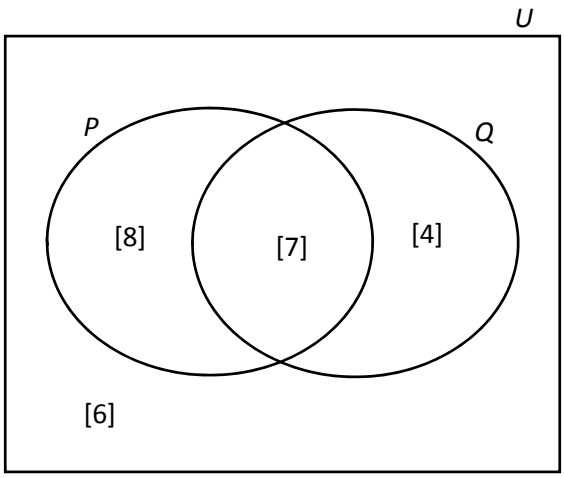
Paper 1: Marking Scheme 2016

The Left Side shows the solution.
The Right Side shows how marks were awarded.

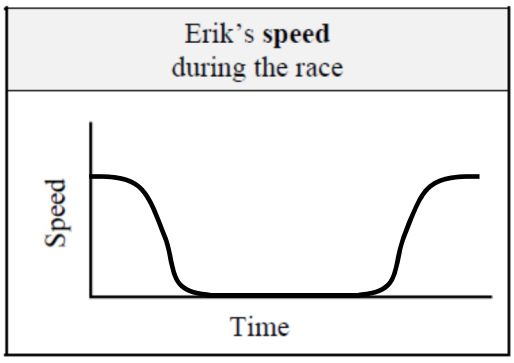
Q1	Model Solution – 30 Marks	Marking Notes
(a)(i)	$17 \times 1{\cdot}06 = €18{\cdot}02$ **OR** $6\% = €1{\cdot}02$ $106\% = €17 + €1{\cdot}02$ $= €18{\cdot}02$	**Scale 10B (0, 4, 10)** Accept correct answer without work. Accept answer without € sign. *Partial Credit* • Shows understanding of percentages e.g. 0·06, $\frac{3}{50}$, 94% • Finds increase (i.e. 1·02) *Full Credit –1* • Subtracts €1·02 (i.e. finds decrease instead of increase)
(a)(ii)	$\frac{18{\cdot}02-17}{18{\cdot}02} \times 100$ $= \frac{1{\cdot}02}{18{\cdot}02} \times 100$ $= 5{\cdot}66\ldots$ $= 5{\cdot}7\%$ [1 DP] **OR** $100 - \left(\frac{17}{18.02} \times 100\right)$ = 5.7% [1 DP]	**Scale 5C (0, 2, 4, 5)** Accept correct answer without work. *No Credit* • Answer of 6% with no supporting work *Low Partial Credit* • One relevant operation, e.g. 17/18·02, 18·02 – 17, etc. • One relevant operation with €17 as the base price, e.g. 18·02/17, etc. *High Partial Credit* • 1·02/18·02 • (17/18·02) × 100 • Finds reduction as a percentage of €17 (i.e. answer of 6%) with supporting work
(b)	(i) $(5 + 4) \times (2 + 3) = 45$ (ii) $5 + 4 \times (2 + 3) = 25$ (iii) $(5 + 4) \times 2 + 3 = 21$	**Scale 15C (0, 5, 12, 15)** Accept correct answer without work. *Low Partial Credit* • One part correct • Calculations that imply correct brackets in one part, e.g. 9 × 5 = 45 in (i) *High Partial Credit* • Two parts correct

