Q4	Model Solution – 30 Marks	Marking Notes
(a)	$u_3 = \sqrt{\frac{u_2}{u_1}} = \sqrt{\frac{64}{2}} = \sqrt{32} = (2^5)^{\frac{1}{2}} = 2^{\frac{5}{2}}$	**Scale 10C (0, 3, 7, 10)** **3 steps:** **1.** Substitutes u_1 and u_2 into u_3 **2.** Writes 64 or 32 as a power of 2 **3.** Finishes (deals with square root) *Low Partial Credit* • Work of merit, for example, some correct substitution into u_3 *High Partial Credit* • 2 steps correct
(b) (i)	$[5e^k - 13 = 13 - 5e^{-k}]$ $5y - 13 = 13 - \frac{5}{y}$ $5y^2 - 13y = 13y - 5$ $5y^2 - 26y + 5 = 0$ **OR** $T_2 - T_1 = T_3 - T_2$ $T_1 + T_3 = 2T_2$ $5(e^k)^2 - 26(e^k) + 5 = 0$ $5e^{2k} - 26e^k + 5 = 0$ $5e^k + 5e^{-k} = 26$ $T_1 + T_3 = 2T_2$ **OR** $a = \frac{5}{y}$ $\frac{5}{y} + d = 13$ $d = 13 - \frac{5}{y}$ $13 + \left(13 - \frac{5}{y}\right) = 5y$ $26y - 5 = 5y^2$ $5y^2 - 26y + 5 = 0$	**Scale 10C (0, 3, 7, 10)** Each method shown has 3 steps. *Method 1:* **1.** Equates common differences **2.** Replaces e^k with y **and** e^{-k} with $\frac{1}{y}$ or y^{-1} **3.** Writes in required form *Method 2:* **1.** Shows $T_1 + T_3 = 2T_2$ for any arithmetic sequence **2.** Replaces y with e^k and simplifies **3.** Divides by e^k to show $T_1 + T_3 = 2T_2$ *Method 3:* **1.** Finds the common difference in terms of y **2.** Finds equation in y **3.** Writes in required form *Low Partial Credit* • Work of merit, for example, finds one common difference, or replaces e^k with y **or** y with e^k, or states $T_3 - T_2 = T_2 - T_1$ *High Partial Credit* • 2 steps correct

Q4	Model Solution – 30 Marks	Marking Notes
(b) (ii)	$(y - 5)(5y - 1) = 0$ $y = 5$ or $\frac{1}{5}$ $e^k = 5$ or $e^k = \frac{1}{5}$ $k = \ln 5$ or $k = \ln\frac{1}{5} = \ln(5^{-1}) = -\ln 5$	**Scale 10D (0, 3, 5, 8, 10)** **3 steps:** **1.** Fully substituted quadratic formula **OR** factors found **2.** Solves for y **3.** Solves for k, in correct form *Low Partial Credit* • Work of merit, for example, effort at factorisation, or identifies a, b, or c *Mid Partial Credit*

		Mid Partial Credit • 1 step correct *High Partial Credit* • 2 steps correct *Full Credit –1* • 2 values of e^k correctly found, only 1 value of k correctly found

