A Level Statistics

AQA Past Exam Questic

Solutions

TOPIC: Least S sion

In the new specification you will not be asked to calculate the values of a and b in any way other than on the calculator

You will not be asked to plot or draw a scatter graph or the LSR on a scatter graph so these questions form past paper shave been omitted

Candidates may use any calculator allowed by Pearson regulations. Calculators must not have retrievable mathematical formulae stored in them.

Instructions

• Use **black** ink or ball-point pen.

• If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.

• **Fill in the boxes** at the top of this page with your name, centre number and candidate number.

• Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.

• Answer the questions ***on paper***

• You should show sufficient working to make your methods clear. Answers without working may not gain full credit.

• Unless otherwise stated, statistical tests should be carried out at the 5% significance level.

• When a calculator is used, the answer should be given to three significant figures unless otherwise stated.

Information

• ***You may use the*** booklet 'Statistical Formulae and Tables'

• There are **12** questions in this question paper. The total mark for this paper is ***123***

• The marks for **each** question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

• Read each question carefully before you start to answer it.

• Try to answer every question.

• Check your answers if you have time at the end.

• If you change your mind about an answer, cross it out and put your new answer and any working underneath.

• Check your answers if you have time at the end.

AQA_JAN_2012_5

Q	Solution	Marks	Total	Comments
5	**See supplementary sheet for alternative solutions and additional guidelines to parts (b), (d) and (e)**			
(a)	Calorific value depends upon moisture content Moisture (content) is set/are fixed values	B1	1	Must be in context; **not** "it", etc Use of x and y $\Rightarrow$ B0
(b)	b (gradient) = –0.076 b (gradient) = –0.07 to –0.08 a (intercept) = 5.35 to 5.36 a (intercept) = 5.1 to 5.6 Thus y = (5.35 to 5.36) –0.076x	B2 (B1) B2 (B1) BF1	5	AWRT; including –ve sign (–0.07582) AWFW; including –ve sign *Treat rounding of correct answers as ISW* AWFW (5.35385) AWFW F on a and b even if rounded
(c)	a: calorific value of wood with zero/no moisture or dry maximum calorific value b: each 1(%) rise in moisture content reduces calorific value by 0.076 MWh/tonne As x increases y decreases	B1 B2 (B1)	3	OE; $a \leq 0$ $\Rightarrow$ B0 In context and with values; F on b $b \geq 0$ $\Rightarrow$ B0 Negative relationship/correlation
(d)	y_{27} = 3.28 to 3.32 = 2.5 to 3.5	B2 (B1)	2	AWFW (3.30659) AWFW; even if by interpolation from original data giving likely values of 3 or 3.04
(e)	r(35, 2.5) = –0.21 to –0.19 = 0.1 to 0.3	B2 (B1)	2	AWFW; including –ve sign (–0.20000) AWFW; ignore sign
(f)	Good/reasonable/accurate/correct/etc Accept more positive qualifying adjectives	B1	1	OE; ignore reasoning Very good (B1) Not good (B0)
(g)(i)	Extrapolation/outside (observed) range (of x)	B1	1	OE
(ii)	y_{80} = –0.5 to –1 Negative value for calorific value is impossible or More energy needed than is generated	B1 Bdep1	2	AWFW (–0.71209) OE; dependent on B1 Must be in context; negative value impossible $\Rightarrow$ Bdep0

