Question 1

Q1	Model Solution – 15 marks	Marking Notes
(a), (b) & (c)	(a) $17{\cdot}5°$ C, $17{\cdot}9°$C, $18{\cdot}49°$C etc. (b) $17{\cdot}5°$ C $\leq t < 18{\cdot}5°$ C (c) $t \in \mathbb{R}$ Values of temperature (t) will take on decimal places over the course of a day (continuous)	**Scale 15D (0, 4, 8, 12, 15)** *Low Partial Credit:* • Some work of merit, for example: one correct value in (a); one correct endpoint of the required interval in (b). • Correct box ticked in (c) and no further work. • Correct reason based on incorrect tick in (c). *Mid Partial Credit:* • Work of merit in (a) **and** (b) **and** (c). *High Partial Credit:* • Two values correct in (a). • (b) **or** (c) fully correct.

Question 2

Q9	Model Solution – 10 marks	Marking Notes
(a) **(b)** **&** **(c)**	(a) $4x(5x+4)-3(x-2)$ $20x^2+16x-3x+6$ $20x^2+13x+6$ (b) $(3-5y)(3+5y)$ (c) $\frac{5^7\times5^6}{5^{\frac{1}{2}}}=\frac{5^{13}}{5^{\frac{1}{2}}}=5^{\frac{25}{2}}$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* • One term correctly multiplied in (a). • Indicates or shows understanding of difference of two squares in (b). • 3 or $5y$ appear in (b). • Some correct work with indices in (c). *Mid Partial Credit:* • One part correct and work of merit in one of the other two parts. • Work of merit in (a) **and** (b) **and** (c). *High Partial Credit:* • Two parts correct.

Question 3

Q13	Model Solution – 10 marks	Marking Notes
(a) & (b)	(a) Total height $= x + 0{\cdot}5$ m (b) $x(x + 0 \cdot 5) = 50$ $x^2 + 0 \cdot 5x - 50 = 0$ $2x^2 + x - 100 = 0$	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit:* • Some work of merit, for example: indicates that the height of the square image is x. • Incorrect operation, for example: $x \times 0{\cdot}5$ in (a). • Some work of merit in (b), for example: an area expression in x set equal to 50; indication that area $=$ length $\times$ width. • (a) correct. *Mid Partial Credit:* • Work of merit in both parts. *High Partial Credit:* • (a) correct and work of merit in (b), for example: $x(x + 0 \cdot 5) = 50$. • (b) correct.
(c)	$x = \dfrac{-1 \pm \sqrt{1^2 - 4(2)(-100)}}{2(2)}$ $x = \dfrac{-1 \pm \sqrt{801}}{4}$ $x = 6{\cdot}825 \ldots \quad x = -7{\cdot}325 \ldots$ $x = 6{\cdot}83 \quad x \neq -7{\cdot}33$ [$x = 6$ m 83 cm or $x = 6{\cdot}83$ m] [to the nearest centimetre]	**Scale 5C (0, 2, 4, 5)** *Low Partial Credit:* • Some correct substitution in the quadratic formula. • Identifies a or b or c. *High Partial Credit:* • Quadratic formula fully substituted. • One error in filling in formula but evaluates correctly. • $-1 \pm \frac{\sqrt{801}}{4}$ and finishes correctly. • Correct answer without work. *Full Credit –1:* • No rounding or incorrect rounding. • Answer not correct to the nearest centimetre. • Negative answer not excluded.

Question 4

Q.12	Model Solution – 30 Marks	Marking Notes
(a)	$(a)^2 - (4n)^2$ $(a - 4n)(a + 4n)$	**Scale 5B (0, 3, 5)** Accept correct answer without supporting work *Partial Credit* • $(a)^2$ or $(4n)^2$ • Difference of two squares indicated eg. $(a - 16n)(a + 16n)$ • One correct factor
(b)	(i) $(8x - 3)(x + 6)$ **OR** $45x = 48x - 3x$ $8x^2 + 48x - 3x - 18$ $8x(x + 6) - 3(x + 6)$ $= (8x - 3)(x + 6)$ (ii) $Eg. (x + 6)(x + 1)$ $= \boldsymbol{x^2 + 7x + 6}$ or any other quadratic expression that has $(x + 6)$ as a factor	**Scale 15D (0, 5, 9, 12, 15)** Accept correct answers without supporting work Note: $(x + 6)$ does not merit any credit as it is given in both parts *Low Partial Credit* • Work of merit in one part, for example: One correct term in factoring eg. 8x or -3 in (i) or sets up multiplication in (ii) • Finds root as $\frac{3}{8}$ or $0 \cdot 375$ *Mid Partial Credit* • One part correct • Work of merit in both parts *High Partial Credit* • One part correct and work of merit in other part

