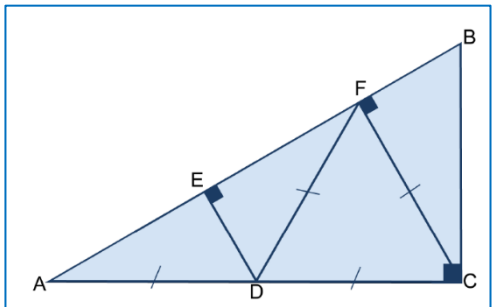
Q1	Answers	Notes	Total
	.1 **First** and **Second** graph descriptions correct .2 First comparison (third and fourth graphs) both correct .3 Second comparison (fifth and sixth graphs) both correct .4 Third comparison (seventh and eighth graphs) both correct	.1 Text/MCQ/Mini-Cloze Object Large standard deviation Text/MCQ/Mini-Cloze Object Zero standard deviation .2 Text/MCQ/Mini-Cloze Object Different mean Same standard deviation .3 Text/MCQ/Mini-Cloze Object Different mean Different standard deviation .4 Text/MCQ/Mini-Cloze Object Same mean Different standard deviation	**4**

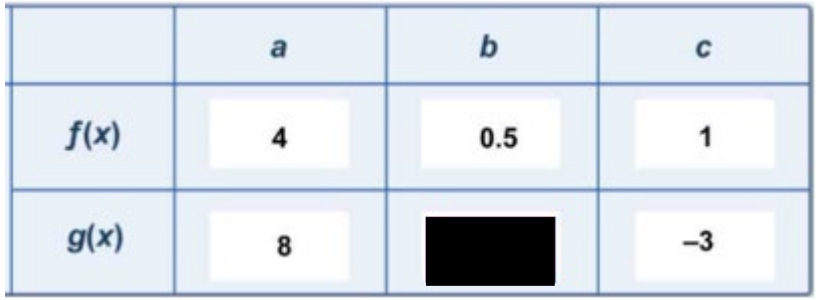
Q2		Answers	Notes	Total
		$P(A)=\frac{18}{25}$, $P(A\mid B)=\frac{2}{3}$ and $P(A\cap B)=\frac{8}{25}$		
	a	.1 Correctly substitute into the conditional probability formula $P(A\mid B)=\frac{P(A\cap B)}{P(B)}$ OR recognize that $\frac{8}{25}$ is $\frac{2}{3}$ of P(B) .2 Correct working step using their substitution into conditional probability formula OR correct calculations from 8/25 being the 2/3 of P(B). .3 Their correct answer after working steps using the conditional probability formula or the logic behind $\frac{8}{25}$ being the $\frac{2}{3}$ of P(B)	.1 $\frac{2}{3}=\frac{8}{25}\div P(B)$ OE OR $\frac{8}{25}$ is $\frac{2}{3}$ of $P(B)$ .2 (P(B)=) $\frac{8}{25}\div\frac{2}{3}$ OE .3 (P(B)=) their $\frac{12}{25}$ OE .3 ACCEPT only if their P is less than 1.	**3**
	b	**AM1** .1 Evidence of using the rule for independent events .2 Correctly calculate P(A) x theirP(B) .3 Correctly state their product does not equal to $P(A\cap B)$ **AM2** .1 Evidence of using P(A) and P(A|B) .2 $\frac{18}{25}$ and $\frac{2}{3}$ seen .3 Acknowledge that $\frac{18}{25}$ and $\frac{2}{3}$ are not equal	**AM1** .1 $P(A\cap B)$ and $P(A)\times P(B)$ seen or $\frac{8}{25}$ and $\frac{18}{25}\times$ their $\frac{12}{25}$ seen OE .2 their $\frac{216}{625}$ OE .3 their $\frac{216}{625}\neq\frac{8}{25}$ OE ACCEPT their $\frac{216}{625}\neq P(A\cap B)$ .3 DO NOT ACCEPT if there is no calculated product **AM2** .1 $P(A)=P(A\mid B)$ **ACCEPT not seeing this step** .2 $\frac{18}{25}$ and $\frac{2}{3}$ **seen** .3 $\frac{18}{25}\neq\frac{2}{3}$ or $\frac{18}{25}$ not equal to $\frac{2}{3}$ ACCEPT $P(A)\neq P(A\mid B)$	**3**
	c			**2**

		.1 Correctly substitute into the addition rule $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ .2 Their correct answer after using addition rule	.1 $\frac{18}{25} + \text{their}\frac{12}{25} - \frac{8}{25}$ .2 their $\frac{22}{25}$ OE .2 ACCEPT only if their P is less than 1 or equal to 1.	

Q3		Answers	Notes	Total
	a	**AM1** .1 Correctly substitute into Pythagoras .2 The correct value of AF **AM2** .1 Correctly substitute into trigonometric ratio OR sine rule OR cosine rule .2 The correct value of AF	**AM1** .1 $(AF =)\sqrt{10^2 - 5^2}$ or $AF^2 + 5^2 = 10^2$ OE .2 ACCEPT 8.7 or $\sqrt{75}$ or $5\sqrt{3}$ .2 DO NOT ACCEPT 8.67 or 8.6 or 9 **AM2** .1 $\tan 30 = \frac{5}{AF}$ or (AF=)10xcos30 or (AF =) 10sin60 OE OR $\frac{AF}{\sin 120} = \frac{5}{\sin 30}$ or $\frac{AF}{\sin 60} = \frac{5}{\sin 30}$ OE OR $(AF^2 =) 5^2+5^2-2(5)(5)\cos 120$ OE or $(AF^2=) 10^2+5^2-2(10)(5)\cos 60$ OE .1 ACCEPT $(AF =)2 \times 5\cos 30$ or $(AF =)2 \times 5\sin 60$ or AE =4.33(…) or EF=4.33(…) .2 (AF =) 8.66(…) ACCEPT 8.7 or $\sqrt{75}$ or $5\sqrt{3}$ .2 DO NOT ACCEPT 8.67 or 8.6 or 9	**2**

	b	.1 A correct reason for a pair of congruent angles .2 A correct reason for another pair of congruent angles  Given that AD = DC = DF = FC = 5 m:	**Examples of correct reasons for pair of congruent angles:** For angle A: → Angle BAC = Angle FAC → Angle A is common angle → They share same angle A WTTE (they have to mention angle A) ACCEPT angle A = angle A DO NOT ACCEPT they share same angle or they have a common angle DO NOT ACCEPT Angle BAC is similar to Angle FAC For the 90 degrees angle → Angle ACB = Angle AFC → They both have a 90 degrees angle → Both right angle triangles WTTE ACCEPT they are both 30-60-90 triangles DO NOT ACCEPT angle F = angle C For the 60 degrees angle → FC is half AC so angle A=30 hence ABC= Angle ACF=60 DO NOT ACCEPT seeing only Angle ABC= Angle ACF DO NOT ACCEPT without correct justification	**2**

