

		Answers	Notes	Total
1	a	<ul style="list-style-type: none"> •¹ first correctly place •² second correctly placed •³ third correctly placed •⁴ fourth correctly placed 		4

2	a	$\frac{16}{48}$ OE	ACCEPT 0.3 OE ACCEPT 16 out of 48	1
	b	<ul style="list-style-type: none"> •¹ probability of MYP year 1 •² (statement is) incorrect with valid reason 	<ul style="list-style-type: none"> •¹ $\frac{16}{72}$ OE •² (statement is) false because the probabilities are different OR because the total number of students (in each grade) is different WTTE •² ACCPET false and comparing incorrect percentages or probabilities <p>SC for 2 marks (statement is) incorrect since Number of students chose gaming (or Numerators) are the same but the total of students (or denominators) are different WTTE</p> <p>SC for 1 mark incorrect because total in each grade (or Denominators) are different so probability not the same WTTE</p>	2
	c	<ul style="list-style-type: none"> •¹ subtracting 1 from 54 •² dividing by 119 	<ul style="list-style-type: none"> •¹ (54-1=)53 seen •² their $\frac{53}{119}$ <p>$\frac{53}{119}$ OE without working award 2 marks 53 out of 119 without working award 1 mark</p>	

Answers		Notes	Total	
3	a	<ul style="list-style-type: none"> •¹ sine rule seen •² correct substitution into sine rule •³ correct rearrangement and equate with $5\sqrt{2}$ $5\sqrt{2}$ AG 	<ul style="list-style-type: none"> •² $\frac{AC}{\sin 30} = \frac{10}{\sin 45}$ •³ $(AC =) \frac{10 \times \sin 30}{\sin 45}$ and $5\sqrt{2}$ $(AC =) \frac{10 \times \sin 30}{\sin 45}$ only award 2 marks $(AC =) \frac{10 \times \sin 30}{\sin 45} = 5\sqrt{2}$ only award 3 marks 	3
	b	<ul style="list-style-type: none"> •¹ determine angle ACD •² cosine rule seen •³ correct substitution into cosine rule •⁴ their AD from cosine rule calculated correctly before rounding •⁵ their AD correctly calculated after square root and written to nearest cm <p>Alternative Methode AM1</p> <ul style="list-style-type: none"> •¹ determine length AB •² cosine rule seen •³ correct substitution into cosine rule •⁴ their AD from cosine rule calculated correctly before rounding •⁵ their AD correctly calculated after square root and written to nearest cm 	<ul style="list-style-type: none"> •¹ 75 (degrees) seen •³ $AD^2 = 5^2 + (5\sqrt{2})^2 - 2(5)(5\sqrt{2})\cos 75$ or 56.6(98)...OE •⁴ their 7.5(298)..... •⁵ their 8 (cm) •⁵ DO NOT ACCEPT if their value from •⁴ is a whole number <p>Alternative Methode AM1</p> <ul style="list-style-type: none"> •¹ $(\frac{AB}{\sin 105} = \frac{10}{\sin 45}; AB =) 5 + 5\sqrt{3}$ or 13.6602..... •³ $AD^2 = 15^2 + (13.6602\dots)^2 - 2(15)(13.6602\dots)\cos 30$ or 56.6(98)...OE •⁴ their 7.5(252...) •⁵ their 8 (cm) •⁵ DO NOT ACCEPT if their value from •⁴ is a whole number <p>Note:</p> <p>Using a rounded value for $5\sqrt{2}$ (eg 7), the final answer for AD will be 7 (cm) award 4 marks</p>	5