Q2	Model Solution – 20 Marks	Marking Notes
(a)	(i) $\frac{0{\cdot}20}{20} = \frac{1}{100}$ (ii) $\frac{0{\cdot}5}{200} = \frac{1}{400}$	**Scale 5C (0, 2, 4, 5)** Accept correct answer without work. *Low Partial Credit* • One conversion correct e.g. €20 = 2000c • Makes fraction with relevant numbers e.g. 20/20 or 0·5/2 *High Partial Credit* • One part correct • Both conversions correct *Full Credit –1* • Answer as a percentage or a decimal
(b)(i)	Brand A is cheaper. Brand A: 3·60/2 = €1·80 per litre Brand B: 1·50/0·75 = €2·00 per litre **OR** Brand A: 3·60/8 = €0·45 per 250ml Brand B: 1·50/3 = €0·50 per 250ml **OR** Brand A: (3·60/8)×3 = €1·35 per 750ml **OR** Brand B: (1·50/3)×8 = €4 per 2 litre **OR** Brand A: 2/3·60 = 0·55… litre per € Brand B: 0·75/1·50 = 0·5 litre per €	**Scale 10B (0, 4, 10)** Accept cost per same amount for both brands, e.g. per 250 ml, per 2 litres, etc. This may require only 1 conversion (A or B). *Partial Credit* • One relevant calculation • Some correct conversion • Correct answer with no work *Full Credit –1* • Working out fully correct, but no statement or incorrect statement

Q2	Model Solution – 20 Marks	Marking Notes
(b)(ii)	Lowest price = €9·60 $3 \times A$ = €10·80 $(2 \times A) + (2 \times B)$ = €10·20 $(1 \times A) + (4 \times B)$ = €9·60 $7 \times B$ = €10·50	**Scale 5C (0, 2, 4, 5)** Accept answer without € sign. *Low Partial Credit* • Price of one combination worked out (not necessarily ≥ 5 litres) • Uses price per litre from b(i) • States: 1 Brand A and 4 Brand B *High Partial Credit* • Price of two correct combinations worked out • Correct answer with no other work *Full Credit –1* • €9·60 given as answer, and the price of one other relevant combination found • Price of all four combinations worked out, lowest not identified

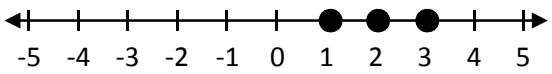
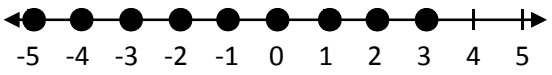
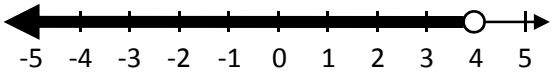
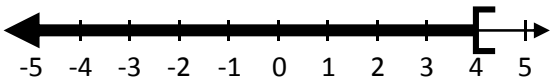
Q3	Model Solution – 10 Marks	Marking Notes
		**Scale 10C (0, 3, 8, 10)** Accept correct answer without work. Treat solution as requiring three steps: Step 1: Finds $\#(P \cap Q)$ Step 2: Splits value in the ratio 2 : 1 Step 3: Fill in the Venn diagram (#*U* must equal 25, and [6] must be correct) *Low Partial Credit* • Relevant work in any step • 1 step correct *High Partial Credit* • Any 2 steps correct (excluding case where $\#(P \setminus Q) = 2$ and $\#(Q \setminus P) = 1$)

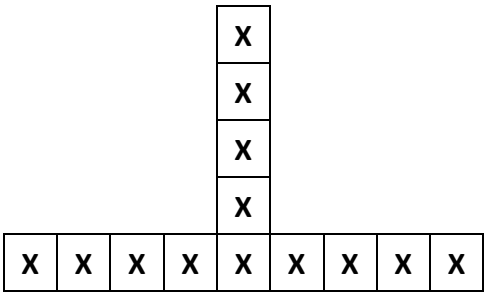
Q4	Model Solution – 5 Marks	Marking Notes
	1. Always true 2. Sometimes true 3. Always true 4. Never true 5. Sometimes true	**Scale 5D (0, 2, 3, 4, 5)** Accept correct answer without work. *Low Partial Credit* • Relevant work on a Venn diagram • 1 correct *Mid Partial Credit* • 2 correct *High Partial Credit* • 4 correct