	c	**AM1 (Using proportions)** .1 Their correct ratio using AC and theirAF seen or used .2 Correctly apply their ratio on AC .3 Their correct value for AB **AM2 (trigonometry using AC)** .1 Correct angle ABC OR BAC seen or used .2 Correctly substitute their angle into trigonometric ratio .3 Their correct value for AB **AM3 (trigonometry FB and AF or Pythagoras AC)** .1 Correct angle BCF OR CBF seen or used .2 Correctly substitute their angle into trigonometric ratio .3 Their correct answer for AB using theirBF added to theirAF or using Pythagoras with AC and theirBC.	**AM1** .1 $\frac{\text{their}AF}{AC} = \frac{\text{their}8.66}{10}$ (= 0.866…) or $\frac{AC}{\text{their}AF} = \frac{10}{\text{their}8.66}$ (= 1.1547…) OE .2 $10 \times \text{their}1.1547\ldots$ or $\frac{10}{\text{their}0.866}$ .2 DO NOT ACCEPT if their ratio is 2 or $\frac{1}{2}$ .3 (AB =) their 11.547(005…) ACCEPT 11.5 or 11.55 **AM2** .1 (BAC=)30 OR (ABC=) 60 .2 $\sin\text{their}60 = \frac{10}{AB}$ or $\cos\text{their}30 = \frac{10}{AB}$ OE ACCEPT $\frac{10}{\sin\text{their}60}$ or $\frac{10}{\cos\text{their}30}$ OE .3 (AB=) their11.547(005…) ACCEPT 11.5 or 11.55 **AM3** .1 (BCF=)30 or (CBF=)60 .2 $\tan\text{their}30 = \frac{BF}{5}$ OE or $\sin\text{their}60 = \frac{5}{BC}$ OE or $BC = \frac{5}{\cos\text{their}30}$ OE .2 ACCEPT (BF=) 2.89 or 2.9 or (BC=) 5.77 .3 (their8.66 + their2.89 =) their11.547(005…) ACCEPT 11.5 or 11.55	**3**

Q4	Answers	Notes	Total
	.1 One correct .2 A second correct .3 A third correct .4 The fourth and fifth correct		4

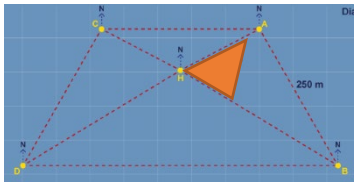
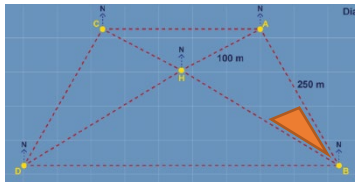
	a	b	c
$f(x)$	4	0.5	1
$g(x)$	8	[redacted]	–3

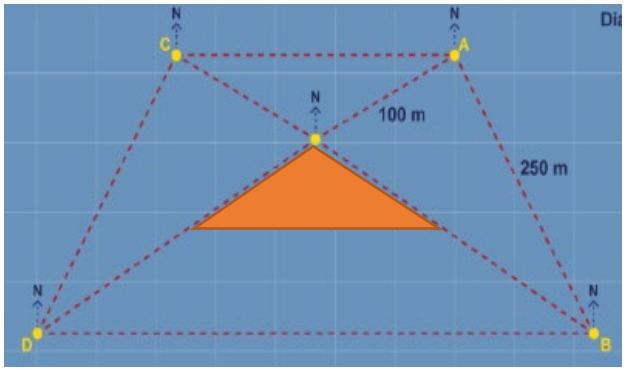
Q5		Answers	Notes	Total
	a	**Important note: Candidates may use a correct method but not listed below. Mark it in-line with any of these methods. If in doubt contact your team leader for advice.** **AM1 (55 as an alternate interior angle)** ·1 Correctly subtract 55 from 180 ·2 Subtract the sum of 125 and 140 from 360 95 AG **AM2 (55 as an alternate interior angle)** ·1 Correctly subtract 140 from 360 ·2 Subtract the difference of 180 and 55 from 220 95 AG **AM3 (supplementary angle and alternate interior angle)** .1 Correctly subtract 140 from 180 .2 Add 55 and 40 95 AG **AM4 (complementary angle and alternate interior angle)** .1 Correctly subtract 55 from 90 .2 Correctly subtract the sum of 35, 90 and 140 from 360 95 AG **AM5 (bearing of H from A)** .1 Correctly determine bearing of H from A .2 Correctly subtract 140 from 235 95 AG	**AM1** ·1 $180-55$ or 125 ·2 $360-(125+140)$ ACCEPT $140+125+95=360$ .2 ACCEPT 360 – 265 only if .1 is awarded **AM2** ·1 360 – 140 or 220 ·2 220 – (180 – 55) or 220 –125 **AM3** .1 180 – 140 or 40 .2 55 + 40 **AM4** .1 90 – 55 or 35 .2 360 – (35 + 90 + 140) ACCEPT 270 – (150 + 35) ACCEPT 360 – 265 only if .1 is awarded **AM5 (bearing of H from A)** .1 180 + 55 = 235 DO NOT ACCEPT only seeing 235 .2 235 – 140	**2**

	b	·1 Correctly substitute into cosine rule ·2 Correctly calculate the square of BH ·3 Correctly square root their result	·1 $(x^2 =)100^2 + 250^2 - 2 \times 100 \times 250 \times \cos 95$ OE ·2 76857(.787...) ACCEPT not seeing this step ·3 their 277(.232...)	**3**
	c	·1 Correctly identify the shortest route	·1 HABDCH or HCDBAH ACCEPT HBACDH or HDCABH	**1**

<table>
<tr><td>5</td><td>d</td><td colspan="2">SPECIAL NOTE 1
Even though candidate may have a route that does not include BD, marking to ensure fairness and consistency must be made following all the steps.

SPECIAL NOTE 2
If candidates use both AC and BD in c) they will make calculations for both distances in d) – identify the distance that will give the most marks and ignore the other distance calculation. However for .5 when they find the total distance, they must calculate the sum using their AC and BD found in d).</td></tr>
<tr><td>5</td><td>d</td><td>.1 Correct method to calculate
angle AHB or angle ABH

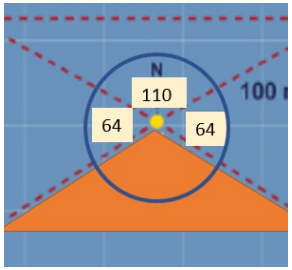
AHB
 
ABH
 

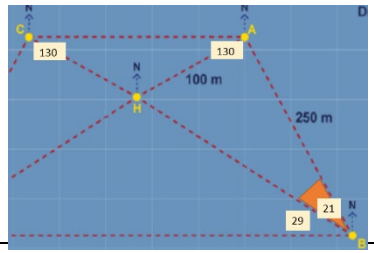
.2 Their correct angle BHD (bottom)
  </td><td>.1
<table><tr><th>AHB</th><th>ABH</th></tr><tr><td>$\frac{\sin AHB}{250}=\frac{\sin 95}{their277}$ OE

$250^2 = 100^2 + their277^2 - 2(100)(their277)\cos(AHB)$

AHB=64(.0390602)</td><td>$\frac{\sin ABH}{100}=\frac{\sin 95}{their277}$ OE

$100^2 = 250^2 + their277^2 - 2(250)(their277)\cos(ABH)$

ABH = 21(.0779…)</td></tr></table>
.2
<table><tr><th>Using their AHB</th><th>Using their ABH</th></tr><tr><td>360–110–2(their64) or
(BHD=) their 122
  </td><td>(Trapezium total :360)
(Upper angles 130)
(Lower angles $\frac{1}{2}$(360-2(130)) = 50)
(HBD = 50–their21 = their29)

180 – 2(their29) or
(BHD=) their122
  </td></tr></table>
.2 DO NOT ACCEPT 110 for angle BHD for .2</td></tr>
</table>