		Answers	Notes	Total
4	a	<ul style="list-style-type: none"> •¹ a vertical stretch/dilation/enlargement/compression of (factor) 4 OR horizontal stretch/dilation/enlargement/compression of (factor) $\frac{1}{2}$ •² a reflection about/on x axis. •³ a horizontal translation of 2 units left •⁴ a vertical translation of 1 unit upwards 	<ul style="list-style-type: none"> •¹ ACCEPT in y direction instead of vertical •¹ ACCEPT in x direction instead of horizontal •² ACCEPT seeing reflection and x-axis •² ACCEPT mirror about/on x axis. •³ ACCEPT seeing left and 2 •³ ACCEPT shift 2 left or move left and 2 or 2 units in the $-x$ direction or -2 units in the x direction •⁴ ACCEPT seeing up and 1 •⁴ ACCEPT 1 unit in the y-axis <p>For •³ and •⁴ ACCEPT description using translation vectors ex $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$</p> <p>ACCEPT seeing answers in any order ACCEPT seeing multiple transformations in same box</p>	4
	b	<ul style="list-style-type: none"> •¹ recognize axis of symmetry •² difference of $\frac{1}{2}$ •³ sum of their $\frac{-1}{2}$ and -2 •⁴ their correct value of the other solution <p>Alternative method 1 (AM1)</p> <ul style="list-style-type: none"> •¹ attempt to expand $g(x) = 0$ •² correctly expanding •³ correctly factorize or substitute correctly into formula •⁴ their correct value of the other solution 	<ul style="list-style-type: none"> •¹ their -2 seen •² their $\frac{1}{2}$ seen •² ACCEPT "half step" in context, maybe be seen on the diagram •³ ($x =$) their -2 - their $\frac{1}{2}$ •⁴ their $\frac{-5}{2}$ OE <p>Alternative method 1 (AM1)</p> <ul style="list-style-type: none"> •¹ $-4(x^2 + 4x + 4) + 1 = 0$ •² $-4x^2 - 16x - 15 = 0$ or $-4x^2 - 16x - 15 = 0$ OE •³ $(2x + 5)(2x + 3) = 0$ or $\frac{16 \pm \sqrt{16^2 - 4(-4)(-15)}}{2(-4)}$ OE 	4

Alternative method 2 (AM2)

- ¹ attempt to solve
- ² square root both sides correctly
- ³ sum of their $\frac{-1}{2}$ and -2
- ⁴ their correct value of the other solution

•⁴ their $\frac{-5}{2}$ OE

Alternative method 2 (AM2)

- ¹ $-4(x + 2)^2 = -1$ or $(x + 2)^2 = \frac{1}{4}$
- ² $x + 2 = \pm\frac{1}{2}$
- ³ $(x =) -2 \pm\frac{1}{2}$
- ⁴ (c =) their $\frac{-5}{2}$ OE
- ⁴ DO NOT ACCEPT if their result ≥ 0

$\frac{-5}{2}$ OE without working award 3 marks

$\frac{-5}{2}$ OE with one working step award 4 marks

		Answers	Notes	Total
5	a	<ul style="list-style-type: none"> •¹ substitutes correctly into an area of triangle formula •² their result correct 	<ul style="list-style-type: none"> •¹ $0.5 \times 4 \times 4$ or $0.5 \times 4 \times 4 \times \sin 90$ •² their 8 	2
	b	<ul style="list-style-type: none"> •¹ substitutes correctly in area of sector formula •² their area of the sector correctly calculated •³ $4\pi - 8$ AG $4(\pi - 2)$ 	<ul style="list-style-type: none"> •¹ $\frac{1}{2} \times \frac{\pi}{2} 4^2$ OR $\frac{90}{360} \times \pi \times 4^2$ OE •² their 4π •² may be awarded for substituting incorrectly provided the formula used is an area formula •³ ACCEPT if they calculate LHS to be 4.566... and show that it is equal to $4(\pi - 2) = 4.566...$ 	3
	c	<ul style="list-style-type: none"> •¹ recognizing angle AO_2B is 60° •² area of triangle ABD correct •³ their area of sector ABD correct using their angle AO_2B •⁴ correctly subtracting their area of triangle from their area of sector •⁵ sum their area for two segments correctly •⁶ correctly round their answer 	<ul style="list-style-type: none"> •¹ 60° or equilateral triangle seen •² $(\frac{1}{2} \times 4\sqrt{2} \times 4\sqrt{2} \sin 60 =) 8\sqrt{3}$ or 13.856... or 13.9 •³ their $\frac{16\pi}{3}$ or their 16.755... or their 16.8 •⁴ their $\frac{16\pi}{3}$ - their $8\sqrt{3}$ OR 2.89875... OR 2.9 •⁴ DO NOT ACCEPT unless one of the above marks is awarded •⁵ their 7.465... accept not seeing this step •⁵ DO NOT ACCEPT unless two of the above marks are awarded •⁶ their 7.5 •⁶ DO NOT ACCEPT if their value from •⁵ is a whole number <p>7.5 without working award 5 marks 7.465.. without working award 4 marks</p>	6