Question 5

Q3	Model Solution – 20 Marks	Marking Notes
(a),(b)	(a) $P = (-1, 3)$ (b) $x = 0$ $0 + 7y = 20$ $y = \frac{20}{7}$ Answer: $\left(0, \frac{20}{7}\right)$ **OR** Slope of PQ = $-\frac{1}{7}$ Let $R(0, y)$ be the point where PQ crosses the y-axis Slope $PR = \frac{y-3}{0-(-1)} = -\frac{1}{7}$ $-7(y - 3) = 1$ $-7y + 21 = 1$ $y = \frac{20}{7}$ Answer: $\left(0, \frac{20}{7}\right)$	**Scale 10C (0, 4, 7, 10)** *Low Partial Credit* • Work of merit, for example, in (a), one co-ordinate correct, or correct co-ordinates reversed, in (b) indicates $x = 0$, point read from diagram *High Partial Credit* • (a) correct and work of merit in (b) • Finds $\frac{20}{7}$
(c)	Slope of PQ = $-\frac{1}{7}$ Perpendicular slope = 7 $y - 2 = 7(x - 6)$ $y - 2 = 7x - 42$ $-7x + y + 40 = 0$ or $7x - y - 40 = 0$ **OR** Slope of PQ = $-\frac{1}{7}$ Perpendicular slope = 7 $2 = 7(6) + c$ $c = 2 - 42 = -40$ $y = 7x - 40$ $-7x + y + 40 = 0$ or $7x - y - 40 = 0$	**Scale 5D (0, 2, 3, 4, 5)** Consider solution as involving 4 steps: Step 1: find slope of PQ Step 2: find perpendicular slope Step 3: Full substitution into 'Equation of line' formula Step 4: Rewrite equation of the line in the form $\boldsymbol{ax + by + c = 0}$ *Low Partial Credit* • Work of merit, for example, some correct substitution into relevant formula *Mid Partial Credit* • 2 steps correct *High Partial Credit* • 3 steps correct *Full Credit – 1* • Answer given as $-7x + y + 40$ or $7x - y - 40$

Q3	Model Solution – 20 Marks	Marking Notes
(d)	5 mm represents 100 m 1 cm represents $2 \times 100 = 200$ m 7·1 cm represents $7{\cdot}1 \times 200$ $= 1420$ 1420 m = 1·42 [km] **OR** 5 mm represents 100 m 1 mm represents 20 m 7·1 cm = 71 mm 71 × 20 = 1420	**Scale 5C (0, 2, 3, 5)** Treat solution as requiring 3 steps (which may be presented implicitly, and not in this order): **1.** Use 5 mm to find what 1 cm represents, in m **2.** Use 1 cm to find what $7 \cdot 1$ cm represents, in m **3.** Convert m to km. *Low Partial Credit* • Work of merit, for example, one relevant conversion (5 mm = $\frac{1}{2}$ cm, etc.) *High Partial Credit*

	1420 m = 1·42 [km] **OR** 5 mm represents 100 m $7 \cdot 1 \text{ cm} = 71 \text{ mm}$ $\frac{71}{5} = 14 \cdot 2$ $14 \cdot 2 \times 100 = 1420$ 1420 m = 1·42 [km]	• 2 of the steps above correct, for example, finds $0{\cdot}2$ (the number of km represented by 1 cm) • Correct answer without work