Section B

Q7	Model Solution – 50 Marks	Marking Notes
(a) (i)	$|AD|^2 = 90^2 - 60^2$ $90^2 = 60^2 + |AD|^2$ $|AD| = \sqrt{8100 - 3600} = \sqrt{4500} = 30\sqrt{5}$	**Scale 10C (0, 4, 7, 10)** *Low Partial Credit:* $|OD| = 60$ Pythagoras formulated Effort to find angle other than $\angle ODA$ *High Partial Credit:* $\sqrt{8100 - 3600}$ or equivalent
(a) (ii)	$\cos(\angle DOA) = \frac{60}{90}$ $\cos^{-1}\left(\frac{6}{9}\right) = 0{\cdot}84$ Or $\sin(\angle DOA) = \frac{30\sqrt{5}}{90} = \frac{\sqrt{5}}{3} = 0{\cdot}745356$ $|\angle DOA| = 48{\cdot}189^{\circ}$ $|\angle DOA| = 0{\cdot}84139 = 0{\cdot}84$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* Relevant trigonometric ratio formulated *High Partial Credit:* Relevant trigonometric ratio fully substituted
(a) (iii)	Area of sector: $\frac{1}{2}r^2\theta$ $\frac{1}{2}(0{\cdot}9)^2 \times 2(0{\cdot}84) = 0{\cdot}6804 \text{ m}^2$ Area Δ ACO : $\frac{1}{2}|AC||OD| = \frac{1}{2}(60\sqrt{5})60 \text{ cm}^2$ $\frac{1}{2}(1{\cdot}34164)(0{\cdot}6) = 0{\cdot}40 \text{ m}^2$ Or Area Δ ACO : $\frac{1}{2}|AO||OC| \sin(\angle AOC) =$ $\frac{1}{2}(90)(90)\sin 2(48{\cdot}189^{\circ})$ $= 4024{\cdot}9174 \text{ cm}^2 = 0{\cdot}40 \text{ m}^2$ Area of segment $= 0{\cdot}6804 - 0{\cdot}40 = 0{\cdot}28$	**Scale 10D (0, 4, 5, 8, 10)** *Low Partial Credit:* Formula for area of sector with some substitution Formula for area of Δ ACO with some substitution *Mid Partial Credit:* One relevant area fully substituted *High Partial Credit:* Both relevant areas fully substituted Mishandling conversion of units
(a) (iv)	Volume $= 0{\cdot}28 \times 2{\cdot}5 = 0{\cdot}7$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* Formula for **volume** of trough with some substitution Indicates some relevant use of $2{\cdot}5$ *High Partial Credit:* Formula fully substituted

(b) (i)	Volume = $\pi\left[\left(\left(\frac{2}{3}\right)1{\cdot}25^3\right)\right]$ $+\pi[(1{\cdot}25^2 \times 3{\cdot}5)]$ $+\pi\left[\left(\left(\frac{1}{3}\right)1{\cdot}25^2 \times 1{\cdot}5\right)\right]$ $= 4{\cdot}0906 + 17{\cdot}1805 + 2{\cdot}4544$ $= 23{\cdot}73$	**Scale 15D (0, 5, 7, 11, 15)** *Low Partial Credit:* 1 volume formula with some substitution *Mid Partial Credit* 2 volumes fully substituted *High Partial Credit:* 3 volumes fully substituted

(b) **(ii)**	$23{\cdot}73 \times 0\ 02 = 0{\cdot}4746$ cm^3 $\frac{r}{h} = \frac{1{\cdot}25}{1{\cdot}5} = \frac{5}{6}$ $r = \frac{5h}{6}$ Volume in cone $= \frac{1}{3}\pi\left(\frac{5h}{6}\right)^2 \times h = 0{\cdot}4746$ $h^3 = \frac{0{\cdot}4746.3.6}{25\pi} = 0{\cdot}65262$ $h = \sqrt[3]{0{\cdot}65262} = 0{\cdot}8674$ $h = 0{\cdot}87$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* volume $\times\, 0{\cdot}98$ or equivalent volume multiplied by 2% effort at *r* : *h* *High Partial Credit:* Volume formula expressed in one variable

Q3	Model Solution – 30 Marks	Marking Notes
(a)	**Method 1** $(4, 6), (-3, -1), (0, 11).$ $\downarrow \quad \downarrow \quad \downarrow$ -11 $(4, -5), (-3, -12), \quad (0, 0)$ AREA $= \frac{1}{2}\lvert 4(-12) - (-3)(-5)\rvert$ $= \frac{1}{2}\lvert -63\rvert$ $= 31 \cdot 5$ **OR** **Method 2** Uses any one of the following formulae: 1. Area $= \frac{1}{2}\boldsymbol{absinc}$ 2. Area $= \frac{1}{2} \times$ **base** $\times$ **perpendicular height**	**Scale 15D (0, 4, 8, 12, 15)** **Method1** *Low Partial Credit:* • Work of merit in translating one point to $(0,0)$ *Mid Partial Credit:* • Three points correctly translated • Two of the given points subbed in to the area formula and evaluated *High Partial Credit* • Correct substitution into Area formula • One error in translating points and finishes correctly **Method 2** *Low Partial Credit:* • Work of merit, for example, finds one relevant piece of data eg. length of one side *Mid Partial Credit:* • All information relevant to one formula calculated, for example, the lengths of 2 sides and the included angle; or the length of one side and the perpendicular height *High Partial Credit* • Correct substitution into Area formula