Answers			Notes	Total
6	a	the correct result before rounding AG 197 bpm	196.8	1
	b	<ul style="list-style-type: none"> •¹ multiply maximum heart beat by 80 % •² their 157.6 correctly rounded to the nearest beat 	<ul style="list-style-type: none"> •¹ 0.8 x 197 or 157.6 •¹ ACCEPT 0.8 x 196.8 or 157.44 •² their 158 •² DO NOT ACCEPT if their incorrect value from •¹ is a whole number 158 without working award 2 marks 157 without working award 1 mark 	2
	c	<ul style="list-style-type: none"> •¹ one correct algebraic step •² apply one log rule correctly •³ write their t in terms of log base 10 correctly •⁴ their calculation involving log correct 	<ul style="list-style-type: none"> •¹ $\frac{108}{70} = (1.04)^t$ •² $\log\left(\frac{108}{70}\right) = t \log(1.04)$ or $(t =) \log_{1.04}\left(\frac{108}{70}\right)$ OE •³ $(t =) \log\left(\frac{108}{70}\right) \div \log(1.04)$ •⁴ $(t =)$ their 11.056(30036) or 11.06 or 11 •⁴ DO NOT AWARD if their $t \leq 9$ or > 12 11.056(30036) or 11.06 without working award 3 marks 11 or 11.5 without working award 1 mark $(t =) \log(1.542857143) \div \log(1.04)$ only award 3 marks SC for 1 mark Using trial and error until substituting with $t=11$ into the correct formula and calculating 107.76...bpm 	4
	d	<ul style="list-style-type: none"> •¹ correct comment on safety •² seeing 80% of maximum heart rate •³ comment on effectiveness of the exercise in relation to duration or time when 80% of maximum heart rate was achieved 	<ul style="list-style-type: none"> •¹ safe because it was below maximum heart rate or below 197 WTTE •² reached their 158 or 80% of their H •³ ineffective because it reached 80% of max heart rate for only few minutes or ineffective because it reached their 158 for only few minutes •³ ACCEPT effective because heart rate reached 80% of maximum 	3

			<p>SC for 1 mark Correct description with acceptable terminology of the behaviour of the graph (e.g. increases then decreases, then increases)</p>	
--	--	--	--	--

Answers			Notes	Total
7	a	<ul style="list-style-type: none"> •¹ percentage of carbohydrates •² the correct result 	<ul style="list-style-type: none"> •¹ 55% or 0.55 seen •¹ ACCEPT any 55 seen •² (180x55/45=) 220 (g) 220 without working award 2 marks Do not award •² if their result is less than 180 (g) 	2
	b	<ul style="list-style-type: none"> •¹ identify the 12400 (kJ) as the total and adding ratios •² correct calculation towards the result •³ their result correctly rounded to nearest kJ 	<ul style="list-style-type: none"> •¹ identifying the 12400 (kJ) as the total and 2 + 3 + 4 = 9 or 12400/9 or seeing 1377.777... or 1378 <li style="text-align: center;">$\frac{7 \times 12400}{9}$ •² 9 or 9644.44.... or their 1378 x 7 or 9639 •² ACCEPT stating values of calories in mid-day meal and dinner meal separately eg. 5511.111....and 4133.333... •³ their 9644 (kJ) or 9646 •³ ACCEPT stating values of calories in mid-day meal and dinner meal separately eg. 5511 and 4133 OR 5512 and 4134 •³ DO NOT ACCEPT if their incorrect value from •² is a whole number 9644 or 9646 without working award 2 marks 5511 and 4133 without working award 2 marks 5511 or 4133 without working award 1 mark 9644.44... or 9639 without working award 1 mark 	3
	c	<ul style="list-style-type: none"> •¹ multiply 12 400 by 7 •² subtract 77 790 from 86 800 OR add 77790 to 9010 and equate with 86800 <p>AG 9010 (kJ)</p>	<ul style="list-style-type: none"> •¹ 86 800 (kJ) •² 86 800 – 77 790=9010 OR 77790+9010=86800 <p>SC for 2 marks</p> $: \frac{77790 + 9010}{7} = 12400$	2