Q5	Model Solution – 25 Marks	Marking Notes
(a)	(i) $\frac{\text{Distance}}{\text{Time}} = \frac{300}{60} = 5$ m/s (ii) $\frac{\text{Distance}}{\text{Time}} = \frac{100}{40} = \frac{5}{2}$ **or** 2·5 m/s	**Scale 10C (0, 3, 8, 10)** Accept correct answer without units. In (i) accept $\frac{300}{60}$ or similar (i.e. unsimplified) In (ii) accept correct answer without work. *Low Partial Credit* • A correct relevant formula • Correct distance or time for either (i) or (ii) • Relevant work on graph *High Partial Credit* • (i) or (ii) correct *Full Credit –1* • (i) correct and answer not fully simplified in (ii)
(b)	1. Claire 2. Bill 3. Dee	**Scale 10C (0, 3, 8, 10)** Accept correct answer without work. *No Credit* • Same answer in all 3 boxes *Low Partial Credit* • 1 part correct *High Partial Credit* • 2 parts correct
(c)		**Scale 5B (0, 2, 5)** Accept correct answer without work. *Partial Credit* • 1 section of graph correct (speed decreasing **or** speed = 0 **or** speed increasing) • Graph touches the time axis when Erik has stopped • Indicates an understanding of speed on the given distance/time graph

Q6	Model Solution – 20 Marks	Marking Notes
(a)	3·14, π, $\frac{22}{7}$, $\sqrt{10}$ **OR** 3·14, 3·141..., 3·142..., 3·16...	**Scale 10C (0, 3, 8, 10)** Accept correct answer without work. Accept correct answer in decimal form (as long as values are distinguishable). *Low Partial Credit* • Any two consecutive numbers in the correct increasing order. • A relevant approximation of any one of the numbers. *High Partial Credit* • Three numbers in increasing order with supporting work. • Numbers not ordered, but π and $\frac{22}{7}$ to at least 3 decimal places and $\sqrt{10}$ to at least 2 decimal places. *Full Credit –1* • Numbers in decreasing order.
(b)	$\sqrt{10}$: Irrational It cannot be written as a fraction using only integers **or** It goes on forever without repeating as a decimal **or** *any other equivalent reason* 3·14: Rational It can be written as a fraction using only integers [e.g. $\frac{314}{100}$] **or** It doesn't go on forever without repeating as a decimal **or** *any other equivalent reason*	**Scale 5C (0, 2, 4, 5)** Accept "It can/cannot be written as a fraction" or "It does/doesn't go on forever as a decimal", as appropriate. *Low Partial Credit* • 1 part (tick or reason) correct • Defines a rational or irrational number • Both correctly identified but no reason or incorrect reasons given *High Partial Credit* • 1 tick and corresponding reason correct

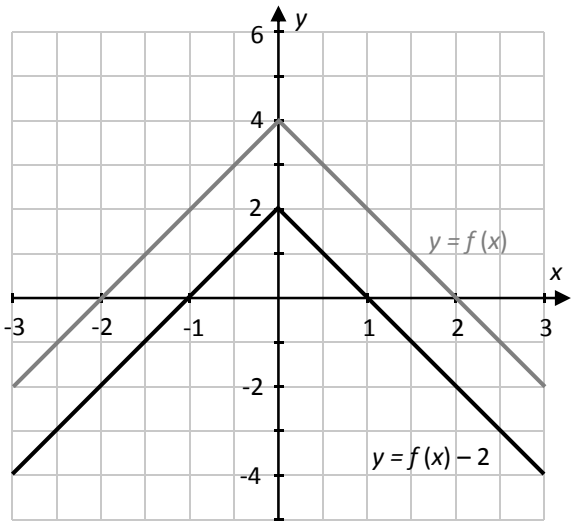
Q6	Model Solution – 20 Marks	Marking Notes
(c)	*Answer*: 101 *Justification*: $3{\cdot}14 \times 10^2 = 314$, so power = 2 $\Rightarrow$ 2+1 = 3 digits **or** *any other valid justification*	**Scale 5B (0, 2, 5)** *Partial Credit* • Correct answer (i.e. 101) • Relevant example • Shows understanding of scientific notation