Q3	Model Solution – 30 Marks	Marking Notes
(b) (i)	Mid-point $= \left(\frac{-1+5}{2}, \frac{k+l}{2}\right)$ $= \left(2, \frac{k+l}{2}\right)$ **OR** -1 to 5 is 6 steps, then $x = -1 + 3 = 2$ k to l is $(l-k)$ steps, then $y = k + \frac{l-k}{2} = \frac{k+l}{2}$ Mid-point $= \left(2, \frac{k+l}{2}\right)$	**Scale 5B (0, 2, 5)** *Partial Credit:* • Work of merit, for example, some correct substitution into relevant formula

Q3	Model Solution – 30 Marks	Marking Notes
(b)(ii)	Slope $AB = \frac{l-k}{5-(-1)} = \frac{l-k}{6}$ Perpendicular slope $= -\frac{6}{l-k}$ Slope of $3x + 2y - 14 = 0$ is $-\frac{3}{2}$ $-\frac{6}{l-k} = -\frac{3}{2}$ so $\boldsymbol{l - k = 4}$ ... Eqn 1 or Slope $AB = \frac{2}{\ }$ then $(-1, k)$and $(5, l) \in$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* • Work of merit, for example, relevant use of midpoint of $[A, B]$, or finds a relevant slope (of AB or of bisector) *Mid Partial Credit:* • Equation 1 or 2 correct found

	Slope $AB = \frac{[illegible]}{3}$, then $(-1, k)$ and $(5, l) \in$ $y = mx + c$, also gives $\boldsymbol{l - k = 4}$ ... Eqn 1 $\left(2, \frac{k+l}{2}\right) \rightarrow 3(2) + 2\left(\frac{k+l}{2}\right) - 14 = 0$ $\boldsymbol{k + l = 8}$ ... Eqn 2 $\begin{cases} l + k = 8 \\ l - k = 4 \end{cases}$ $2l = 12$ ..... $l = 6,\ \ k = 2$ **OR** Slope $AB = \frac{l-k}{6}$ and perpendicular $= -\frac{6}{l-k}$ Eqn of perp bisector: $y - \frac{k+l}{2} = -\frac{6}{l-k}(x - 2)$ $2y - k - l + \frac{12}{l-k}x - \frac{24}{l-k} = 0$ or $\frac{12}{l-k}x + 2y - k - l - \frac{24}{l-k} = 0$ Equating coefficients: x: $\frac{12}{l-k} = 3$ so $4 = l - k$ ... **Eqn 1** Const.: $-k - l - \frac{24}{l-k} = -14$ $-k - l - \frac{24}{4} = -14$ So $k + l = 8$ ... **Eqn 2** Solve for $l = 6, k = 2$	• Finds equation of perpendicular bisector in terms of l and k *High Partial Credit:* • Equation 1 and 2 correct found

Q5	Model Solution – 30 Marks	Marking Notes
(a) (i) (ii) (iii)	**(i)** Mean $\frac{0+3+2+2+4+5+1}{7} = \frac{17}{7} = 2 \cdot 42 \ldots$ = 2.4 [1 d.p.] Standard deviation $= 1 \cdot 59.. =$ 1.6 [1 d.p.] **(ii)** $r = -0 \cdot 76204 \ldots$ $r = -0 \cdot 762$ [3 d.p.] **(iii)** *Any valid explanation, for example:* If the number of red cubes increases then there will be less green cubes	**Scale 20D (0, 6, 12, 17, 20)** Note: Accept correct answer without supporting work Consider solution as requiring 4 items: 1. Mean 2. Standard deviation 3. r 4. Explanation *Low Partial Credit:* • Work of merit, for example, finds the total number of red cubes *Mid Partial Credit:* • 1 item correct and work of merit in any other item *High Partial Credit:* • 3 items correct *Full Credit -1* • One or more answers not to required number of decimal places
(b)	3 faces: 8 2 faces: 24 1 face: 22 no faces: 6	**Scale 10C (0, 4, 7, 10)** Accept correct answer without work *Low Partial Credit:* • Work of merit, for example, relevant work on the diagram • One correct value • Reference to total of 60 cubes *High Partial Credit* • Two correct values