	<p>d</p> <ul style="list-style-type: none"> •¹ correctly setting first equation •² correctly setting second equation •³ reduce their two equations to one correct equation including one unknown •⁴ their value for first unknown (r or s) correct •⁵ substituting correctly into one of their equations to calculate the value of the other unknown •⁶ their calculation for the other unknown correct <p>Alternative method for trial and error responses (AM1)</p> <ul style="list-style-type: none"> •¹ correctly setting first equation •² correctly setting second equation •³ seeing two numbers with sum their 5 •⁴ seeing two numbers which satisfy their other equation •⁵ their r or their s correct •⁶ their r and their s correct 	<ul style="list-style-type: none"> •¹ $1700r + 2700s = 10\ 000$ OE •² $r + s = 5$ OE •³ $1700s + 2700r = 10000$ OR $1700(5-r) + 2700r = 10000$ $\frac{1700s + 1700r = 8500}{1000r = 1500}$ •⁴ $r = 1.5$ (h) OR $s = 3.5$ (h) •⁵ $1.5 + s = 5$ OR $r + 3.5 = 5$ •⁶ $r = 1.5$ (h) and $s = 3.5$ (h) <p>1.5 and 3.5 without working award 5 marks</p> <p>Alternative method for trial and error responses (AM1)</p> <ul style="list-style-type: none"> •¹ $1700r + 2700s = 10\ 000$ •² $r + s = 5$ •³ trial e.g. 3 and 2 •⁴ trial e.g. 25 and 10 if their other equation is $2r + 5s = 100$ •⁵ their 1.5 or their 3.5 •⁶ their 1.5 and their 3.5 <p>1.5 and 3.5 without working award 5 marks Their 1.5 and their 3.5 without working award 3 mark</p>	6
--	---	--	---

7	e		<p>F: Identification of factors</p> <p>1 Two factors mentioned from:</p> <ul style="list-style-type: none"> - Total energy intake - proportion of the meals in a day - The meal is balanced or well balanced diet or healthy meal eg Fat:Carb:Protein - exercise or energy output - relevant factor not mentioned in video. Example: duration of sleep, sleep time, reducing stress <p>ACCEPT factors seen in calculations</p>	<p>C: Calculations</p> <p>Any attempt for one of the following calculations:</p> <ul style="list-style-type: none"> -Amount of output energy remaining for Saturday (10000-8300=1700) -Amount of intake energy remaining for Saturday (9010-6000=3010 OR $4 \times 9010 / 9 = 4004 \dots 4$). -Proportions of nutrition for the remaining meal (0.2xtheir3010 Protein, 0.25xtheir3010 Fat, and 0.55xtheir3010 Carbs) <p>ACCEPT 12400-9010=3390 as only attempt to calculate energy intake for Saturday and hence C1</p>	<p>J: Justification of accuracy and makes sense</p> <p>Suitable rounding used in any element (example using 3000 instead of 3010)</p> <p>Or</p> <p>Realising not accurate with invalid reason</p>	<p>A: Advice for Gerry</p> <p>Advice related to one of:</p> <ul style="list-style-type: none"> -Keep or continue track of energy intake and energy burnt, or meals in the appropriate nutrition proportion or balanced diet/eating healthy - increase exercising hours to increase burning -Decrease intake energy because in many days he was more than average or eat the right amount every day 	<p>S: How advice makes sense</p> <p>Reason supported by evidence related to information given:</p> <p>Examples:</p> <ul style="list-style-type: none"> -Balance between burning energy and energy intake for healthy lifestyle -Meal in the appropriate nutrition proportion or balanced diet makes him perform well 	10
---	---	--	---	--	--	---	---	----