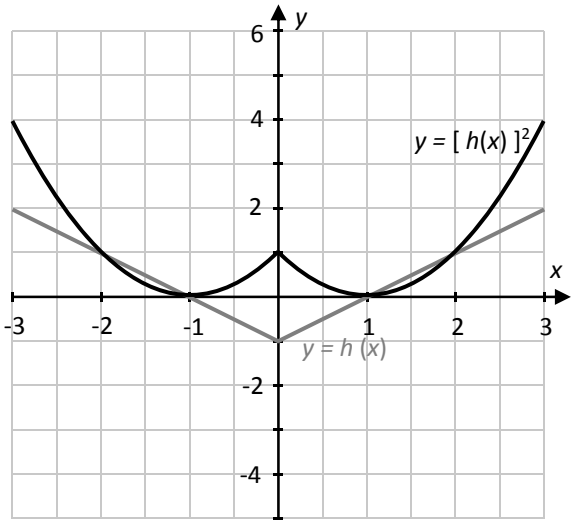
Q7	Model Solution – 15 Marks	Marking Notes
(a)	$\frac{2(2x+4)}{6} - \frac{3(5x-7)}{6} = 5$ $\Rightarrow \frac{4x+8-15x+21}{6} = 5$ $\Rightarrow \frac{-11x+29}{6} = 5$ $\Rightarrow -11x + 29 = 30$ $\Rightarrow -11x = 1$ $\Rightarrow x = -\frac{1}{11}$ *or equivalent*	**Scale 10D (0, 2, 4, 8, 10)** *Low Partial Credit* • Any work of merit, e.g. 3(2), 6 (or any multiple of 6), 2(2x+4), 3(5x-7) *Mid Partial Credit* • $\frac{2(2x+4)-3(5x-7)}{6} = 5$ • $\frac{2(2x+4)}{6} - \frac{3(5x-7)}{6} = 5$ • $\frac{6(2x+4)}{3} - \frac{6(5x-7)}{2} = 6(5)$ *High Partial Credit* • Correct linear equation without fractions and with brackets distributed. • $4x + 8 - 15x + 21 = 30$, or equivalent. • Correct answer without work.
(b)	(i)  (ii)  (iii)  **OR**  	**Scale 5C (0, 2, 4, 5)** Accept 0 as an element in (i). Accept correct answer without work. *Low Partial Credit* • One graph correct *High Partial Credit* • Two graphs correct *Full Credit – 1* • 4 included in one or more solutions, otherwise all parts fully correct

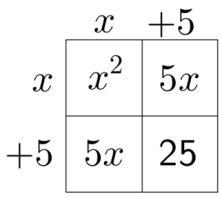
<table>
<tr><th>Q8</th><th>Model Solution – 30 Marks</th><th>Marking Notes</th></tr>
<tr><td>(a)</td><td>  </td><td>Scale 10B (0, 4, 10)
Accept diagram with boxes, or X s, or both.
Partial Credit
• Similar shape to previous stages, as long as the sequence is increasing</td></tr>
<tr><td>(b)</td><td>$N = 4 + 3S$
OR
<table><tr><th>Stage(S)</th><th>Number(N)</th></tr><tr><td>0</td><td>4 + 0(3)</td></tr><tr><td>1</td><td>4 + 1(3)</td></tr><tr><td>2</td><td>4 + 2(3)</td></tr><tr><td>3</td><td>4 + 3(3)</td></tr><tr><td>.</td><td>.</td></tr><tr><td>.</td><td>.</td></tr><tr><td>S</td><td>4 + 3(S)</td></tr></table>$N = 4 + 3S$</td><td>Scale 5C (0, 2, 4, 5)
Accept correct answer without work.
Low Partial Credit
• Number of Xs written down for any stage from 0 to 3 or beyond.
• Identifies common difference
• Identifies the first term
• Any linear graph or formula, or mentions ‘linear’
• Relevant formula, e.g. $T_n = a + (n-1)d$, or $y = mx + c$
High Partial Credit
• Starts with $T_1 = 4$, finishes correctly (i.e. $N = 1 + 3S$, or equivalent)
• $y = 1 + 3x$
• Formula in the correct form with either the constant term or the coefficient of S correct i.e. $N = 4 + pS$ or $N = q + 3S$
Full Credit –1
• Swaps N and S (i.e. $S = 4 + 3N$)
• Uses different variables, without defining them e.g. $y = 4 + 3x$
• 4 + 3S</td></tr>
</table>