Question 6

Q12	Model Solution – 15 marks	Marking Notes
(a)	Perpendicular bisector of any **one** of $[AB]$, $[AC]$ or $[BC]$. Construction arcs shown with bisector continued to the third vertex. **Or** Angle bisector of any **one** of $\angle ABC$, $\angle ACB$ or $\angle BAC$. Construction arcs shown with angle bisector continued to opposite side.	**Scale 5B (0, 2, 5)** Allow tolerence of ± 2mm for perpendicular bisector and ± 2° for angle bisector. *Partial Credit:* • Work of merit, for example: a relevant construction arc drawn. • No construction lines. *Full Credit –1:* • Axis of symmetry not fully drawn.
(b)(i) & (b)(ii)	$\lvert\angle ACB\rvert = 60^\circ$ Length of Circular Arc $= \frac{\theta}{360}(2\pi r)$ $= \frac{60}{360}(2\pi)(40)$ $= 41{\cdot}8879$ $= 41{\cdot}89$ cm [to 2 decimal places]	**Scale 10D (0, 3, 5, 8, 10)** Allow $\pi = \frac{22}{7}$ or $3{\cdot}14$ for full marks. *Low Partial Credit:* • (i) correct. • 40 or 60 correctly substituted in $\frac{\theta}{360}(2\pi r)$. • 40 substituted for r in $2\pi r$. • 40 substituted for r in $l = r\theta$. • Indication that the sum of the angles in a triangle is 180°. *Mid Partial Credit:* • Work of merit in both parts. • (ii) correct without work and (i) not answered or incorrect. *High Partial Credit:* • (ii) correct and (i) not answered or incorrect. *Full Credit –1:* • No units or incorrect units in (i). • No rounding or incorrect rounding in (ii).

Question 7

Q8	Model Solution – 25 Marks	Marking Notes
(a)	$C = 180 - (90 + 35) = 55[°]$ **OR** $C = 90 - 35 = 55[°]$ **OR** $\tan C = \frac{220}{154}$ $C = \tan^{-1}\frac{220}{154}$ $= 55 \cdot 008$ $= 55[°]$	**Scale 10B (0, 4, 10)** Accept correct answer without work *Partial Credit* • Work of merit, for example, mention of 180, or $90 + 35$ • $\tan C = \frac{220}{154}$ *Full Credit -1* • Calculator in incorrect mode
(b)	$y^2 = 154^2 + 220^2$ $y^2 = 23716 + 48400 = 72116$ $y = \sqrt{72116} = 268{\cdot}54 \ldots$ $= 269$ [m] [nearest metre]	**Scale 10C (0, 4, 7, 10)** Accept correct answer without units *Low Partial Credit* • Work of merit, for example, some substitution into relevant formula, or indicates squaring of a side • Correct trigonometric equation fully set up *High Partial Credit* • Fully substituted formula **and** some other relevant work (for example, correctly squares a term, or squares incorrectly but correct square root found) • Finds 23716 and 48400 • Correct answer without work • Uses trigonometry to find y correctly *Full Credit –1* • No rounding or incorrect rounding

Q8	Model Solution – 25 Marks	Marking Notes
(c)	Let $z = h + 220.$ $\tan 20° = \frac{h}{154}$ $h = 154 \tan 20° = 56{\cdot}05 \ldots$ $z = 220 + 56{\cdot}05$ = 276·05 =276 [m] [nearest metre]	**Scale 5D (0, 2, 3, 4, 5)** Consider solution as requiring 3 steps: **1.** Set up equation correctly **2.** Evaluate h **3.** Evaluate z If incorrect trig equation is set up, Step 1 is not correct, but other 2 steps can be *Low Partial Credit* • Work of merit, for example, some substitution into relevant formula *Mid Partial Credit* • One step correct *High Partial Credit* • Two steps correct *Full Credit –1* • No rounding or incorrect rounding • Calculator in incorrect mode

Question 8

Q3	Model Solution – 25 marks	Marking Notes
(a)	$V_{block} = 35 \times 45 \times 16 = 25\,200 \text{ cm}^3$	**Scale 10B (0, 5, 10)** Accept correct answer without work. *Partial Credit:* • Some correct substitution into a relevant formula. *Full Credit −1:* • No units or incorrect units
(b) & (c)	(b) $V_{cylinder} = \pi(r^2)(9) = 9\pi r^2 \text{ cm}^3$ (c) $V_{wax\ used} = 25\,200 \times 90\% = 22\,680 \text{ cm}^3$ $9\pi r^2 = \frac{22\,680}{100}$ $r^2 = \frac{22\,680}{900\pi}$ $r = \sqrt{\frac{22\,680}{900\pi}}$ $r = 2{\cdot}8322$ $r = 2{\cdot}8$ cm [to 1 decimal place]	**Scale 15D (0, 4, 8, 12, 15)** Note: Surface Area formula used in (b) merits MP at most. Accept answer from (a). Consider solution as requiring 5 steps: 1. Finds volume of cylinder in (b) 2. Finds the volume of wax used 3. Sets up equation correctly. 4. Finds r^2 5. Finds r *Low Partial Credit:* • One step correct. *Mid Partial Credit:* • Two steps correct. *High Partial Credit:* • Three steps correct. • One error and finishes correctly. *Full Credit −1:* • No rounding, incorrect rounding or early rounding. • No units or incorrect units. • Answer not in terms of π in (b).