Q1	Model Solution –30 Marks	Marking Notes
(a)	$(n-3)^2 = \left(\sqrt{3n+1}\right)^2$ $n^2 - 6n + 9 = 3n + 1$ $n^2 - 9n + 8 = 0$ $(n-8)(n-1) = 0$ $n = 8, n = 1$ Answer: $n = 8$ [as $n = 1$ gives $-2 = \sqrt{4}$]	**Scale 10D (0, 3, 5, 7, 10)** Note: Low partial credit at most for a linear equation *Low Partial Credit* • Work of merit, for example, indication of squaring • Trials values of n *Mid Partial Credit* • Fully correct quadratic (2nd line in solution) *High Partial Credit* • Quadratic factorised • Fully correct substitution into the quadratic formula • Verifies $n = 8$ is a solution *Full Credit -1* • Apply a * for incorrect solution(s) not eliminated.
(b)	$\frac{4}{2t+1} - \frac{7}{12t} = \frac{4(12t) - 7(2t+1)}{(2t+1)(12t)}$ $= \frac{48t - 14t - 7}{(2t+1)(12t)}$ $= \frac{34t - 7}{(2t+1)(12t)}$	**Scale 10C (0, 4, 6, 10)** *Low Partial Credit:* • Work of merit, for example, identifies the numerator or the common denominator *High Partial Credit* • $\frac{4(12t)-7(2t+1)}{(2t+1)(12t)}$ • $\frac{4(12t)}{(2t+1)(12t)} - \frac{7(2t+1)}{(2t+1)(12t)}$ *Full Credit -1* • Numerator simplified correctly with an incorrect common denominator, where the correct common denominator appears earlier in the solution

Q1	Model Solution –30 Marks	Marking Notes
(c)	**1:** $x + 2y = 143$ **2x(-2):** $-2y - 6w = 148$ **4:** $x - 6w = 291$ **3:** $4x + 5w = 4$ **4x(4):** $4x - 24w = 1164$ **5:** $29w = -1160$ So $w = -40$ **4:** $x - 6(-40) = 291$ So $x = 51$ **1:** $51 + 2y = 143$ So $y = 46$	**Scale 10D (0, 3, 5, 7, 10)** Consider solution as involving 3 steps: **1.** Arrives at 2 equations in the same 2 variables (one can be a given equation) **2.** Finds 1 equation in 1 variable **3.** Finds 3 variables *Low Partial Credit* • Work of merit, for example, any correct transposition *Mid Partial Credit* • One step correct *High Partial Credit* • Two steps correct

Q3	Model Solution – 30 Marks	Marking Notes
(a)	$\frac{1}{6}\sin 6x + C$	**Scale 5B (0, 2, 5)** *Partial Credit* • Some correct integration, for example, $\sin x$ *Full Credit –1* • Apply a * if the $+C$ term is missing
(b) (i)	*Co-ordinates of the point of contact* $f(2) = -21$, so point is $(2, -21)$ *Slope of the tangent at* $x = 2$ $f'(x) = 6x^2 - 18x + 5$ $f'(2) = -7$ ... slope of tangent *Equation of the tangent at* $x = 2$ $y - (-21) = -7(x - 2)$ or equivalent	**Scale 5D (0, 2, 3, 4, 5)** Note: Engagement with Step 3 is required to be awarded credit for Step 4 Consider solution as involving 4 steps: **1.** Finds $\boldsymbol{y}$-value at $\boldsymbol{x = 2}$ **2.** Differentiates $\boldsymbol{2x^3 - 9x^2 + 5x - 11}$ **3.** Finds $\boldsymbol{f'(2)}$ **4.** Finds the equation of the tangent *Low Partial Credit* • Work of merit, for example, some correct differentiation; Substitutes $x = 2$ in $f(x)$; Formula for the equation of a line with some relevant substitution *Mid Partial Credit* • 2 steps correct *High Partial Credit* • 3 steps correct