		.3 Correctly substitute into cosine rule to get BD or AC **OR** Correctly substitute into a correct trig ratio to get half BD or half AC **OR** correctly substitute into sine rule to get BD or AC .4 Correctly calculate their BD or AC .5 Correctly add their values for their route	.3 $(BD^2 =)\text{their}277^2 + \text{their}277^2 - 2(\text{their}277)(\text{their}277)\cos\text{their}122$ or $(AC^2 =)100^2 + 100^2 - 2(100)(100)\cos 110$ ACCEPT use of 110 in .3 for their BHD or 55 for half BHD $(BD^2 =)\text{their}277^2 + \text{their}277^2 - 2(\text{their}277)(\text{their}277)\cos 110$ **OR** $\sin 61 = \frac{\text{half BD}}{\text{their}277}$ or $\sin 55 = \frac{\text{half BD}}{\text{their}277}$ or $\sin 55 = \frac{\text{half AC}}{100}$ OE **OR** $\frac{BD}{\sin 122} = \frac{\text{their}277}{\sin 29}$ or $\frac{BD}{\sin 110} = \frac{\text{their}277}{\sin 35}$ or $\frac{AC}{\sin 110} = \frac{100}{\sin 35}$ OE .4 (BD=) Their484.5(393178…) or 453.81(02325…) seen (AC=) 163.8(30…) Correct .4 implies .3 . 5 Correct answer 1184.5 or 1185 (100+250+their484.5+250+100=) their1184.5 or their 1185 (100+250+their453.8+250+100=) their1153.8 or their 1154 (their 277+250+their163.8+250+their 277=) their1217.8 or their 1218 .5 ACCEPT values for their route in part c) even if route is incorrect .5 DO NOT ACCEPT if their route is incomplete (ex : doesn't end at H)	

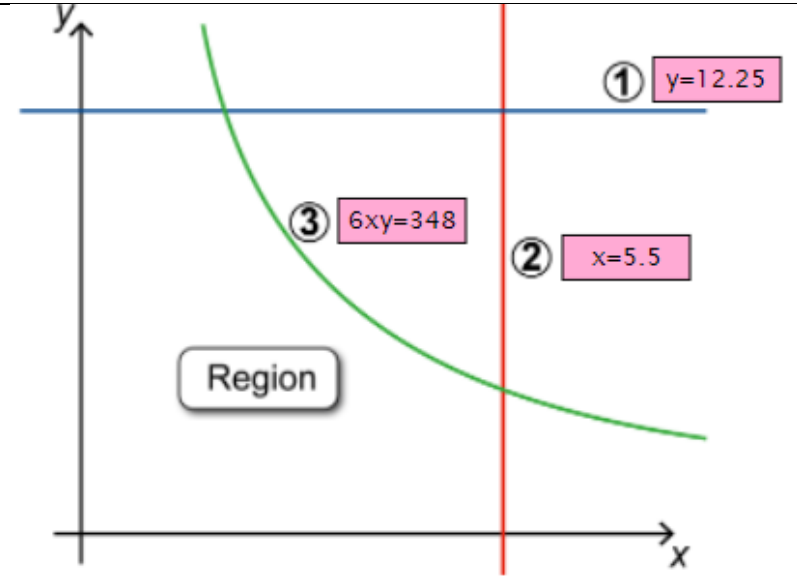
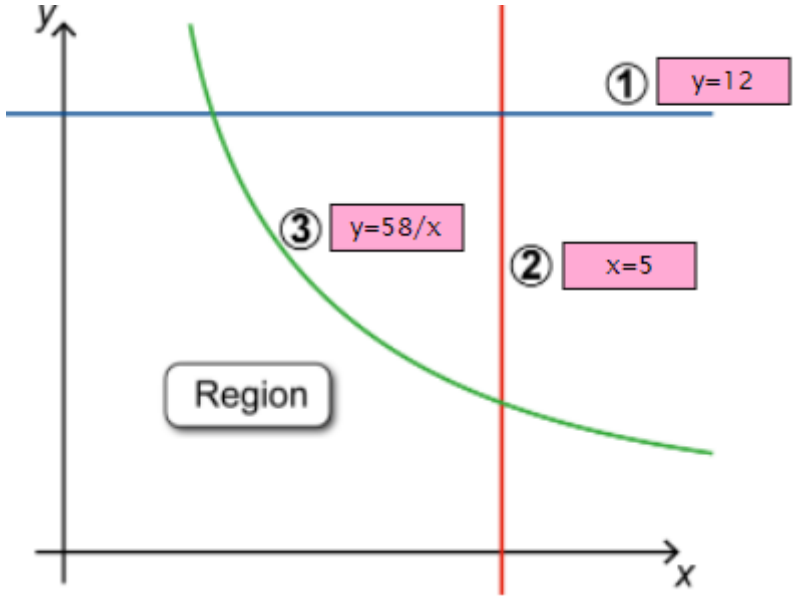
Q6		Answers	Notes	Total
	a	.1 Correct area for two from: square, circle or half mouth seen .2 Correct area for third seen .3 Subtract, at least, their circle from their square .4 The correct answer before rounding AG 196	.1 Two from: 20×20 or 400 , $7^2\pi$ or 153.9(…) or 153.86 or 154, $\frac{100}{2}$ or 50 .2 Third from: 20×20 or 400 , $7^2\pi$ or 153.9(…) or 153.86 or 154, $\frac{100}{2}$ or 50 .3 their400 - their153.9(…) or their400 - their153.9(…) - their50 OE .3 ACCEPT only if .1 is awarded .4 196.06(…) or 196.1 ACCEPT using $\pi = 3.14$ and reaching 196.14 or 196.1 .4 ACCEPT seeing evidence of correct rounding in intermediate steps Examples: 400 – 154 – 50 = 196 if 153.9(…) is seen in their response 400 – 204 = 196 if 203.9(...) is seen in their response	**4**

	b	**AM1** .1 Correct length ratio .2 Correct area ratio .3 The correct fraction after applying the area ratio AG 18.5 **AM2** .1 Correct length ratio .2 Correctly dividing areas .3 Correctly show that area ratio is the square of length ratio AG 18.5	**AM1** .1 $\frac{37.6}{4.7}$ or 8 or $\frac{1}{8}$ OE .2 $(\frac{1}{8^2} =)\frac{1}{64}$ OE or $(8^2 =)64$ OE ACCEPT $(\frac{37.6}{4.7})^2$ .3 $\frac{1184}{64}(=18.5)$ or $\frac{37}{2}$ OE ACCEPT $64 \times 18.5 = 1184$ .3 ACCEPT $\frac{1184}{(\frac{37.6}{4.7})^2}$ **AM2** .1 $\frac{37.6}{4.7}$ or 8 or $\frac{1}{8}$ OE .2 $(\frac{1184}{18.5} =)64$ or $(\frac{18.5}{1184} =)\frac{1}{64}$ OE ACCEPT $\sqrt{\frac{1184}{18.5}} = 8$ .3 $64 = 8^2$ or $\frac{1}{64} = (\frac{1}{8})^2$ or 64 is square of 8 WTTE .3 ACCEPT ratio of area is the square of ratio of side or length ratio is the square root of area ratio WTTE .3 DO NOT ACCEPT 64 is a multiple of 8	**3**

	c	**AM1 (using equations)** .1 Correctly write the second equation .2 Correct step towards solving the correct equations .3 Correctly solve their equations for one unknown x OR y .4 Correctly write their corresponding value of the other unknown satisfying one of their equations .5 Correctly identify x=24 and y=6 **AM2 (using numbers)** .1 Correctly calculate their area using their numbers of small and big triangles .2 Correctly calculate the area using 24 small triangles and 6 big triangles .3 Correctly calculate the area of painting left .4 Seeing their value of x is 4 times their value of y .5 Correctly identify x=24 and y=6	**AM1 (using equations) Note: only .3 and .4 are using their** .1 $2x + 5y = 80$ ACCEPT using inequality .2 correct substitution: $2x + 5 \times \frac{x}{4} = 80$ or $2 \times 4y + 5y = 80$ OR correct coefficients for elimination. Example: 2x + 5y = 80 and 2x – 8y = 0 or 8x + 20y = 320 and –5x + 20y =0 .2 DO NOT ACCEPT working with their equations from .1 .3 (x =) their $\frac{320}{13}$ or 24.61(...) OE OR (y =) their $\frac{80}{13}$ or 6.15(…) OE .4 (x =)their $\frac{320}{13}$ or 24.61(...) OE OR (y =) their $\frac{80}{13}$ or 6.15(…) OE .5 x = 24 and y = 6 or 24 small (triangles) and 6 big (triangles) **AM2 (using numbers) Note: Only .1 and .4 are using their** .1 $(2 \times \text{their}24 + 5 \times \text{their}6 =)$ their78 .2 $(2 \times 24 + 5 \times 6 =) = 78$ .3 (80 – 78=) 2 (cm^2) .4 their24 is 4 times their6 .5 x = 24 and y = 6 or 24 small (triangles) and 6 big (triangles)	**5**