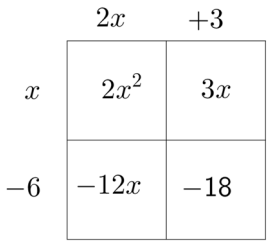
Q8	Model Solution – 30 Marks	Marking Notes
(c)	$4 + 3k = 130$ $3k = 126$ $k = 42$	**Scale 10B (0, 4, 10)** Accept correct answer without work *Partial Credit* • Some attempt at trial and error • Extends sequence towards 130 • Substitutes values into formula • Sets answer from (b) equal to 130
(d)	(i) *Any configuration where the number of **X**s is 1, 3, and 5, respectively.* (ii) $p + 6$	**Scale 5C (0, 2, 4, 5)** Accept correct answer without work. *Low Partial Credit* • Any 3 terms of a linear sequence with common difference of 2 • Any one stage correct in (i) • Indicates that the first difference is 2 • Work of merit in (ii) *High Partial Credit* • (i) **or** (ii) correct (patterns must be drawn in (i) for it to be taken as correct)

Q9	Model Solution – 20 Marks	Marking Notes
(a)	(i) 3^2 (ii) 3^0 (iii) $3^{3/2}$ (iv) $3^{-1/3}$	**Scale 10D (0, 2, 4, 8, 10)** Accept correct answer without work. *Low Partial Credit* • Any work of merit e.g. $3\sqrt{3}$, $3^{\frac{1}{3}}$, 3×3, $3^{\frac{2}{3}}$ • 1 part correct *Mid Partial Credit* • 2 parts correct *High Partial Credit* • 3 parts correct
(b)	$16\,n^4$	**Scale 5B (0, 2, 5)** Accept correct answer without work *Partial Credit* • Any work of merit e.g. n^4, ± 16, $(-2n)(-2n)$ or -2^4
(c)	$x = -1$ and $\sqrt{x^2} = 1$ **or** *any other negative value of x, with the corresponding value of* $\sqrt{x^2} = \lvert x \rvert$.	**Scale 5B (0, 2, 5)** Accept a description in place of an example, e.g. "if x is a negative number, then $\sqrt{\boldsymbol{x^2}}$ is the positive of that" *Partial Credit* • $x =$ any negative value and no work or incorrect work on $\sqrt{x^2}$ • $x =$ any non-negative value and s$\sqrt{x^2}$ = the same non-negative value

Q10	Model Solution – 15 Marks	Marking Notes
(a)	(i) | x | –3 | –2 | –1 | 0 | 1 | 2 | 3 | | $f(x)$ | –2 | 0 | 2 | 4 | 2 | 0 | –2 | | $f(x) - 2$ | –4 | –2 | 0 | 2 | 0 | –2 | –4 | (ii)  	**Scale 10C (0, 3, 8, 10)** Accept correct answer (i.e. table and graph fully correct) without work. Treat solution as requiring three steps: Step 1. Completing $\boldsymbol{f(x)}$ row Step 2. Completing $\boldsymbol{f(x) - 2}$ row Step 3. Plotting the graph of $\boldsymbol{f(x) - 2}$ *Low Partial Credit* • 4 values of $\boldsymbol{f(x)}$ filled in correctly • 1 correct value for $\boldsymbol{f(x) - 2}$ • Graph in correct shape without work • One step correct *High Partial Credit* • Two steps correct • Correct graph (as per solution) without work *Full Credit –1* • All correct except one value from table or graph • Table and graph fully correct for $\boldsymbol{f(x) + k}$, where $k \neq -2$