Q3	Model Solution – 30 Marks	Marking Notes
(b) (ii)	$f'(x) = 6x^2 - 18x + 5$ $f''(x) = 12x - 18$ $f''(x) = 0$ $12x - 18 = 0$ $x = \frac{3}{2}$ **Also accept the following for *Full Credit*:** *x values at local maximum & local minimum* $f'(x) = 0$ $6x^2 - 18x + 5 = 0$ $x_1 = \frac{18 + \sqrt{204}}{12}$ $x_2 = \frac{18 - \sqrt{204}}{12}$ *x co-ordinate of the point of inflection:* $\frac{x_1 + x_2}{2} = \frac{36}{12} \div 2$ $x = \frac{3}{2}$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit* • Work of merit, for example, some correct differentiation of $f(x)$ or $f'(x)$; states $f''(x) = 0$ • Brings down derivative from (i) *High Partial Credit* • Correct $f''(x)$ • Finds x values of local maximum and local minimum
(c)	Slope of $l = \frac{1}{2}$	**Scale 15D (0, 4, 6, 8, 15)**

	Lines drawn parallel to l and touching the graph of $p(x)$ at $x \approx 2 \cdot 2$ and $x \approx 6 \cdot 8$	*Low Partial Credit* • Work of merit, for example, mentions slope of $l = \frac{1}{2}$ • Draws a line parallel to $l(x)$ • Draws a horizontal line at $y = \frac{1}{2}$ • Relevant work to draw graph of $p'(x)$ • Draws two parallel tangents to $p(x)$ that are **not** parallel to $l(x)$ *Mid Partial Credit* • One tangent drawn correctly *High Partial Credit* • Two tangents drawn correctly • One tangent drawn correctly and corresponding x value estimated correctly • Graphs of $l'(x)$ and $p'(x)$ shown on the diagram

Q7	Model Solution – 50 Marks	Marking Notes
(a)	20% of $40000 = 8000$ 40% of $14000 = 5600$ Gross tax $= 13600$ $\text{Net Pay} = 54000 - (13600 - 1775)$ $= 54000 - 11\,825$ $= [€]42\,175$	**Scale 10D (0, 3, 5, 7, 10)** Consider the solution as involving 3 steps **1.** Finds Gross Tax **2.** Subtracts Gross Tax from Gross Income **3.** Deals with Tax Credit Note: 3 may happen before 2, that is, Tax Credit may be subtracted from Gross Tax, or added to Gross Income (because Tax Credit is less than Gross Tax) *Low Partial Credit* • Work of merit in one step *Mid Partial Credit* • One step correct *High Partial Credit* • Two steps correct

Q7	Model Solution – 50 Marks	Marking Notes
(b)	**(i)** $\frac{1647{\cdot}75}{1{\cdot}00279}$, $\frac{1647{\cdot}75}{(1{\cdot}00279)^2}$, and $\frac{1647{\cdot}75}{(1{\cdot}00279)^3}$ **(ii)** **Method 1:** $\frac{1647\cdot 75}{1\cdot 00279}+\frac{1647\cdot 75}{(1\cdot 00279)^2}+\cdots\frac{1647\cdot 75}{(1\cdot 00279)^{300}}$ $S_n = \frac{\frac{1647{\cdot}75}{1{\cdot}00279}\left[1-\left(\frac{1}{1{\cdot}00279}\right)^{300}\right]}{1-\frac{1}{1{\cdot}00279}}$ $= €334562.61 \ldots.$ $= €334563$ [nearest euro] **Method 2:** $1647\cdot 75 = P\frac{0\cdot 00279(1\cdot 00279)^{300}}{(1\cdot 00279)^{300}-1}$ $P = \frac{1647\cdot 75[(1\cdot 00279)^{300}-1]}{0\cdot 00279(1\cdot 00279)^{300}}$ $= €334\,562.61$ $= €334563$ [nearest euro]	**Scale 15D (0, 4, 6, 8, 15)** Note1: Step 3 is not given if there is more than one error in substitution in Step 2 Note2: If work of merit is awarded in (i), then the same work of merit cannot get credit in (ii). For example, if 0.00279 is awarded WOM in (i), then 0.00279 cannot be awarded WOM in (ii). Note 3: It is acceptable for the solution to part (ii) to appear in the answer box for part (i) Note 4: Accept solutions where **two** monthly repayments of $€\mathbf{1647\cdot 75}$ are being made, that is all correct answers will be doubled **3 Steps** **1.** Present values of the 1st three monthly repayments **2.** Fully correct substitution into geometric/amortisation formula **3.** Finds sum of money borrowed *Low Partial Credit* • Work of merit in either part, for example, in **(i)** writes 0.279% as a decimal; in **(ii)** some correct substitution into relevant formula *Mid Partial Credit* • 1 step correct • Work of merit in both parts *High Partial Credit*