Q7		Answers	Notes	Total
	a	.1 Correctly substitute into Arithmetic Progression .2 The correct common difference	.1 $3.5 = 1.5 + 5d$ or $\frac{(3.5-1.5)}{5}$ OE .2 0.4 OE	**2**
	b	Correctly substitute their 0.4 AND 1.5 into the correct arithmetic sequence formula	$(H_n =)$ 1.5 + their0.4(n–1) OE ACCEPT seeing u_1 + their0.4(n–1) if u_1=1.5 is used in part c)	**1**
	c	.1 Correctly substitute n = 12 in their H_n .2 Their correct answer	.1 $(H_5 =)$ 1.5 + their0.4(12 –1) OE .2 their 5.9 (m) .2 ACCEPT only if their 5.9 is in the range]3.5 , 10]	**2**
	d	**AM1 (solving for x)** .1 Correctly set an equation in terms of x .2 Correctly rearrange the equation .3 The correct value for x before rounding down x=5 AG	**AM1 (solving for x)** .1 $3.5x + 1.5(x–1) + 2 \times 2 = 30$ OE ACCEPT using inequality .2 $5x = 27.5$ ACCEPT $5x + 2.5=30$ ACCEPT using inequality .3 $(x = \frac{27.5}{5} =)5.5$	**3**

		AM2 (using x=5) .1 Correctly set calculations for width .2 Correctly calculate one of : → width of sections and gaps →total width excluding gaps →the remaining distance .3 Correct argument that x = 5 is the maximum possible in the width of 30	**AM2 (using x=5)** .1 Two from → 5×3.5 OE → 4×1.5 OE → 2×2 OE or $30-2\times 2$ OE .2 One of the following is seen → $(5\times 3.5+4\times 1.5+2\times 2=)27.5$ ACCEPT width of sections and in-between gaps $(5\times 3.5+4\times 1.5=)23.5$ → $(30-4\times 1.5-2\times 2=)20$ → $(30-5\times 3.5-4\times 1.5-2\times 2=)2.5$ .3 A corresponding argument from: → $\frac{27.5}{5}=5.5$ or making calculations with x=6 and showing that total 32.5 is more than 30 → $\frac{20}{3.5}=5.7(1...)$ → Recognise 2.5 remaining WTTE DO NOT ACCEPT $\frac{30}{6}$ =5	

	e	.1 Two correct from: x = 5.5 , y = 12.25, 6xy = 348 OE , Region ACCEPT x = 5 , y = 12 .2 A third correct from: x = 5.5 , y = 12.25, 6xy = 348 OE , Region ACCEPT x=5 , y=12 .3 A fourth correct from: x = 5.5 , y= 12.25, 6xy = 348 OE , Region ACCEPT x = 5 , y = 12 DO NOT ACCEPT inequalities Ex: x < 5.5 and y < 12.25 or x <= 5.5 and y <= 12.25 DO NOT ACCEPT numbers not simplified Ex: $y = \frac{6-1.1}{0.4}$	 	**3**

	f	See table below	**10**

7f	**(1 mark)**	**(2 marks)**	**(3 marks)**	**(4 marks)**
Factors (F)	**Two** factors seen in factors box from: - number of seats in a row or in a section, number of sections, or width of section(s) - number of tiers or height - <u>total</u> number of seats or capacity of theatre - width of theatre or space available - gaps that must be left (either in-between or at the ends) ACCEPT using values for any of the above ACCEPT WTTE DO NOT ACCEPT only 'number of seats' as a factor	**Three** factors seen in factors box from: - number of seats in a row or in a section, number of sections, or width of section(s) - number of tiers or height - <u>total</u> number of seats or capacity of theatre - width of theatre or space available - gaps that must be left (either in-between or at the ends) ACCEPT using values for any of the above ACCEPT WTTE DO NOT ACCEPT only 'number of seats' as a factor		

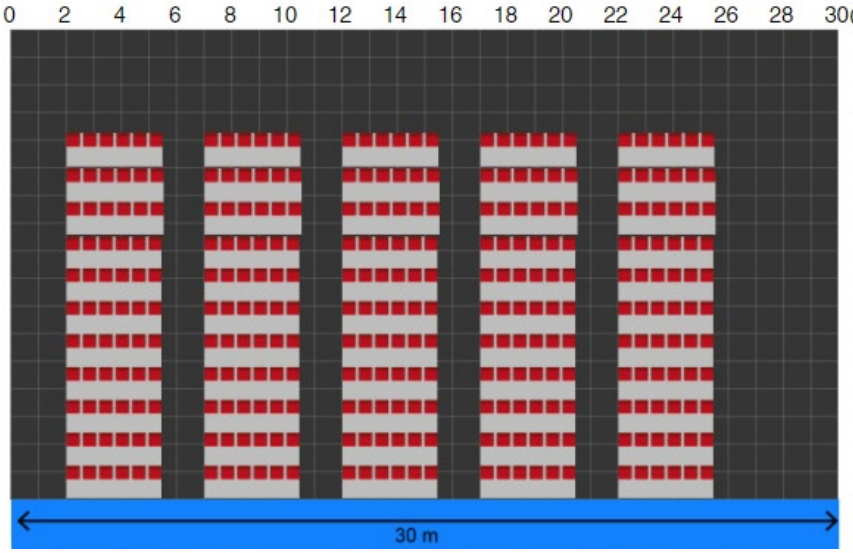
Cal (C)	**Correct calculations for their number of seats in a row or in a block** Total seats per row: 5 × 6 or 30 ACCEPT 348/12 = 29 OE **OR** Total seats in one of their blocks Ex: 8 × 6 or 48 12 × 6 or 72 **OR** Number of sections of seats: 348/6=58	**Correct calculations related to the total number of seats in the range [120,420]** Total number of seats 30 multiplied by their number of tiers: Example: 30 × 4=120 **OR** Number of tiers: Their total number of seats divided by 30 Ex: 348/30=11.6 **OR** Number of blocks of seats: Their total number of seats divided by 6 times their number of tiers Ex: 348/78 (78=6 × 13) ACCEPT correct combinations using blocks for a total in the range [120,420] Ex: 5 × 24 = 120 ACCEPT listing number of seats per block for a total in the range [120,420] Ex: 48,48,48,48,24,24,24,24 DO NOT ACCEPT 29 × 12=348	**Correct calculations for total number of seats in the range [330,360]** **EITHER** 11 × 30 = 330 **OR** 12 × 30 = 360 ACCEPT if they make further step and reach total number of seats in the range [330,360] Ex: 12 × 30 – 10 = 350 ACCEPT correct combinations using blocks for a total of 330 or 360 66 × 5=330 or 72 × 5=360 OE ACCEPT listing number of seats per block only if total is 348 Ex: 48,48,48,48,48,24,24,24,24,12 ACCEPT if they make further step and reach total number of seats in the range [330,360] Ex: 12 × 30 – 10 = 350 OE DO NOT ACCEPT 29 × 12=348	**Correct** **calculations for a total number** **of 348 seats** **EITHER** 11 × 30 = 330 then 330+3 × 6=348 **OR** 12 × 30 = 360 then 360 – 2 × 6 = 348 **OR** ACCEPT correct combinations using blocks for a total of 348 Ex: 72 × 3 + 66 × 2 = 348 OE or 72 × 4 + 60 = 348 OE or 48 × 5 + 24 × 4 + 12 = 348 OE DO NOT ACCEPT 29 × 12=348