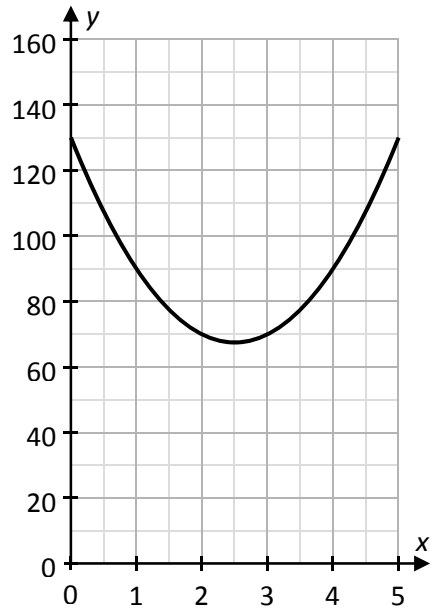
Q10	Model Solution – 15 Marks	Marking Notes
(b)	(i) | x | –3 | –2 | –1 | 0 | 1 | 2 | 3 | | $h(x)$ | 2 | 1 | 0 | –1 | 0 | 1 | 2 | (ii)  	**Scale 5C (0, 2, 4, 5)** Accept correct answer (i.e. table and graph fully correct) without work. No credit for graph from work of no merit *Low Partial Credit* • 4 values of $\boldsymbol{h(x)}$ filled in correctly • 1 correct value for $\boldsymbol{[h(x)]^2}$ calculated *High Partial Credit* • 4 values of $\boldsymbol{[h(x)]^2}$ calculated, for the given x values • 4 points correctly plotted and joined, as per solution • All 7 points correctly plotted as per solution, but not joined or joined incorrectly *Full Credit –1* • All correct except one value from table or graph

Q11	Model Solution – 25 Marks	Marking Notes
(a)(i)	$(x+5)(x+5)$ $= x^2+5x+5x+25$ $= x^2+10x+25$ **OR**  $x^2+10x+25$	**Scale 5B (0, 2, 5)** Accept correct answer without work. *Partial Credit* • Any correct relevant multiplication • $x(x+5)+5(x+5)$ **or** grid set up properly • Shows understanding of distribution *Full Credit –1* • $x^2+5x+5x+25$ **or** grid filled in correctly
(a)(ii)	$x^2+10x+25-(x^2-10x+25)$ $= x^2+10x+25-x^2+10x-25$ $= 20x$ $= 4(5x)$ **OR** $(x+5+x-5)(x+5-(x-5))$ $= (2x)(10)$ $= 20x$, which is divisible by 4.	**Scale 5C (0, 2, 4, 5)** Oversimplification because of incorrect work in (a)(i) merits *Low Partial Credit* at most *Low Partial Credit* • Any correct relevant multiplication • Substitutes some value for x and shows the result is divisible by 4 • Indicates or shows understanding of difference of 2 squares • $2x$ or 10 calculated correctly *High Partial Credit* • All terms correctly multiplied, including signs • $(2x)(10)$ *Full Credit –1* • Failure to make final statement • Getting to the line $20x$.
(b)(i)	$(5x)^2-(7n)^2$ $= (5x+7n)(5x-7n)$ **OR** $(-5x-7n)(7n-5x)$	**Scale 10C (0, 3, 8, 10)** Accept correct answer without work. *Low Partial Credit* • Indicates or shows understanding of difference of 2 squares • $5x$ **or** $7n$ appears • 5 **and** 7 appear *High Partial Credit* • Correct, other than sign errors • $(5x)^2-(7n)^2$ • $5x+7n$ **or** $5x-7n$