AQA_JAN_2013_1

Q	Solution	Marks	Total	Comments
1 (a)	a = **30**	B1	1	CAO
(b)(i)	b (gradient) = **–0.64** b (gradient) = **–0.6 to –0.7**	B2 (B1)		CAO (–0.64) AWFW *Treat rounding of correct answers as ISW* *Written form of equation is **not** required*
	a (intercept) = **31** a (intercept) = **30 to 32**	B2 (B1)		CAO (31) AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ $\left(\sum y^2\right)$ **or** Attempt at S_{xx} & S_{xy} $\left(S_{yy}\right)$ Attempt at **correct** formula for b (gradient) b (gradient) = **–0.64** a (intercept) = **31**	(M1) (m1) (A1 A1)	4	225 7125 135 & **2415** (2643) (all 4 attempted) 1500 & **–960** (618) (both attempted) CAO both
(ii)	Candle **length reduces** by **0.64** (cm) **per hour** Candle **burns 0.64** (cm) **each/per hour** Candle **reduces** by **–0.64** (cm) **each/per hour**	B1 BF1 (BF2) (BF1)		OE; must be in context OE; must be in context OE; must be in context OE; must be in context (double –ve) F on $-0.6 \leq b \leq -0.7$ from (i)
	(Length, y, cm) **decreases** with (time, x, hours) **or** As (time, x, hours) **increases** then (length, y, cm) **decreases**	(B1)	2	OE; context **not** required B0 for reference only to correlation
(iii)	When x = 50, y = (31 or 30) – 0.64 × 50 = **–1 or –2** **or** When y = 0, x = 31 ÷ 0.64 = **48 to 48.5** **or** 30 ÷ 0.64 = **46.8 to 47**	B1		CAO; accept **correct** comparison of 32 with either 30 or 31 AWFW AWFW
	Claim **not** justified **or** –1 is impossible **or** value < 50	Bdep1		OE; dependent on previous B1
	Claim cannot be answered due to uneven burning **or** unlikely to burn completely	(B1)	2	Extrapolation required

3(a)	b (gradient) = 7.05 b (gradient) = 7(.00) to 7.1(0)	B2 (B1)		AWRT (7.05134) AWFW Treat rounding of correct stated answers as ISW
	a (intercept) = 2500 to 2502 a (intercept) = 2490 to 2510	B2 (B1)	4	AWFW (2501.091) AWFW
	or Attempt at $\sum x \ \ \sum x^2 \ \ \sum y \ \ \& \ \sum xy \ \ \left(\sum y^2\right)$			1351 268047 27034 & 5269065 (105653202) (all 4 attempted)
	or Attempt at S_{xx} & S_{xy} $\left(S_{yy}\right)$	(M1)		7304 & 51503 (1247894) (both attempted)
	Attempt at **correct** formula for b (gradient)	(m1)		
	b (gradient) = 7.05 a (intercept) = 2500 to 2502	(A1) (A1)		AWRT AWFW
	Accept a & b interchanged only if identified correctly by a **clearly shown equation** (stated answers are not sufficient) in (b)			If a and b are not identified anywhere in solution, then: 7.05 ⇒ B1 2500 to 2502 ⇒ B1
(b)	$y_{200} = a + b \times 200$	M1		Used May be implied by correct answer
	= 3890 to 3930	A1	2	AWFW (3911.36)
(c)	Large residuals / residual range suggest estimate may be unreliable **or** Largest residuals only small in relation to y-values (10%) so estimate may be reliable (unreliable)	B1 B1dep B1 B1dep	2	 (unreliable) requires (10% or equivalent)
	Special Case: If B0 B0dep then: Involves interpolation Does not involve extrapolation Within observed range	 (B1)		 Any one; or equivalent

5(a)	Time taken is dependent upon leaving time	B1	1	Or equivalent
(b)	b (gradient) = 1.28 (or 141/110)	B2		AWRT; (CAO or equivalent) (1.28182)
	b (gradient) = 1.25 to 1.35	(B1)		AWFW Treat rounding of correct answers as ISW
	a (intercept) = 29.95 to 30 (or 659/22)	B2		AWFW; (CAO or equivalent) (29.95455)
	a (intercept) = 29 to 31	(B1)		AWFW
	Thus $y = 30 + 1.28x$	B1F	5	F on a and b
	or			
	Attempt at Σx Σx^2 Σy and Σxy $\left(\Sigma y^2\right)$			275 9625 682 and 20575 (47494) (All four attempted)
	or	(M1)		
	Attempt at S_{xx} and S_{xy} $\left(S_{yy}\right)$			2750 and 3525 (5210) (Both attempted)
	Attempt at correct formula for b gradient	(m1)		
	b (gradient) = 1.28 (or 141/110)	(A1)		AWRT; (CAO or equivalent)
	a (intercept) = 29.95 to 30 (or 659/22)	(A1)		AWFW; (CAO or equivalent)
	Thus $y = 30 + 1.28x$	(B1F)		F on a and b
	Accept a and b interchanged only if identified correctly by a clearly shown equation			If a and b are not identified anywhere in the question, then: 1.25 to 1.35 $\Rightarrow$ B1 29 to 30 $\Rightarrow$ B1
(c)	7.45 am $\Rightarrow x = 15$	B1		CAO; stated, used or implied
	$\Rightarrow y_{15} = 30 + 1.28 \times 15$	M1		Use of $10 < x < 20$
	= 47 to 52	A1		AWFW (49.2)
	Time before 9.00 am = 9.00 – (7.45 + c's y_{15})	M1		May be implied
	= 23 to 28	A1	5	AWFW (25.8)
	SC Answer of 17 CAO (use of c's y_{15} = 58) gains 2 marks			**NB:** An answer of 8.32 to 8.37 gains B1 M1 A1 M0 A0
(d)(i)	$y_{85} = 30 + 1.28 \times 85 = 135$ to 146	B1	1	AWFW (138.9)
(ii)	Extrapolation/ outside/ above range of x-values	B1		Or equivalent
	Implies leaves home at 8.55 so different traffic conditions	B1	2	Or equivalent; 8.55 may be implied by 5 minutes

