	N	Gradient <i>MN</i> ( <i>G</i> )												
5	(2.5 , 5)	(5,6)	$\frac{2}{5}$												
6	(3 , 5)	(6,6)	$\frac{2}{6}$												

<p>c</p>	<p>.1 correctly describe one pattern for <math>G</math> in words</p> <p>.2 correctly describe a second pattern for <math>G</math> in words</p>	<p>ACCEPT complete terminology only, for example (below are four different descriptions)  <b>Numerator</b> is the same or constant or always 2 or difference zero WTTE  <b>Denominator</b> increases by 1 or adds 1 or goes up by 1 WTTE  <b>Denominator</b> difference 1, common difference 1, linear with difference 1, arithmetic with difference  <b>Denominator</b> second difference zero</p> <p>ACCEPT spelling mistakes Example:          Using: "Numberator" or "Nominator" instead of "Numerator"          Using: "Demurator" instead of "Denominator"</p> <p>ACCEPT "dividend" instead of "numerator" and "divisor" instead of "denominator"</p> <p>DO NOT ACCEPT Using "rise" instead of numerator or using "run" instead of "denominator"</p> <p>DO NOT ACCEPT general description. Examples:          (Numerator or Denominator) Integers or whole numbers, positive, arithmetic, decreasing, composed of only fractions, numerator is even</p> <p>DO NOT ACCEPT the rule in words or description related to <math>n</math> for example:          2 over <math>n</math> or 1 over half of <math>n</math> or denominator equal <math>n</math> , WTTE</p> <p>DO NOT ACCEPT  <math>n</math> goes up by 1 , it is decreasing , general rules in terms of <math>n</math> example: <math>G = 2/n</math></p> <p><b>Note, in the case when they have more than two different patterns:</b>          If two are accepted and the rest are all correct: award 2 marks          Ex: Denominator integers and adds 1 and Second difference is zero          Ex: Denominator linear and increases by 1 and has difference of 1</p> <p>If two are accepted and any of the rest is incorrect: award 1 mark          Ex: Denominator increases by 1 and Second difference is zero and <math>G</math> decreases by half</p> <p>If only one is accepted, ignore the rest and award 1 mark</p> <p><b>SC for 1 mark</b>          Two different <u>correct</u> descriptions using incorrect terminology. Examples:          The top is constant and bottom increases by 1          The rise is constant and the run increases by 1          Denominator is constant and numerator increases by 1</p>	<p>2</p>
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<p>d</p>	<p>.1 The correct general rule</p> <p>.2 the correct simplified general rule with correct notation for <math>G</math> in terms of <math>n</math></p>	<p>.1 <math>(G=) \frac{2}{n}</math> or <math>\frac{1}{0.5n}</math> or <math>2 \div n</math> or <math>2/n</math> or <math>\frac{2}{1n}</math> or <math>\frac{4}{2n}</math> or <math>2 \times \frac{1}{n}</math> OE</p> <p>.2 <math>G = \frac{2}{n}</math></p> <p>ACCEPT <math>G_n = \frac{2}{n}</math> or <math>G(n) = \frac{2}{n}</math></p> <p>ACCEPT using <math>g</math> and <math>N</math></p> <p>DO NOT ACCEPT description in words</p> <p><b>SC for 1 mark</b> If NR in 8d and the correct general rule seen in 8c or 8e</p> <p><b>SC for 1 mark</b> If they write in 8d the rule in terms of <math>a</math> and <math>d</math> Ex: <math>\frac{1}{a+(n-1)d}</math> then in 8e, when they test/verify, they directly use 1 instead of <math>a</math> and 1 instead of <math>d</math></p>	<p><b>2</b></p>
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<p>e</p>	<p>.1 correctly substitute <math>n \geq 5</math> into their general rule (from 8c or 8d)</p> <p>.2 correctly calculate their value of <math>G</math> after substituting <math>n \geq 5</math></p> <p>.3 recognise that their <u>correctly calculated</u> value of <math>G</math> is the same as their predicted value</p>	<p>.1 Ex: <math>\frac{2}{5}</math>                  .1 DO NOT ACCEPT if their general rule for <math>G</math> is linear</p> <p>.2 Ex: 0.4 OE (for <math>n=5</math>) ACCEPT <math>\frac{2}{5}</math>                  .2 DO NOT ACCEPT incorrectly calculated result after substitution in incorrect seen rule                  Ex: <math>\frac{2}{2n+1} = \frac{2}{2 \times 5 + 1} = \frac{2}{5}</math> (award bp1 only)                  .2 DO NOT ACCEPT if their general rule for <math>G</math> is linear</p> <p>.3 If they use <math>n=5</math> or <math>n=6</math>                  ACCEPT only if they say "as seen in the table" WTTE or we see the predicted values re-written here in part e)</p> <p>.3 If they use <math>n &gt; 6</math>                  ACCEPT only if they say "the same as when we continue the pattern" WTTE <b>and</b> state how.                  Example:                  for <math>\frac{2}{7}</math>; "same as it is obtained by adding 1 to 6" or "same as 7 is the value after 6" WTTE                  or they show the further predictions including 2/7 here in part e)</p> <p><b>Note:</b> <math>n \geq 5</math> directly substituted in <math>2/n</math>, award bp1 and bp2 only if their 8d is <math>2/n</math>                  Example seeing <u>only</u> 2/5 or 2/8 when their 8d is <math>2/n</math> award bp1 and bp2</p> <p><b>SC for 1 mark</b>                  Correctly test their general rule by applying the steps of verification mentioned in the left column including <u>bp3</u> with a value of <math>n \leq 4</math></p> <p><b>SC for 1 mark</b>                  Verify, including <u>bp3</u>, with a value of <math>n \geq 5</math> the correctly described pattern or recursive rule or the rule for denominator from part b) or c). Example:                  If their rule <math>G=n</math>; <math>G=5</math> <u>as seen in the table</u>                  If their rule <math>G=n</math>; <math>G=7</math> <u>as seen in the table</u> <b>and</b> it is the same as <math>6+1</math></p>	<p>3</p>
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**QIG 9**