Q11	Model Solution – 25 Marks	Marking Notes
(b)(ii)	(2 x + 3) (x – 6) **OR** Guide Number = $2 \times (-18) = -36$ $2x^2 - 12x + 3x - 18$ = $2x(x-6) + 3(x-6)$ = $(2x+3)(x-6)$ **OR**  (2 x + 3) (x – 6)	**Scale 5C (0, 2, 4, 5)** Accept correct answer without work. *No Credit* • ( ) ( ) *Low Partial Credit* • Some work of merit, e.g. factorises $2x^2$ or 18 or finds / factorises 36 • Any correct substitution into the quadratic formula *High Partial Credit* • $2x(x-6) + 3(x-6)$ • $x(2x+3) - 6(2x+3)$ • Answer given multiplies out to give two correct terms (including signs) • Solves correctly $2x^2 - 9x - 18 = 0$ $\left(\text{i.e. } x = 6 \text{ and } x = -\frac{3}{2}\right)$

Q12	Model Solution – 25 Marks	Marking Notes
(a) E1&E2	E1: $y + 5 = 19$ $y = 14$ E2: $2y^2 + 1 = 19$ $2y^2 = 18$ $y^2 = 9$ $y = 3$ [as $y > 0$]	**Scale 15D (0, 4, 9, 13, 15)** Accept correct answers without work *Low Partial Credit* • Sets up one equation *Mid Partial Credit* • Sets up two equations • Solves E1 *High Partial Credit* • Solves E2 • Solves E1 and work of merit in solving E2 (must make at least one correct transposition)
(a) E3	E3: $2y^2 + 1 = y + 5$ $2y^2 - y - 4 = 0$ $y = \frac{-(-1)\pm\sqrt{(-1)^2-4(2)(-4)}}{2(2)}$ $= \frac{1\pm\sqrt{33}}{4}$ $= 1{\cdot}686...$ [as $y > 0$] $= 1{\cdot}69$ [2 DP]	**Scale 5D (0, 2, 3, 4, 5)** Accept "1·69" verified in both relevant expressions **or** subbed into E3 Consider solution as requiring 4 steps: Step 1. Sets up the equation with LHS = 0 Step 2. Writes down the quadratic formula or identifies *a*, *b*, and *c* Step 3. Correct substitution into the quadratic formula Step 4. Evaluates to 2 decimal places *Low Partial Credit* • 1 step correct *Mid Partial Credit* • 2 steps correct *High Partial Credit* • 3 steps correct (assume steps 1 and 2 are done if step 3 is correct) *Full Credit –1* • Answer left in surd form, i.e. $\frac{1\pm\sqrt{33}}{4}$, or rounded incorrectly
(b)	If 1st bag = 19 kg, then $y = 14$ so 3rd bag ≠ 19 kg **or** *any other valid explanation*	**Scale 5A(0, 5)** Accept: "All three *y* values are different", "If two weights are the same, the other must be different", etc.

Q13	Model Solution – 15 Marks	Marking Notes
	Area ABC $= 12\,a^2$ $\Rightarrow \quad \frac{1}{2}(6\,a)\,.\,\lvert AC\rvert = 12\,a^2$ $\Rightarrow \quad \lvert AC\rvert = 4\,a$ Area of square $= \lvert BC\rvert^2$ $= \lvert AB\rvert^2 + \lvert AC\rvert^2$ [Pyth Thm] $= (6\,a)^2 + (4\,a)^2$ $= 36\,a^2 + 16\,a^2$ $= 52\,a^2$	**Scale 15D (0, 4, 9, 13, 15)** Accept correct answer without work. Treat solution as requiring four steps: Step 1. Formula for the area of a triangle Step 2. Finding |AC| Step 3. Substitution into Pythagoras' Thm Step 4. Finish to find the area of BDEC *Low Partial Credit* • 1 step correct • Relevant formula: Pythagoras Theorem, area of a square, area of a rectangle *Mid Partial Credit* • 2 steps correct (if Step 2 is done then assume Step 1 is also done) *High Partial Credit* • 3 steps correct (if Step 3 is done then assume Step 1 & Step 2 are also done)