		• 2 steps correct *Full Credit-1* • Repayments made at the start of each month, otherwise correct • Rounded incorrectly or no rounding, otherwise correct • (i) not written in the correct form, otherwise correct

Q7	Model Solution – 50 Marks	Marking Notes
(c) (i)	$\frac{dF}{dt} = 5000(0 \cdot 04)e^{0 \cdot 04t}$ $= 200e^{0 \cdot 04t}$ $t = 3 \cdot 5$: $\frac{dF}{dt} = 5000(0 \cdot 04)e^{0 \cdot 04(3 \cdot 5)}$ $= 200e^{0 \cdot 14}$ $= 230 \cdot 05$ $= 230$ [nearest € per year]	**Scale 10C (0, 4, 6, 10)** Note: $F'(t) = 5000e^{0.04t}$ – Award LPC at most *Low Partial Credit* • Work of merit in differentiation, for example, $F'(t) = ae^{0.04t}$ *High Partial Credit* • Differentiation fully correct • $F'(t) = \frac{5000e^{0.04t}}{0.04}$ and finishes correctly *Full Credit -1* • Apply a * for incorrect rounding or no rounding
(c) (ii)	$\frac{1}{5}\int_0^5 (5000e^{0 \cdot 04t})dt$ $= \frac{1}{5}(5000)\left[\frac{e^{0 \cdot 04t}}{0 \cdot 04}\right]_0^5$ $= 1000\left(\frac{e^{0 \cdot 04(5)}}{0 \cdot 04} - \frac{e^{0 \cdot 04(0)}}{0 \cdot 04}\right)$ $= €5535 \cdot 06..$ $= €5535$ [nearest euro]	**Scale 10D (0, 3, 5, 7, 10)** Note1: Indication of integration is required to be awarded any credit Note2: If $\frac{1}{5}$ is omitted, treat step 1 as not fully correct, but all other steps can be accepted as correct 1. $\frac{1}{5}\left[\int_0^5 F(t)dt\right]$ 2. Integrates correctly 3. Subs in limits 4. Evaluates correctly *Low Partial Credit* • Work of merit, for example, integration indicated *Mid Partial* • 2 steps correct *High Partial Credit* • 3 steps correct *Full Credit -1* Apply a * for incorrect rounding or no rounding

Q7	Model Solution – 50 Marks	Marking Notes
(c) (iii)	$e^{0 \cdot 04} = 1 \cdot 04081...$ AER= $4 \cdot 08\%$ [2DP] **OR** $F(0) = 5000e^{0.04(0)}$ $= 5000$ $F(1) = 5000e^{0.04(1)}$	**Scale 5B (0, 2, 5)** *Partial Credit* • Finds any one term in $F(t)$ • Identifies $e^{0 \cdot 04}$ as the compounding factor *Full Credit -1:* • Answer given as 0.04, with work

	$= 5204.053 \ldots$ $F(1) - F(0) = 204.053 \ldots$ $\text{AER} = \dfrac{204.053 \ldots}{5000} \times 100$ $= 4 \cdot 08\%$ [2DP] **OR** $\dfrac{5204 \cdot 053 \ldots}{5000} = 1 \cdot 04081 \ldots$ $\text{AER} = 4 \cdot 08\%$ [2DP]		

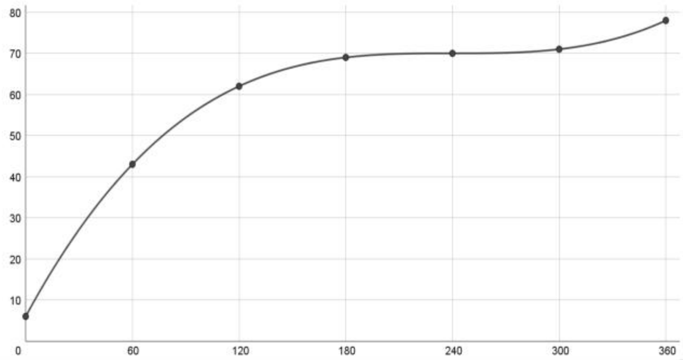
Q8	Model Solution – 50 Marks	Marking Notes