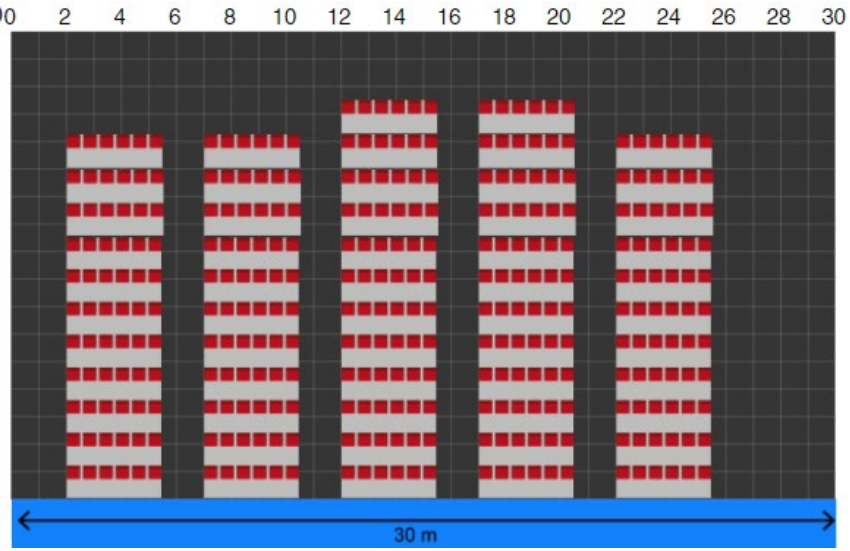
Justify (J)	**Weak justification** **Awareness of effect of constraints** I made the best use (or didn't make the best use) of space within the constraint(s) WTTE ACCEPT for the constraints if they list at least one constraint DO NOT ACCEPT if C0 and D0 are awarded	**Good justification** I made the best use (or didn't make the best use) of space within the constraint(s) WTTE ACCEPT for the constraints if they list at least one constraint **AND** I have blocks of different sizes that do not exceed 12 tiers WTTE (seen on canvas or in calculations) DO NOT ACCEPT if C0 and D0 are awarded		
Design (D)	**Two from:** Gaps between sections ≥ 1.5 Gaps left and right ≥ 2 $330 \leq$ Total number of seats ≤ 348 Tiers ≤ 12 ACCEPT number of seats seen in response box different from number on canvas ACCEPT error in the gaps up to 0.25m DO NOT ACCEPT if their total number of seats on canvas is less than 120	**The four of:** Gaps between sections ≥ 1.5 Gaps left and right ≥ 2 $330 \leq$ Total number of seats ≤ 348 Tiers ≤ 12 ACCEPT number of seats seen in response box different from number on canvas A CCEPT error in the gaps up to 0.25m		

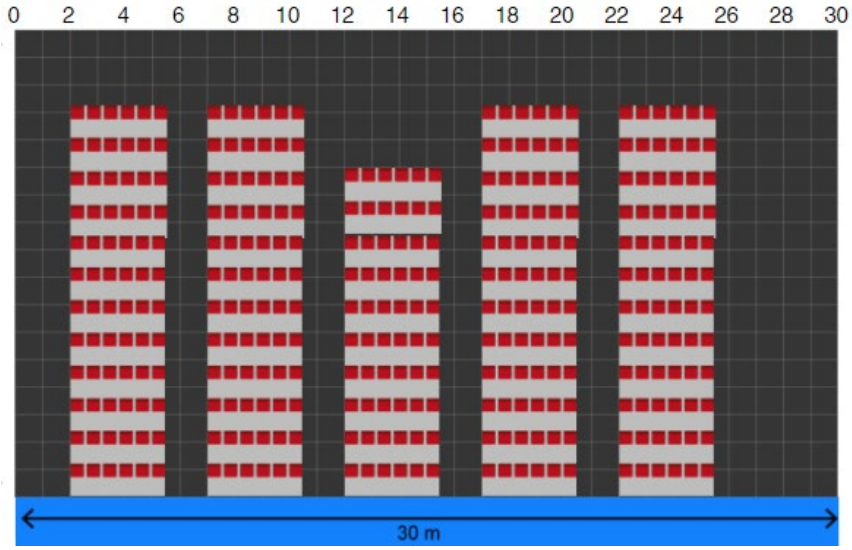
For examples of marks for the design (D) scroll down

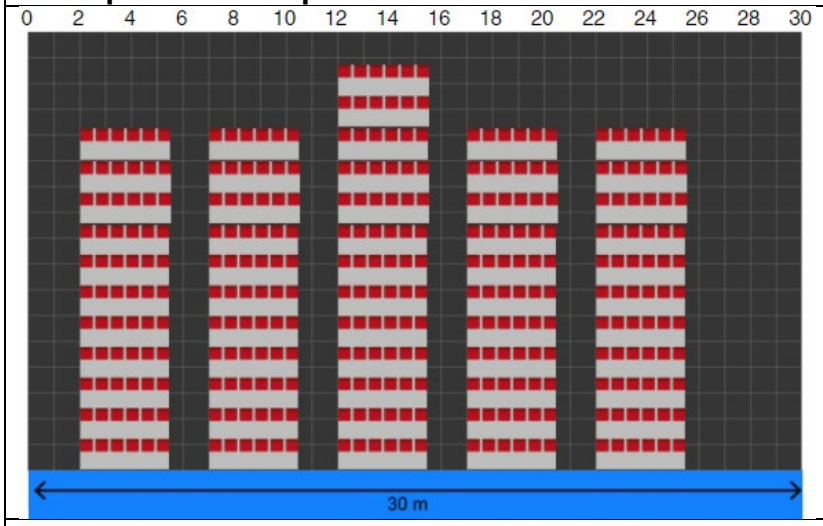
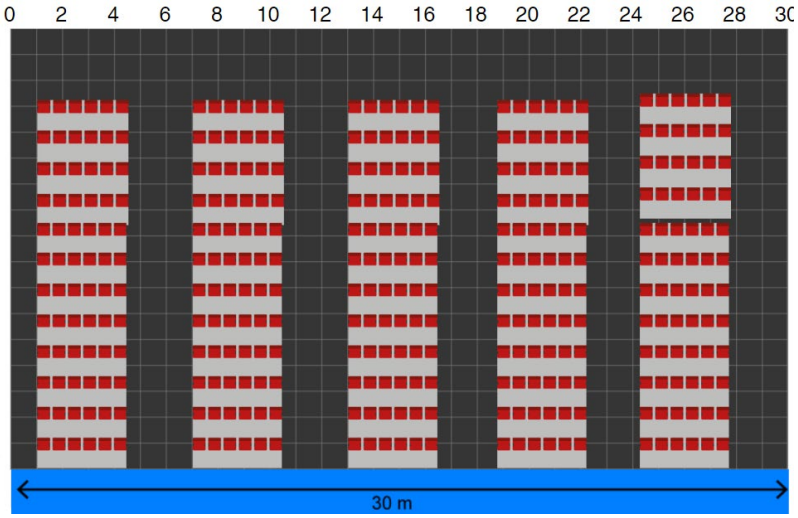
Accepted for D2