Q14	Model Solution – 45 Marks	Marking Notes
(a)		**Scale 15D (0, 4, 9, 13, 15)** Accept correct graph without work. Award a linear graph at most *Low Partial Credit*. *Low Partial Credit* • Some work of merit, e.g. some correct substitution for x in $h(x)$. *Mid Partial Credit* • $h(x)$ evaluated correctly for any three values of $x \in \{0,1,2,3,4,5\}$ (Accept points shown on the graph) *High Partial Credit* • 6 points on the graph of $h(x)$ plotted correctly. • 5 points on the graph of $h(x)$ plotted and joined correctly *Full Credit –1* • Curve with a flat bottom, otherwise correct
(b)	(i) 130 cm (ii) 67.5 cm (iii) 2·5 hours	**Scale 15C (0, 5, 12, 15)** Accept correct answers without work. Accept answers taken from either the graph or the function In (ii), tolerance of ± 3 units on *y*-axis, but not in next box up or down. *Low Partial Credit* • 1 part correct • Relevant line on graph (either a vertical line from the lowest point or a horizontal line from the lowest point) *High Partial Credit* • 2 parts correct *Full Credit –1* • Unit(s) incorrect or omitted, otherwise fully correct

Q14	Model Solution – 45 Marks	Marking Notes
(c) (i)&(ii)	**Method 1** *Part (i)* (0, 180): $a\,(0)^2 + b\,(0) + c = 180$ [E1] $\Rightarrow \quad c = 180$ *Part (ii)* (3, 0): $a\,(3)^2 + b\,(3) + 180 = 0$ [E2] $\Rightarrow \quad 9a + 3b = -180$ $\Rightarrow \quad 3a + b = -60$ (6, 180): $a\,(6)^2 + b\,(6) + 180 = 180$ [E3] $\Rightarrow \quad 36a + 6b = 0$ $\Rightarrow \quad 6a + b = 0$ E3 – E2: $\Rightarrow \quad 3a = 60$ $\Rightarrow \quad a = 20$ E2: $b = -60 - 3\,(20)$ $\Rightarrow \quad b = -120$ **OR** **Method 2** Quadratic has 2 roots at $x = 3$ $\Rightarrow \quad g(x) = a\,(x-3)^2$ $= a\,(x^2 - 6x + 9)$ $= ax^2 - 6ax + 9a$ (0, 180): $a(0)^2 - 6a(0) + 9a = 180$ $\Rightarrow \quad a = 20$ $\Rightarrow \quad g(x) = 20x^2 - 120x + 180$ i.e. $a = 20,\ b = -120,\ c = 180$ **OR**	**15D (0, 4, 9, 13, 15)** Accept correct answers without work. *Low Partial Credit* • Work of merit, e.g. identifies (0,180), (3,0), or (6,180); relevant substitution in $g(x)$; relates c to y-intercept; attempt at relevant shifting of graph; *Mid Partial Credit* • Finds $c = 180$ • Finds E1 and E2 and E3 • Finds $a = 20$ • $(x-3)^2$ *High Partial Credit* • Finds c and E2 and E3 • $20\,(x-3)^2$ • Finds a or b, having found c

Q14	Model Solution – 45 Marks	Marking Notes
(c) (i)&(ii) cntd	**Method 3** The shifted quadratic graph through (0,0) and (3,180) is of the form $y = ax^2$ $\Rightarrow \quad a\,(3)^2 = 180$ $\Rightarrow \quad a = 20$ Shift quadratic 3 units back to the right: $\Rightarrow \quad g(x) = 20\,(x - 3)^2$ $= 20\,(x^2 - 6x + 9)$ $= 20x^2 - 120x + 180$ i.e. $a = 20,\ b = -120,\ c = 180$	*See previous page.*