(a)

(i)

x	0	60	120	180	240	300	360
$T(x)$	6	*43*	62	69	70	71	*78*

(ii)



Scale 10D (0, 3, 5, 7, 10)

Solution consists of 13 parts:

- 5 values in table
- 7 points plotted
- Points joined appropriately (not with line segments)

Low Partial Credit

- Work of merit in finding one value of T
- 1 part correct

Mid Partial Credit

- 7 parts correct

High Partial Credit

- 10 parts correct

Full Credit-1

- 12 parts correct
- Correct graph with no table entries

Q8	Model Solution – 50 Marks	Marking Notes

(b)

$\text{Max} = 21 + 19(1) = 40$

$\text{Min} = 21 - 19(1) = 2$

OR

$$S'(t) = -(19)\left(\frac{2\pi}{365}\right)\sin\frac{2\pi t}{365}$$

$$S'(t) = 0$$

$$-(19)\left(\frac{2\pi}{365}\right)\sin\frac{2\pi t}{365} = 0$$

$$\frac{2\pi t}{365} = 0 \Rightarrow t = 0$$

$$\text{Max} = S(0) = 40$$

$$\frac{2\pi t}{365} = \pi \Rightarrow t = \frac{365}{2}$$

$$\text{Min} = S\left(\frac{365}{2}\right) = 2$$

Marking Notes

Scale 5C (0, 2, 3, 5)

Note: Accept correct answer without supporting work

Low Partial Credit

- Work of merit, for example, mentions max value of $cosA = 1$
- Indicates $+19$ or -19
- Correct indication of 21 or 19 on the graph
- Some correct differentiation of $S(t)$

High Partial Credit

- Max or min correct
- Finds the values of t for which $S'(t) = 0$
- Indicates ± 19

Full Credit -1

- Answers given as 2 and 40, but doesn't indicate which is maximum and which is minimum
- Maximum = 2 and Minimum = 40

(c)	$C(t) = S(t)$ $S(t) = S(t) - 2.4 + 0.03t$ $-2 \cdot 4 + 0 \cdot 03t = 0$ $0 \cdot 03t = 2 \cdot 4$ $t = 80$ [days]	**Scale 10C (0, 4, 6, 10)** *Low Partial Credit* • Work of merit in setting up equation *High Partial Credit* • $-2 \cdot 4 + 0 \cdot 03t = 0$
(d)	Graph L *Any valid justification, for example*: $-2 \cdot 4 + 0 \cdot 03t$ is linear with a positive slope and so it will make the trigonometric function $S(t)$ go upwards over time	**Scale 15C (0, 6, 8, 15)** *Low Partial Credit* • Correct graph selected • Work of merit in justification, for example, connects function type with graphs *High Partial Credit* • Justification for the graph increasing over time, but doesn't justify the wave nature of the graph • Justification for the wave nature of the graph but doesn't justify the increase over time

Q8	**Model Solution – 50 Marks**	**Marking Notes**
(e)	$C'(t) = 0{\cdot}03 - \frac{38\pi}{365}\sin\left(\frac{2\pi t}{365}\right) = 0$ $0{\cdot}03 = \frac{38\pi}{365}\sin\left(\frac{2\pi t}{365}\right)$ $\frac{0 \cdot 03(365)}{38\pi} = \sin\left(\frac{2\pi t}{365}\right)$ $\sin^{-1}\left(\frac{0 \cdot 03(365)}{38\pi}\right) = \frac{2\pi t}{365}$ $0 \cdot 09185 = \frac{2\pi t}{365}$ $t = 5 \cdot 336 = 5$ [days] [$\in \mathbb{N}$]	**Scale 10C (0, 4, 6, 10)** *Low Partial Credit* • Work of merit, for example, sets up equation *High Partial Credit* • $\frac{0{\cdot}03(365)}{38\pi} = \sin\left(\frac{2\pi t}{365}\right)$ *Full Credit -1* • Apply a * for calculator in incorrect mode