**Question 8f (20 marks) (Remember from the general notes that we ACCEPT seeing equations not inline or the fraction line missing)**

**Predictions for Length MN**

$\sqrt{\frac{29}{4}}$ OE
$\sqrt{\frac{40}{4}}$ OE
$\sqrt{\frac{53}{4}}$ OE

$\frac{\sqrt{29}}{4}$
$\frac{\sqrt{40}}{4}$
$\frac{\sqrt{53}}{4}$

DO NOT ACCEPT

Mark	1
<b>Predictions (P)</b>	Correctly predict <b>two</b> terms for <i>L</i>  Ignore additional predictions
	<b>ACCEPT</b>
	Whether in the table or in the response box.  <b>Simplified surds</b> Ex: $\frac{\sqrt{40}}{2}$ or $\frac{2\sqrt{10}}{2}$ or $\sqrt{10}$  Different notations or in words provided they give correct values. Ex: $\sqrt{29 \div 4}$ or $(29/4) \wedge 0.5$ or $\text{root}(29/4)$
	<b>DO NOT ACCEPT</b>
	Incorrect values. Ex: $\text{root } 29/4$ , $29/4^{0.5}$  In decimals. Ex: $2.69(25\dots)$ or $5.38\dots/2$ $3.16(22\dots)$ or $6.32\dots/2$

**The general rule for L:**

$$L = \sqrt{\frac{n^2+4}{4}} = \frac{\sqrt{n^2+4}}{2} = \sqrt{0.25n^2 + 1} \text{ OE} \quad \text{DO NOT ACCEPT} \quad L = \frac{\sqrt{n^2+4}}{4} \text{ OE}$$

**The rule for M: (0.5n , 5) OE      The rule for N: (n , 6)**

**For Their general rule for L**

ACCEPT quadratic or exponential or  $\sqrt{\text{quadratic}}$

DO NOT ACCEPT linear or  $\sqrt{\text{linear}}$  as in this case it will be only considered their rule

**Helpful notes:**

Having their general rule for  $L = n^2 + 4$ , which is accepted as attempt for the general rule, allows maximum of:

D3 will be achieved only if they also have **Attempt to** describe one pattern in words. If not then D2

T2 if tested correctly, V2 if they correctly calculate their value for L when  $n \geq 5$ , J2 if they assume quadratic and find coefficients

N1 will be achieved only if they have Correctly described one pattern for L in words using correct terminology. If not then N0

L2 if they have 4 items and at least 1 coherence

Having their rule for L linear or  $\sqrt{\text{linear}}$ , which is not accepted as attempt for the general rule, allows maximum of:

D1 achieved only if they have **Attempt to** describe one pattern in words. If not then D0

T1 if tested correctly, V1 if verified correctly, J1 if they justify the rule for  $M=0.5n$  (and achieved D1)

N1 will be achieved only if they have Correctly described one pattern for L in words using correct terminology. If not then N0

L1 if they have three items

When a response is not including the 4 under the root in their predictions

$\frac{\sqrt{29}}{4}$
$\frac{\sqrt{40}}{4}$
$\frac{\sqrt{53}}{4}$

And their general rule is  $L = \frac{\sqrt{n^2+4}}{4}$  and describe the pattern as quadratic. AWARD P0 and D3

For T: If tested correctly award T2

For V: If verified correctly award V2 (Max V2 as they do not have the correct predicted value for  $L$ )

For J: If they justify using “find the correct values of coefficients using any method”, award J2

For N: Since they have correct notation of their general rule for  $L$ , award N1

For L: They have their general rule so if they have 4 items and at least one coherence award L2. If only 3 items award L1

Mark	1	2	3	4
<p><b>Description (D)</b></p> <p><b>ACCEPT incorrect terminologies, notation errors, non-simplified rule, but penalize in notation (N)</b></p>	<p><b>Attempt to</b> describe one pattern in words or recursive rule for <math>L</math></p> <p>Example: (for <math>n^2 + 4</math>)                      Difference (or the increase WTTE) increases by 2, Second difference 2                      Difference (or the increase WTTE) is odd                      Quadratic                      Or (Recursive rule) <math>U_n = U_{n-1} + 2n - 1</math> or <math>U_{n+1} = U_n + 2n + 1</math>                      (Recursive rule): <math>L=L-1 + 2n-1</math> or <math>L+1=L+2n+1</math></p> <p>Example: (for <math>0.25n^2 + 1</math>)                      What I add increases by <math>1/2</math>, Second difference <math>1/2</math>                      Quadratic                      Or (Recursive rule) <math>U_n = U_{n-1} + 0.5n - 0.25</math> or <math>U_{n+1} = U_n + 0.5n + 0.25</math>                      (Recursive rule): <math>L=L-1 + 0.5n-0.25</math> OE or <math>L+1=L+0.5n+0.25</math> OE</p> <p><b>DO NOT ACCEPT</b>                      Patterns for denominator                      Seeing only "fraction under the root"</p>	<p><b>Attempt to</b> describe one pattern in words or recursive rule for <math>L</math></p> <p><b>AND</b></p> <p>Their general rule for <math>L</math> as a <u>quadratic</u> satisfying at least <b>one</b> value for <math>n</math> in their(<math>n^2 + 4</math>)</p>	<p><b>Attempt to</b> describe one pattern in words or recursive rule for <math>L</math></p> <p><b>AND</b></p> <p>Attempt the general rule for <math>L</math></p> <p><b>DO NOT ACCEPT</b>                      The general rule for <math>L</math> in words or partially in words</p>	<p><b>Attempt to</b> describe one pattern in words or recursive rule for <math>L</math></p> <p><b>AND</b></p> <p>The general rule for <math>L</math></p>
	<p><b>Ignore additional incorrect patterns</b></p> <p><b>OR</b></p> <p>Their general rule for <math>L</math> as a <u>quadratic</u> satisfying at least <b>one</b> value for <math>n</math> in their(<math>n^2 + 4</math>)</p> <p><b>OR</b></p> <p>Correct general rule for <math>M</math> (<math>0.5n</math>, <math>5</math>)  <b>ACCEPT</b> <math>M = 0.5n</math>  <b>DO NOT ACCEPT</b>                      Correctly described pattern in words for <math>M</math> or <math>N</math></p>	<p><b>OR</b></p> <p>Attempt the general rule for <math>L</math>.</p> <p><math>\sqrt{n^2 + 4}</math> or <math>0.25n^2 + 1</math> OE                      or a <u>quadratic</u> satisfying at least <b>two</b> values for <math>n</math> in their(<math>n^2 + 4</math>)</p>	<p><b>OR</b></p> <p>The general rule for <math>L</math>.</p> <p><math>(L =) \sqrt{\left(\frac{n^2+4}{4}\right)}</math> OE</p> <p><b>DO NOT ACCEPT</b>  <math>(L =) \frac{\sqrt{n^2+4}}{4}</math> OE</p>	