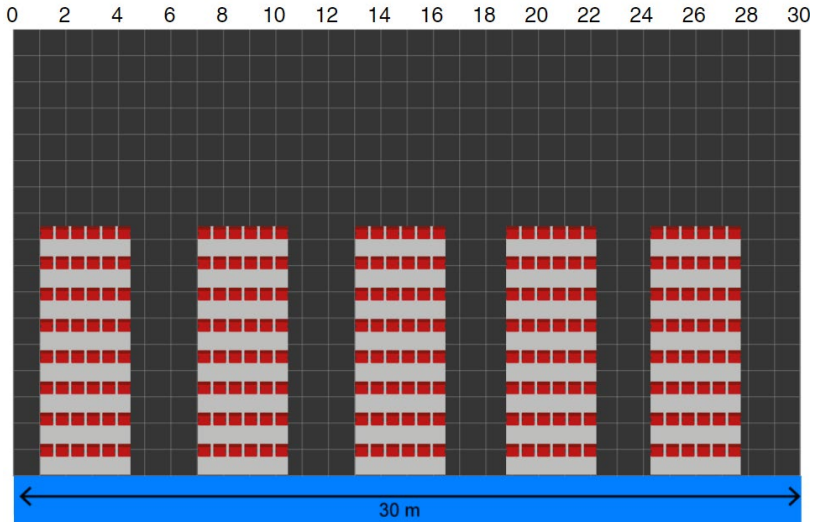
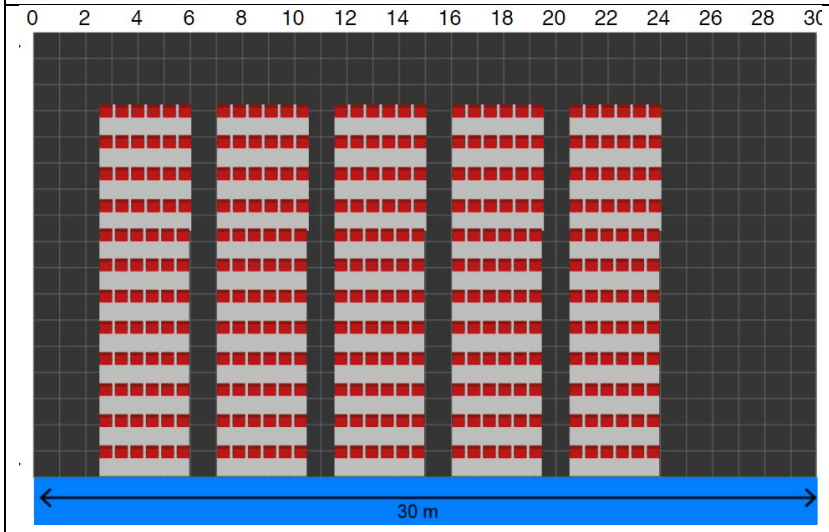
Gaps between sections ≥ 1.5 AND Gaps left and right ≥ 2 AND $330 \leq$ Total number of seats ≤ 348 AND tiers ≤ 12

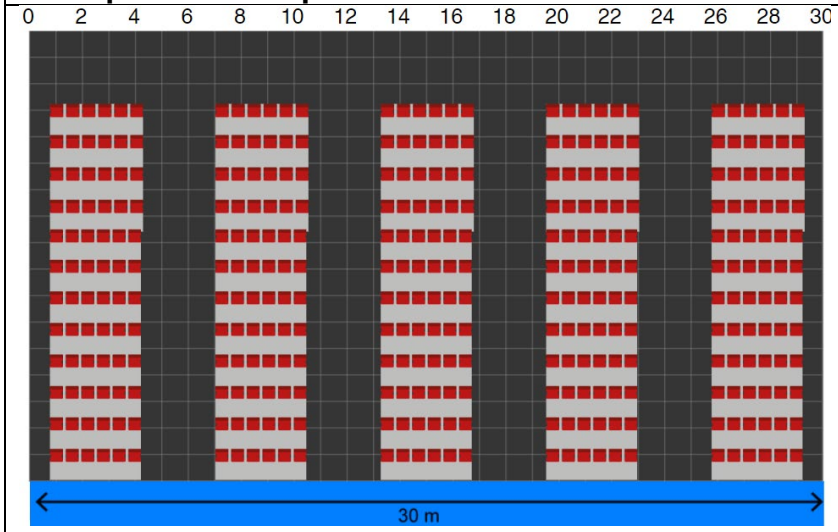
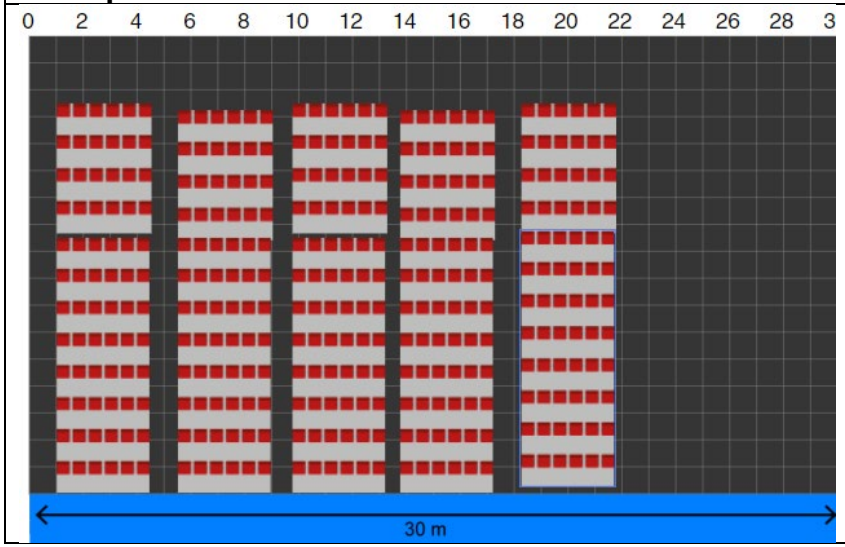