Question 9

Q11	Model Solution -15 marks	Marking Notes
(a) **&** **(b)**	(a) 21 000 people remain 6 minutes after the end of the match. (b) $W(20,0)$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* • Some work of merit, for example: 6 refers to time or 21 000 refers to the number of people. • One correct coordinate, for example $(x, 0)$ or $(20, y)$, where $x \neq 20$ and $y \neq 0$. • (b) correct and no work in (a). *Mid Partial Credit:* • Work of merit in both parts. • (a) correct and no work in (b). *High Partial Credit:* • (a) correct and work of merit in (b). • (b) correct and work of merit in (a).
(c)(i) **&** **(c)(ii)**	$P = 30\,000 - 1500(12)$ $= 30\,000 - 18\,000$ $= 12\,000$ 1500 people leave the stadium each minute after the match ends.	**Scale 5D (0, 2, 3, 4, 5)** Accept correct answer without work in (i). *Low Partial Credit:* • Some work of merit in either (i) or (ii). • 12 substituted correctly in the given equation. • Some reference to rate or slope or speed in (ii). • Recognises that $t = 12$. *Mid Partial Credit:* • Work of merit in both parts. *High Partial Credit:* • (i) **or** (ii) correct.

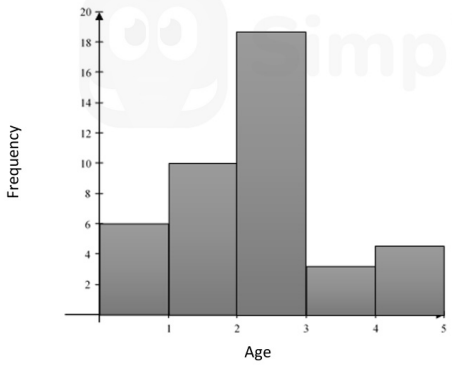
Question 10

Q5	Model Solution – 15 marks	Marking Notes
(a), (b) & (c)	(a) $a \times b = c$ **1** even × even = even **2** odd × odd = odd **3** odd × even = even (b) EEE | EEO | EOE | OEE EOO | OEO | OOE | OOO (c) $\frac{7}{8}$	**Scale 15D (0, 4, 8, 12, 15)** 9 items required: 8 entries in tables and probability *Low Partial Credit:* • 1 item correct. • Work of merit, for example: correct numerator or denominator in (c). *Mid Partial Credit:* • 5 items correct. • Two parts correct. *High Partial Credit:* • Two parts correct and work of merit in the third part. *Full Credit –1:* • 7 in 8 or 7: 8 in (c).

Question 11

Q7	Model Solution – 15 Marks	Marking Notes
(a)	Number of €5 notes: 3, 5 Number of €2 coins: 6, 1 *or with Way 2 = (5, 1) and Way 3 = (3, 6)*	**Scale 5C (0, 2, 3, 5)** Accept correct answers without supporting work. *Low Partial Credit* • Some work of merit, for example: attempt at trial and improvement *High Partial Credit* • One way correct
(b)	All even numbers can be made using €2 coins. €5 is the smallest odd number which can be made. All remaining odd numbers can be made using a €5 note and the required number of €2 coins. **OR** No €2: 5, 10, 15, ... = all no's ending in 0 or 5 One €2: 7, 12, 17, ... = all no's ending in 2 or 7 Two €2: 4, 9, 14, ... = all no's ending in 4 or 9 Three €2: 6, 11, 16, ... = all no's ending in 6 or 1 Four €2: 8, 13, 18, ... = all no's ending in 8 or 3 **OR** $2k$ gives all even $5 + 2k$ gives all odd **OR** *or any other valid explanation*	**Scale 10C (0, 3, 7, 10)** Accept indication of how to make all possible values, without full explanation. *Low Partial Credit* • Some work of merit, for example: gives one way of making an amount other than €2 or €5 *High Partial Credit* • Shows how to make all values in one infinite subset of the natural numbers that are greater than 3, for example: all even numbers; or all (relevant) odd numbers; or all multiples of five