Mark	1	2
Testing (T)	Attempt to test their general rule for $L$ or $their(n^2 + 4)$ using $n \leq 4$  Ex: Correctly substitute in their general rule for $L$ or $their(n^2 + 4)$ value of $n \leq 4$	Correctly test their general rule for $L$ or $their(n^2 + 4)$ using $n \leq 4$ Ex: correctly calculate their value for $L$ or $their(n^2 + 4)$ in their general rule for $L$ or $their(n^2 + 4)$ using $n \leq 4$  <p style="text-align: center;"><b>AND</b></p> Recognise that <u>their</u> correctly calculated value for $L$ or $their(n^2 + 4)$ is the same as <u>the</u> given value in the table  <p style="text-align: center;"><b>ACCEPT</b></p> Seeing their correctly calculated value for $L$ or $their(n^2 + 4)$ , as fraction or decimal, and the given value in the table being equal
	<p style="text-align: center;"><b>OR</b></p> Correctly test their described pattern or their rule (e.g. recursive rule) or <u>the</u> rule $M = 0.5n$ OE  Ex: Testing $L=(4+n)/4$ when $n=1$ ; $(4+1)/4=5/4$	

	1	2	3
Verifying (V)	Attempt to verify their general rule for $L$ or $their(n^2 + 4)$ using $n \geq 5$  Ex: Correctly substitute in their general rule for $L$ or $their(n^2 + 4)$ value of $n \geq 5$	Correctly calculate their value for $L$ or $their(n^2 + 4)$ in their general rule for $L$ or $their(n^2 + 4)$ using $n \geq 5$	<p style="color: red;"><b>ACCEPT only if they have <u>the</u> general rule for <math>L</math></b></p> Correctly calculate their value for $L$ in <u>the</u> general rule using $n \geq 5$  <p style="text-align: center;"><b>AND</b></p> Recognise that <u>their</u> correctly calculated value for $L$ is the same as <u>the</u> correct predicted value for $L$ obtained by continuing the pattern  <p style="text-align: center;"><b>ACCEPT</b></p> Seeing their correctly calculated value for $L$ , as fraction or decimal, and the correctly predicted value in the table being equal
	<p style="text-align: center;"><b>OR</b></p> Correctly verify their described pattern or their rule (e.g. recursive rule) or <u>the</u> rule $M = 0.5n$ OE  Ex: Verifying $L=(24+n)/4$ when $n=5$ ; $(24+5)/4=29/4$		

Mark	1	2	3	4
<p><b>Justify (J)</b></p> <p><b>ACCEPT seeing anywhere in the response</b></p>	<p><b>ACCEPT only if D1 is achieved</b></p> <p>Attempt to justify <u>their</u> general rule for <math>L</math> ACCEPT justification for <u>their</u> <math>(n^2 + 4)</math> provided it is quadratic Ex: Quadratic model and valid attempt to find values of coefficients using any method.</p>	<p><b>ACCEPT only if D2 is achieved</b></p> <p>Attempt to justify: <math>\frac{n^2+4}{4}</math> OE or <math>n^2 + 4</math> OE Ex: Quadratic model and find the correct values of coefficients using any method</p>	<p><b>ACCEPT only if they have the general rule for <math>L</math></b></p> <p>Good attempt to justify the general rule for <math>L</math> geometrically using <u>the</u> rules for <math>M</math> and <math>N</math> into Pythagoras:</p> <p>Substitute the rules for <math>M</math> and <math>N</math> into Pythagoras and <u>mistakes in simplification or without simplification steps</u></p> <p>Ex: Rule for <math>M = 0.5n</math> Rule for <math>N = n</math> Rule for <math>L</math> is <math display="block">\sqrt{(0.5n - n)^2 + 1^2} = \frac{\sqrt{n^2 + 4}}{2}</math></p>	<p><b>ACCEPT only if they have the general rule for <math>L</math></b></p> <p>Correctly justify <u>the</u> general rule for <math>L</math> geometrically using <u>the</u> rules for <math>M</math> and <math>N</math> into Pythagoras:</p> <p>Substitute the rules for <math>M</math> and <math>N</math> into Pythagoras and <u>correct simplification steps</u></p> <p>Ex: Rule for <math>M = 0.5n</math> Rule for <math>N = n</math> Rule for <math>L</math> is <math display="block">\sqrt{(0.5n - n)^2 + 1^2} = \sqrt{(0.5n)^2 + 1^2} = \sqrt{0.25n^2 + 1} \text{ or } = \sqrt{\frac{1}{4}n^2 + 1}</math></p> <p>ACCEPT only if their form of the general rule is simplified (see N2 for simplified forms)</p>
	<p><b>OR</b></p> <p>Use the arithmetic sequence to justify <u>the</u> rule for <math>M</math> Ex: <math>u_1 = 0.5</math> and <math>d = 0.5</math> and <math>M = 0.5n</math></p>	<p><b>OR</b></p> <p>Weak attempt to justify <u>their</u> general rule for <math>L</math> geometrically using rules for <math>M</math> and <math>N</math> into Pythagoras</p>	<p>Ex: Rule for <math>M = 0.5n</math> Rule for <math>N = n</math> Rule for <math>L</math> is <math display="block">\sqrt{(0.5n - n)^2 + 1^2} = \frac{\sqrt{n^2 + 4}}{2}</math></p>	
	<p><b>OR</b></p> <p>Weak attempt to justify their general rule for <math>L</math> geometrically using values for <math>M</math> and <math>N</math> (at a certain <math>n</math> value) into Pythagoras. Ex: at <math>n=2</math> <math display="block">\sqrt{(2 - 1)^2 + (6 - 5)^2} = \sqrt{2} = \sqrt{\frac{8}{4}}</math></p>	<p>Ex: incorrectly substitute the correct rules of <math>M</math> and <math>N</math> into Pythagoras OR correctly substitute the incorrect rules of <math>M</math> and <math>N</math> into Pythagoras</p>		
	<p><b>OR</b></p> <p>Substitute at least two <u>other</u> values of <math>n</math> in their general rule for <math>L</math> <b>or</b> <u>their</u> <math>(n^2 + 4)</math> or the rule for <math>M</math> <u>and say they are the same or it works</u> WTTE</p>			