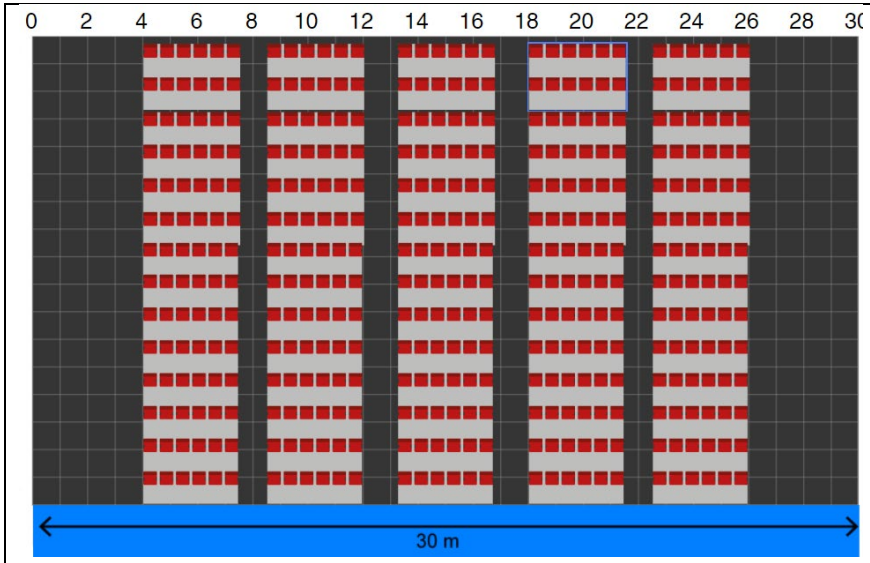
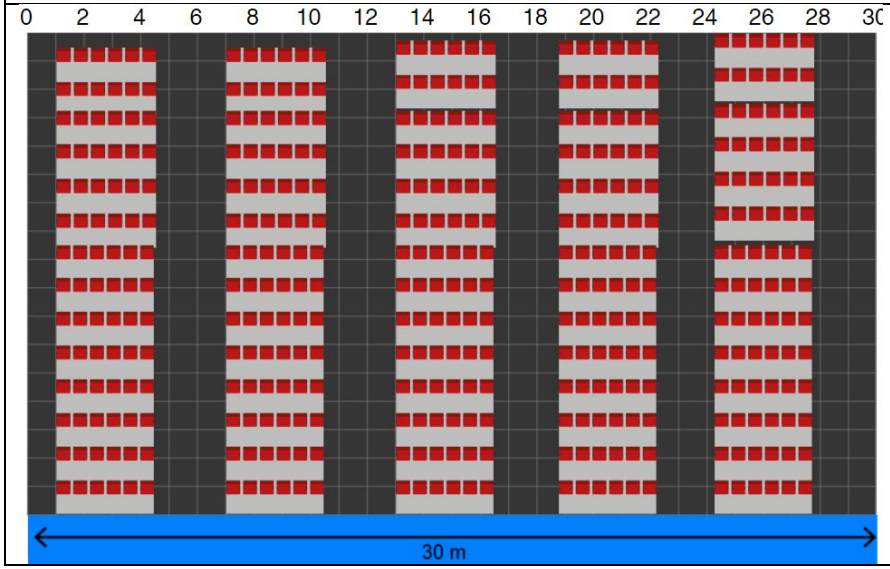




Examples for accepted D1	Reason
	Gaps between sections ≥ 1.5 Gaps left and right ≥ 2 $330 \leq$ Total number of seats ≤ 348
	Gaps between sections ≥ 1.5 tiers ≤ 12

Examples for accepted D1	Reason
	Gaps between sections ≥ 1.5 tiers ≤ 12
	Gaps left and right ≥ 2 tiers ≤ 12

Examples for accepted D1	Reason
	Gaps between sections ≥ 1.5 tiers ≤ 12
Examples for D0	**Reason**
	Only tiers ≤ 12

	Only Gaps left and right ≥ 2
	Only Gaps between sections ≥ 1.5 Note that the gap on the right is >2 but the gap on the left no. So not acceped

Answers			Notes	Total
8	**a**	.1 Correctly describe one pattern in words .2 Correctly describe a second pattern in words	ACCEPT complete terminology only, for example (below are four different descriptions) (*T*) goes up by 4, increases by 4, moves up by 4, adds 4 They are odd numbers Linear with difference 4, arithmetic with difference 4, Constant difference 4 Second difference is zero DO NOT ACCEPT incomplete terminology, for example: Arithmetic, linear, increasing by a constant, constant difference, **the** odd numbers DO NOT ACCEPT the rule in words, for example: 4 times n then subtract 3 The difference between 4*n* and 3 DO NOT ACCEPT *n* goes up by 1 It is increasing general rules in terms of *n*, example: $T = 4n - 3$ More than two different patterns, all correct award **(2 marks)** Ex: adds 4 and Second difference is zero and it is 4 times *n* minus 3 More than two different patterns, with any incorrect award **(1 mark)** Ex: adds 4 and Second difference is zero and it is 4 times *n*	**2**

<table>
<tr>
<td></td>
<td>b</td>
<td>·1 The correct general rule
·2 The correct simplified general rule with correct notation</td>
<td>·1 $4n-3$ or $T=4*n-3$ or $u_n=4n-3$ or $t=4n-3$ or $T=2n+2n-3$ or $T=4x-3$
·2 $T=4n-3$ or $T_n=4n-3$

DO NOT ACCEPT description in words</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>·1 Correctly substitute n ≥ 5 into their general rule
·2 Correctly calculate their value of T after substituting n ≥ 5
·3 Recognize that their result is the same as when continuing the correct pattern. See table below
<table>
<tr><th>Stage
(n)</th><th>Number of triangles
(T)</th></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>2</td><td>5</td></tr>
<tr><td>3</td><td>9</td></tr>
<tr><td>4</td><td>13</td></tr>
<tr><td>5</td><td>17</td></tr>
<tr><td>6</td><td>21</td></tr>
</table>
</td>
<td>·1 Ex: 4 x 5 - 3
·2 Ex: 17 (for the n = 5)
·3 Same as value I predicted in table (and we find the candidate has 17 in the table for n = 5) OR same as when we continue the pattern and explains how 17 is obtained from pattern of adding 4 to 13

·3 ACCEPT seeing the 17 in the table and seeing their calculated T = 17 when n = 5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>AM1
·1 Correctly substitute into trig ratio OR correctly substitute 4 and 8 into Pythagoras OR Correctly recognize ratio of 30-60-90 triangle of 1: $\sqrt{3}$: 2.

·2 Correctly calculate height of triangle h

·3 Correctly substitute values in area of triangle formula OR Correctly calculate area of triangle using decimals AND show that $16\sqrt{3}$ equals the same, using decimals.

$16\sqrt{3}$ AG</td>
<td>AM1
·1 $\sin 60=\frac{h}{8}$ OR $\cos 30=\frac{h}{8}$ OR $h=\sqrt{8^2-4^2}$ ACCEPT $\tan 60=\frac{h}{4}$
Accept not seeing this step.

·2 $\frac{8\sqrt{3}}{2}$ or 6.93 OE ACCEPT $8\sin 60$

·3 $\frac{1}{2}\times 8\times\frac{8\sqrt{3}}{2}$ OE
OR
Both (A=) 27.71(281…) AND $16\sqrt{3}$ =27.71(281…)

AM2 next page</td>
<td>3</td>
</tr>
</table>

		AM2 using $\frac{1}{2}$ab sinC .1 Correctly substitute into the area of triangle formula using sin .2 Correctly calculate area of triangle .3 Show that $16\sqrt{3}$ equals the same $16\sqrt{3}$	**AM2 using $\frac{1}{2}$ab sinC** .1 $(A=)\frac{1}{2}\times 8\times 8\times \sin 60$ .2 (*A*=) 27.71(28…) .3 $16\sqrt{3} = 27.71(28\ldots)$ Showing $16\sqrt{3}$ using other values in the table or using the geometric progression, award 0 marks.	
8	**e**	Scroll down for the marking grid		**23**

Mark	1	2	3	4	5
Predictions (P)	Correctly predict one value for *A* **OR** two value for *L*	Correctly predict two values for *A* **OR** one value for *A* and two values for *L*	Correctly predict two values for *A* **AND** two values for *L*		