		<p>2 Four factor mentioned from the above</p> <p>DO NOT ACCEPT factors seen in calculations</p>	<p>One of the above calculations correct</p>	<p>Realising not accurate with valid reason example:</p> <p>because he did not keep track of all other activities he does during the week</p> <p>He cannot achieve his daily meals proportion since 9010-6000 is not equal to 4x9010/9</p>	<p>Advice related to two of the above</p> <p>Or</p> <p>A critical advice including balance like:</p> <p>-Should not have last day least energy intake and at the same time 1700 exercise out of 10000 needed</p>		
		<p>3</p>	<p>Two of the above calculations correct</p>				

Answers		Notes	Total	
8	a	<ul style="list-style-type: none"> •¹ substitute $n \geq 4$ into T_n rule •² correctly calculate their value of T after substitution $n \geq 4$ •³ recognizing that their result is the same as their predicted value 	<ul style="list-style-type: none"> •¹ Ex: $(T_4 =) \frac{4 \times (4 + 1)}{2} = 10$ •² Ex: 10 (for the $n = 4$) •³ Same as value I predicted in table (and we find the candidate has 10 in the table for $n = 4$) OR same as when we continue the pattern and explains how 9 is obtained from pattern of adding $3 + 1$ to 6 •³ ACCEPT seeing the 10 in the table and seeing their calculated $T = 10$ when $n = 4$ <p>SC for 1 mark If "tested" correctly with a value from the table. For example: testing with $n = 3$ to get $T = 6$</p>	3
	b	<ul style="list-style-type: none"> •¹ Substitute $n - 1$ in T_n OR $n + 1$ in T_n •² add, in terms of n, T_n and T_{n-1} OR T_n and T_{n+1} •³ algebraic step – expand brackets or simplify fraction •⁴ algebraic step – expand bracket and simplify fraction n^2 AG 	<ul style="list-style-type: none"> •¹ eg $T_{n-1} = \frac{(n-1)(n-1+1)}{2}$ $T_{n+1} = \frac{(n+1)(n+1+1)}{2}$ or does not have to be simplified •² $\frac{(n-1)(n-1+1)}{2} + \frac{n(n+1)}{2}$ or $\frac{n(n+1)}{2} + \frac{(n+1)(n+1+1)}{2}$ •³ $\frac{(n-1)n + n(n+1)}{2}$ or $\frac{n^2 - n}{2} + \frac{n^2 + n}{2}$ OR $\frac{n^2 + n}{2} + \frac{n^2 + 3n + 2}{2}$ •⁴ $\frac{(n^2 + n^2 - n + n)}{2}$ or $\frac{(2n^2 - n + n)}{2}$ or $\frac{2n^2}{2}$ OR $(n+1)^2$ <p>SC for 1 mark Substituting with values of n and show that the sum $T_n + T_{n-1}$ is a square number in two cases.</p>	4
	c	<ul style="list-style-type: none"> •¹ Recognize MC_4 is 9 •² correct substitution into Pythagoras $2\sqrt{21}$ AG 	<ul style="list-style-type: none"> ¹ $1 + 2 + 2 + 2 + 2$ •² $(d_4^2 =) (\sqrt{3})^2 + 9^2$ OR $(d_4 =) \sqrt{3 + 81}$ OR $(d_4 =) \sqrt{84}$ 	2

8	d	Mark	1	2	3	4	5
		Predictions (P)	Correctly predicted two terms	Predict correctly one column up to n=6	Predict correctly all values up to n=6		
		Description (D)	<p>Attempt to describe a pattern in words Examples: Comment on difference d_n is 2 root something l_n is arithmetic</p> <p>OR</p> <p>Describe correctly in words their pattern</p> <p>OR</p> <p>attempt to write down a general rule.</p> <p>DO NOT ACCEPT is multiples of 1</p>	<p>Describe correctly one pattern in words Examples: l_n increases by 2 l_n is arithmetic sequence with first term 3 and increases by 2 d_n sq root increases by 4,6,8 d_n under the root is quadratic d_n under the root as second difference equal</p> <p>OR</p> <p>Write down correct general rule for l_n in terms of n Without describing any pattern</p>	<p>Describe correctly two patterns in words Examples: l_n increases by 2 l_n is arithmetic sequence with first term 3 and increases by 2 d_n sq root increases by 4,6,8 d_n under the root is quadratic d_n under the root as second difference equal</p> <p>OR</p> <p>Write down correct general rule for l_n in terms of n AND Describe correctly one pattern in words</p> <p>OR</p> <p>Write down correct general rule for d_n in terms of n Without describing any pattern</p> <p>OR</p> <p>Attempt to write down correct general rule for d_n in terms of n AND Describe correctly one pattern in words</p>	<p>Attempt to write down correct general rule for d_n in terms of n AND Describe correctly two patterns in words</p> <p>OR</p> <p>Write down correct general rule for l_n in terms of n AND Describe correctly two patterns in words</p> <p>OR</p> <p>Write down correct general rule for d_n in terms of n AND Describe correctly one pattern in words or rule for l_n</p>	<p>Write down correct general rule for d_n in terms of n AND Describe correctly two patterns in words</p> <p>ACCEPT The rule is $2\sqrt{n^2 + n + 1}$ but award N1</p> <p>ACCEPT non-simplified rule but award N1</p>