Question 12

Q4	Model Solution – 25 marks	Marking Notes
(a) & (b)	(a)  (b) $\%\ \text{Aged}\ (1-2) = \frac{10}{43} \times 100 = 23{\cdot}26$ $= 23\%$ [to the nearest percentage]	**Scale 10D (0, 3, 5, 8, 10)** Accept area defined by area key or by scale on frequency axis. Accept correct answer for percentage without work. *Low Partial Credit:* • Work of merit, for example: one axis correctly graduated; one correct bar drawn; number of children identified in (b). *Mid Partial Credit:* • Three correct bars in histogram. • All bars of correct height, but with gaps between them. • Work of merit in both parts. • One part correct and no work of merit in the other part. *High Partial Credit:* • One part correct and work of merit in the other part. *Full Credit –1:* • One or both axes are not labelled or incorrectly labelled. • No rounding or incorrect rounding in (b).
(c)	Estimated Mean: $\frac{(6 \times 0.5) + (10 \times 1.5) + (19 \times 2.5) + (3 \times 3.5) + (5 \times 4.5)}{43}$ $= \frac{3 + 15 + 47 \cdot 5 + 10 \cdot 5 + 22 \cdot 5}{43}$ $= \frac{98 \cdot 5}{43}$ $= 2{\cdot}2\dot{9}$ $= 2{\cdot}3$ years [to 1 decimal place]	**Scale 10C (0, 3, 7, 10)** Accept correct answer without work. Accept correct answer without units. *Low Partial Credit:* • Work of merit, for example: indicates division by 43; one correct mid-interval value; numerator with consistent incorrect mid-interval values. *High Partial Credit:* • Consistent incorrect mid-interval values and finishes correctly. • First line of the solution. • One error and finishes correctly. *Full Credit –1:* • No rounding, incorrect rounding or early rounding.
Q4	**Model Solution – 25 Marks**	**Marking Notes**
(d)	$0 - 1$: 2 staff $1 - 2$: 2 staff $2 - 3$: 4 staff $3 - 6$: 1 staff Total: 9 staff	**Scale 5C (0, 2, 4, 5)** Accept correct answer without work. *Low Partial Credit:* • Some work of merit, for example: the correct number of staff for any one of the age groups.

			High Partial Credit: • Correct number of staff for any three of the age groups. *Full Credit –1:* • Correct number of staff for each of the age groups but the least number of staff for all the groups not given.

Question 13

Q10	Model Solution – 20 marks	Marking Notes
(a) & (b)	(a) USC @ $1{\cdot}5\% = 12\,012 \times 0{\cdot}015$ $= €180{\cdot}18$ USC @ $3{\cdot}5\% = 5\,564 \times 0{\cdot}035$ $= €194{\cdot}74$ (b) $\frac{x}{20}$ or $0{\cdot}05x$ **Or** $0{\cdot}07(x - 17\,576) + 374{\cdot}92$	**Scale 15D (0, 4, 8, 12, 15)** Accept correct answers without work. Accept correct answers without unit. *Low Partial Credit:* • Some work of merit, for example: $12\,012 \times 1{\cdot}5$; $1{\cdot}5\% = \frac{3}{200}$, $x \times 5\%$; $5\% = \frac{1}{20}$. *Mid Partial Credit:* • Work of merit in both parts. *High Partial Credit:* • (a) correct • (b) correct with work of merit in (a)
(c)	$0{\cdot}07(x - 17\,576) + 180{\cdot}18 + 194{\cdot}74$ $= 0{\cdot}05x$ $0{\cdot}07x - 1230{\cdot}32 + 374{\cdot}92 = 0{\cdot}05x$ $0{\cdot}07x - 0{\cdot}05x - 1230{\cdot}32 + 374{\cdot}92 = 0$ $0{\cdot}02x = 855{\cdot}40$ $x = \frac{855{\cdot}40}{0{\cdot}02}$ $x = €42\,770$	**Scale 5C (0, 2, 4, 5)** Accept answers from parts (a) and (b). Accept correct answer without unit. *Low Partial Credit:* • Work of merit, for example: $17\,576 \times 0{\cdot}07$; $374{\cdot}92$; $x - 17\,576$. • Relevant work with trial and improvement. • Correct answer without work. *High Partial Credit:* • First line of the solution.