Stage (n)	Side length of outer triangle (L)	Area (A)	Area (A)
1	1	$\frac{\sqrt{3}}{4}$	0.4330127019
2	2	$\sqrt{3}$	1.732050808
3	4	$4\sqrt{3}$	6.92820323
4	8	$16\sqrt{3}$	27.71281292
5	16	$64\sqrt{3}$	110.8512517
6	32	$256\sqrt{3}$	443.4050067
7	64	$1024\sqrt{3}$	1773.620027
8	128	$4096\sqrt{3}$	7094.480108

Description (D)	Correctly describe a pattern in words (for *L or A)* **Examples for *L* :** Value doubles WTTE The difference doubles Increasing by multiplying by 2 All even except 1 It is exponential or geometric Add 1 then add 2 then add 4,…etc OE DO NOT ACCEPT L is increasing *n* goes up by 1 **Examples for *A* :** Value quadruples WTTE The difference quadruples It is exponential or geometric All multiples of $\sqrt{3}$ DO NOT ACCEPT A is increasing *n* goes up by 1 $\sqrt{3}$ is always there Length squared times $\sqrt{3}$ There is a common ratio **OR** Valid attempt to write down general rule for *L* in terms of n Ex.: $L = 2^n$ DO NOT ACCEPT *L*=2n Ignore additional incorrect patterns (for Notation see N)	Correctly describe a pattern in words for *L* and for A See patterns in D1 **OR** Correctly describe a pattern in words (for *L* or *A*) and valid attempt to write down general rule for *L* in terms of *n* Ignore additional incorrect patterns (for Notation see N)	Correctly describe a pattern in words for *L* and *A* and valid attempt to write down general rule for *L* in terms of *n* **OR** Correctly write down the general rule for *L* in terms of *n* $L = 2^{n-1}$ **OR** Valid attempt to write down general rule for *A* in terms of *n* Examples: seeing in their rule 4^n added or multiplied by something $4^n \times \sqrt{3}$ $A = \frac{1}{2} \times 2^n \times 2^n \times \frac{\sqrt{3}}{2}$ $A = \sqrt{3}L$ $A = u_1 \times 4^{n-1}$ Ignore additional incorrect patterns (for Notation see N)	Correctly describe a pattern in words (for *L* or *A*) and correctly write down the general rule for *L* **OR** Correctly describe a pattern in words (for *L* or *A*) and valid attempt to write down the general rule for *A* in terms of *n* **OR** Correctly write down the general rule for *A* in terms of *n* $A = 2^{2n-4}\sqrt{3}$ or $A = \frac{4^n}{16}\sqrt{3}$ or $A = 4^{n-1}\frac{\sqrt{3}}{4}$ or $A = 4^{(n-2)}\sqrt{3}$ Ignore additional incorrect patterns (for Notation see N)	Correctly describe a pattern in words for *L* and for *A* **AND** Correctly write down the general rule for *A* in terms of *n* Ignore additional incorrect patterns (for Notation see N)

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

Justify/proof (J)	Attempt to justify a correct described pattern or their general rule Substitute at least two other values of n in A and say they are the same or the rule works OR Seeing $A = 0.5 \times L \times \text{h}$ OE DO NOT ACCEPT $A = 0.5 \times \text{b} \times \text{h}$ OR Recognize it is geometric progression and define first term $\frac{\sqrt{3}}{4}$ or ratio 4, WTTE DO NOT ACCEPT if D1 not achieved	Correctly justify the general rule for A in relation to geometry in terms of L or height of triangle (h) $\text{A} = \frac{1}{2}L \times L \times \frac{\sqrt{3}}{2}$ or $\text{A} = 0.5 \times L \times L \times \sin 60$ OE or $A = 0.5 \times 2^{n-1} \times \text{h}$ OR Recognize it is geometric progression and define first term $\frac{\sqrt{3}}{4}$ and ratio 4, WTTE DO NOT ACCEPT if D3 not achieved	Attempt to justify the general rule for A in relation to geometry in terms of n Examples using area of triangle but including errors : $\frac{2^{n-1} \times 2^{n-1}\sqrt{3}}{2}$ $\frac{2^{n-2} \times 2^{n-2}\sqrt{3}}{2}$ $\frac{2^{n} \times 2^{n}\sqrt{3}}{2}$ ACCEPT seeing the justification inside their work and not separate at the end DO NOT ACCEPT if D3 not achieved	Correctly justify the correct general rule for A geometrically in terms of n Using the area of a triangle $\text{A} = \frac{B \times h}{2}$ or $\frac{a \times b \times \sin C}{2}$ $\frac{2^{n-1} \times 2^{n-2}\sqrt{3}}{2}$ or $\frac{2^{n-1} \times 2^{n-1} \times \frac{\sqrt{3}}{2}}{2}$ ACCEPT seeing the justification inside their work and not separate at the end DO NOT ACCEPT if D4 not achieved	

Communication criteria

Mark	1	2	3
Notation and terminology (N)	Correct notation of <u>their general</u> rule **OR** Correct terminology describing a pattern DO NOT ACCEPT if they don't have any rules and they don't describe any patterns correct	Correct notation of <u>the general</u> rule for *L* or *A* **OR** The notation of <u>the general</u> rule for *L* or *A* includes errors **AND** Correct terminology describing a pattern in words DO NOT ACCEPT if they don't have the general rule For notation of the general rule for *L*, $L = 2^{n-1}$ ACCEPT using *Un* instead of L only if they mention that $L = U_n$ ACCEPT non simplified rules ex: $L = \frac{2^n}{2}$ OE DO NOT ACCEPT Using * for multiplication Using / for division Using ^ for power Using x instead of *n* "the rule for *L* is:" instead of "*L*="	Correct notation of <u>the general</u> rule for *A* **AND** Correct terminology describing pattern in words for *A* DO NOT ACCEPT if they don't have the general rule for *A* For notation of the general rule for *A* $A = 4^{(n-2)}\sqrt{3}$ or $A = 4^{(n-2)} \times \sqrt{3}$ ACCEPT using *Un* instead of A only if they mention that $A = U_n$ ACCEPT non simplified rules ex: $A = \frac{1}{2} \times 2^{2n-2} \times \frac{\sqrt{3}}{2}$ or $A = 4^{n-1}\frac{\sqrt{3}}{4}$ OE DO NOT ACCEPT The Using * for multiplication Using / for division Using ^ for power Using x instead of *n* "the rule for *A* is:" instead of "*A*="

Continued on next page

Mark	1	2	3
Communication (L) Organisation and coherence Can be awarded even if there are errors in their descriptions and working. **Different items can be considered seen (or identified for coherence) if they include errors but not if awarded 0 marks**	**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 · verify their general rule or rule or recursive rule or pattern · justify their general rule or rule or recursive rule or pattern	**At least four** of the following items are seen: · describe a pattern in words (for *L* or *A*) · write a general rule (for *L* or *A*) · test their general rule (for *L* or *A*) · verify their general rule (for *L* or *A*) · justify their general rule (for *L* or *A*) **AND** For coherence, they identify the processes correctly. **At least one** from the following: · test · verify · justify 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:** they say “justify” or "my rule works because" WTTE and their justification is seen → **For justify:** they substitute at least two values of *n* **and** say “the rule justified” or “it works” WTTE → **For justify:** They justify the general rule for *A* geometrically	DO NOT ACCEPT if D4 not awarded **At least four** of the following items are seen: · describe a pattern in words · write the general rule for *A* · test the general rule for *A* · verify the general rule for *A* · justify the general rule for *A* **AND** For coherence, they identify the processes correctly. **At least two** from the following: · test · verify · justify 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:** they say “justify” or "my rule works because" WTTE and their justification is seen → **For justify:** they substitute at least two values of *n* **and** say “the rule justified” or “it works” WTTE → **For justify:** They justify the general rule for *A* geometrically