Mark	1	2	3
	<b>ACCEPT only if D1 achieved</b>	<b>ACCEPT only if they have <u>the</u> general rule for L</b>	<b>ACCEPT only if they have <u>the</u> general rule for L</b>
	Correctly describe one pattern for L in words <u>using correct terminology</u> Example: The fraction under the root is quadratic, root of a quadratic The numerator under the root is increasing by odd numbers ACCEPT spelling errors and using "root" radical, surd WTTE DO NOT ACCEPT a quadratic then "add" root DO NOT ACCEPT if the pattern is not accepted in D1	Correctly describe one pattern for L in words <u>using correct terminology</u> (see examples in N1) <u>and</u> the notation of <u>the general</u> rule for L includes errors or not simplified or in words (see examples in N1)	Correctly describe one pattern for L in words <u>using correct terminology</u> (see examples in N1)
<b>Notation and terminology (N)</b>  <b>Ignore additional incorrect patterns</b>	<b>OR</b>	<b>OR</b>	<b>AND</b>
	The notation of <u>the general</u> rule for L includes errors or not simplified or in words. Examples: $L = \sqrt{(0.5n - n)^2 + 1^2}$ or $L = \sqrt{0.25 \times n^2 + 1}$	Correct notation of <u>the general</u> rule for L in simplest form $L = \sqrt{\frac{n^2+4}{4}}$ or $L = \frac{\sqrt{n^2+4}}{2}$ or $L = \sqrt{0.25n^2 + 1}$ or $L = \sqrt{\frac{n^2}{4} + 1}$	Correct notation of <u>the general</u> rule for L in simplest form (see examples in N2)
	The rule for L is $\sqrt{\left(\frac{n^2+4}{4}\right)}$ or $L = \sqrt{\frac{1n^2+4}{4}}$	$L = \sqrt{\frac{n^2}{4} + 1}$	
	ACCEPT $( )^{\frac{1}{2}}$ instead of $\sqrt{\quad}$ The general rule in words: Numerator under the root is sum of $n^2$ and 4 then divide by 4 The top is root( $n^2+4$ ) and bottom root 4	ACCEPT $( )^{\frac{1}{2}}$ instead of $\sqrt{\quad}$ ACCEPT with or without brackets Ex: $L =$	
	<b>OR</b>	<b>OR</b>	
Correct notation of <u>their general</u> rule for L. Examples: The numerator = $\sqrt{n^2 + 4}$ or $N = \sqrt{n^2 + 4}$ The numerator under the root is $n^2 + 4$ ACCEPT if not simplified. Ex: $L = \sqrt{\frac{n^2 + n + 4 - 2}{4}}$ DO NOT ACCEPT without seeing the root ( $\sqrt{\quad}$ )	$\sqrt{\left(\frac{n^2+4}{4}\right)}$ or $L = \sqrt{\frac{(n^2+4)}{4}}$ or $L = \sqrt{\left(\frac{n}{2}\right)^2 + 1}$ ACCEPT using $L_n$ or $Ln$ or $L(n)$ instead of L		
<b>OR</b>			
Correct notation of <u>the</u> rule for M in simplest form $M = (0.5n, 5)$ OE ACCEPT The x-coordinate of $M = 0.5n$			
<b>The following are considered errors in terminology</b> Using "top" or "up" to describe "numerator"	<b>The following are considered errors in notation</b> using * for multiplication, using / for division, using $\wedge$ for power, using x instead of n using $U_n$ instead of L without mentioning that $L = U_n$		