		<p>Testing (T)</p> <p>attempt to use n from $\{1,2,3,4\}$ in their described pattern or general rule</p>	<p>Recognizing that their result is the same as value in table</p> <p>ACCEPT seeing their calculated d_n value from their general rule and the value in the table being equal</p> <p>ACCEPT for testing correctly l_n</p>				
		<p>Verify ng (V)</p> <p>attempt to use $n \geq 5$ in their described pattern or general rule</p> <p>ACCEPT for verifying correctly l_n</p>	<p>Calculate correctly their value of d_n using their $n \geq 5$ in their general rule</p>	<p>Recognizing that their result is the same as their predicted value</p> <p>ACCEPT seeing their calculated d_n value from their general rule and their predicted value in the table being equal</p>			
		<p>Justify/ proof (J)</p> <p>Weak attempt to justify their described pattern or their general rule</p> <p>Examples: trying at least two values and arguing as justification that they are the same or rule works</p> <p>OR</p> <p>Attempt to prove the general rule for l_n Example: Arithmetic sequence with common difference 2</p>	<p>Correctly justify their general rule or pattern</p> <p>OR</p> <p>Correctly prove the general rule for l_n</p> <p>Ex: Arithmetic sequence with first term 3 and common difference 2</p> <p>For d_n under the root: Assuming quadratic and solve equations correctly for coefficients</p>	<p>Attempt to prove the general rule for d_n</p> <p>Examples: $\sqrt{(\sqrt{3})^2 + (2n+1)^2}$</p>	<p>Correctly prove the general rule for d_n</p> <p>Examples: Correctly expand under the bracket</p> <p>J4 automatically gains T2 and V3</p>		
		<p>Notation and terminology (N)</p> <p>Notation or terminology is correct</p> <p>OR</p> <p>the notation and terminology have significant errors</p> <p>OR</p>	<p>The notation and terminology are correct</p> <p>Note: One minor error, not in general rule, can be overlooked</p>				

			The general rule is correct but not in correct notation example: $U_n = 2\sqrt{n^2 + n + 1}$	Can be awarded only if they have a general rule ACCEPT using d ACCEPT using U_n instead of d only if they mention that $d = U_n$ ACCEPT the use of x or * for multiplication					
		Communication (L)	Very weak communication Two or three lines of communication OR Only calculations or algebraic steps	Weak communication More than three lines of communication but lack coherence	Good communication More than three lines of coherent communication Can be awarded only if J2 is achieved				

n	Length $MC_n (l_n)$	Length $AC_n (d_n)$
1	3	$2\sqrt{3}$
2	5	$2\sqrt{7}$
3	7	$2\sqrt{13}$
4	9	$2\sqrt{21}$
5	11	$2\sqrt{31}$
6	13	$2\sqrt{43}$

General rules

$$l_n = 2n + 1$$

$$d_n = 2\sqrt{n^2 + n + 1}$$

The proof

$$d_n = \sqrt{(\sqrt{3})^2 + (2n+1)^2} = \sqrt{3 + 4n^2 + 4n + 1} = \sqrt{4n^2 + 4n + 4} = \sqrt{4(n^2 + n + 1)} = 2\sqrt{n^2 + n + 1}$$