Mark	1	2	3
<p><b>Communication (L)</b></p> <p>Organisation and coherence</p> <p>Can be awarded even if there are errors</p> <p>For items: Describing pattern and writing rule can be considered an item even if D0 and N0 awarded</p>	<p><b>At least three</b> from the following items are seen:</p> <ul style="list-style-type: none"> <li>describe a pattern in words</li> <li>write a rule</li> <li>test their general rule or rule or recursive rule or pattern (at least T1)</li> <li>verify their general rule or rule or recursive rule or pattern (at least V1)</li> <li>justify their general rule or rule or recursive rule or pattern (at least J1)</li> </ul>	<p><b>ACCEPT only if they have <u>their general rule for L</u> or for their(<math>n^2 + 4</math>)</b></p> <p><b>At least four</b> of the following items are seen:</p> <ul style="list-style-type: none"> <li>describe a pattern in words</li> <li>write a general rule</li> <li>test their general rule (at least T1)</li> <li>verify their general rule (at least V1)</li> <li>justify their general rule (at least J1)</li> </ul> <p><b>AND</b></p> <p><b>For coherence</b>, they identify the processes correctly.</p> <p><b>At least one</b> from the following:</p> <ul style="list-style-type: none"> <li>test</li> <li>verify</li> <li>justify</li> </ul> <p>Ex:</p> <ul style="list-style-type: none"> <li><b>For test:</b> they say “test” and they substitute in their general rule value(s) of <math>n \leq 4</math> only</li> <li><b>For verify:</b> they say “verify” and they substitute in their general rule value(s) of <math>n \geq 5</math> only</li> <li><b>For justify:</b> They say “justify” and they write a justification</li> </ul> <p><b>Note for coherence:</b> If they say “test and verify” and they substitute in their general rule value(s) of <math>n \leq 4</math> <u>followed by</u> value(s) of <math>n \geq 5</math>, consider it as only one identified process</p>	<p><b>ACCEPT only if they have <u>the general rule for L</u></b></p> <p><b>The following two items must be seen :</b></p> <ul style="list-style-type: none"> <li>write <u>the general rule for L</u></li> <li>justify <u>the general rule</u> (at least J2)</li> </ul> <p><b>AND</b></p> <p><b>At least two</b> of the following items are seen:</p> <ul style="list-style-type: none"> <li>describe a pattern or rule in words</li> <li>test <u>the general rule</u> (at least T1)</li> <li>verify <u>the general rule</u> (at least V1)</li> </ul> <p><b>AND</b></p> <p><b>For coherence</b>, they identify the processes correctly.</p> <p><b>At least two</b> from the following:</p> <ul style="list-style-type: none"> <li>test</li> <li>verify</li> <li>justify</li> </ul> <p>Ex:</p> <ul style="list-style-type: none"> <li><b>For test:</b> they say “test” and they substitute in the general rule for A value(s) of <math>n \leq 4</math> only</li> <li><b>For verify:</b> they say “verify” and they substitute in the general rule for A value(s) of <math>n \geq 5</math> only</li> <li><b>For justify:</b> They say “justify” and they write a justification</li> </ul> <p><b>Note for coherence:</b> If they say “test and verify” and they substitute in the general rule value(s) of <math>n \leq 4</math> <u>followed by</u> value(s) of <math>n \geq 5</math>, consider it as only one identified process</p>