1(a)	b (gradient) = –1.01 to –1(.00) (b (gradient) = –1.05 to –0.95)	B2 (B1)		AWFW	(–1.00337)
	a (intercept) = 53(.0) to 53.2 (a (intercept) = 52(.0) to 54(.0))	B2 (B1)	4	AWFW	(53.06736)
	OR				
	Attempt at $\sum x$, $\sum x^2$, $\sum y$ and $\sum xy$			180, 3986, 297 and 5552.7	
	or Attempt at S_{xx} and S_{xy}	(M1)		386 and –387.3	
	Attempt at **correct** formula for b (gradient)	(m1)			
	b (gradient) = –1.01 to –1(.00)	(A1)		AWFW	
	a (intercept) = 53(.0) to 53.2	(A1)		AWFW	
	Accept a and b interchanged only if then identified correctly in part (b), but B2 in (b) does **not** necessarily imply 4 marks in (a)				
(b)	When x = 21,				
	y = 31.7 to 32.2 (y = 29.9 to 34.1)	B2 (B1)	2	AWFW AWFW	(32.0)
	Evidence of use of 21 in c's equation	(M1)			
	Special Cases (if seen):				
	$y = \frac{33.0+30.7}{2}$ = 31.8 to 31.9	(B1)		AWFW; or equivalent	
	y = 31.85 without working	(B1)			

AQA_JUNE_2007_5

5(a)	Time taken depends upon temperature	B1	1	OE; **not** x set values
(b)	b (gradient) = –0.0873 to –0.087	B2		AWFW $\left(-0.087\dot{2}\dot{7}\right)$
	b (gradient) = –0.09 to –0.08	(B1)		AWFW; $-8.73^{-02} \Rightarrow$ B0
	a (intercept) = 5.94 to 5.96	B2		AWFW $\left(5.950\dot{9}\right)$
	a (intercept) = 5.6 to 6.1	(B1)		AWFW
	Attempt at $\sum x$, $\sum x^2$, $\sum y$ and $\sum xy$			396, 16016, 30.9 and 958.8
	or	(M1)		
	Attempt at S_{xx} and S_{xy}			1760 and –153.6
	Attempt at correct formula for b	(m1)		
	b = –0.0873 to –0.087	(A1)		AWFW
	a = 5.94 to 5.96	(A1)	4	AWFW
	Accept a and b interchanged only if then identified correctly later in question			
(c)(i)	Each 1 °C rise in temperature results in an	B1		Quantified rise in x (results in)
	(average) decrease of 0.087 m (5 s)	B1	2	Decrease in y
	in time taken for pellets to dissolve			OE
(ii)	a is y–value at $x = 0$ at which water is	B1		Indication that it is y at $x = 0$
	solid/ice/frozen so pellets cannot dissolve	B1	2	Mention of solid or ice or frozen
(d)(i)	When x = 30			
	y = 3.3 to 3.4	B2		AWFW $\left(3.33\dot{2}\dot{7}\right)$
	y = 2.9 to 3.7	(B1)		AWFW
	If B0, use of their equation with x = 30	(M1)	2	
(ii)	When x = 75			
	y < 0 or negative	B1		OE
	which	↑Dep↑		
	is impossible	B1	2	OE; **not** extrapolation

4(a)	b (gradient) = –0.5485 to – 0.5475 b (gradient) = –0.55 to – 0.54 Omission of –ve sign	B2 (B1) (B0)		AWFW (–0.54814) AWFW
	a (intercept) = 49.7 to 49.9 a (intercept) = 49 to 50	B2 (B1)		AWFW (49.7982) AWFW
	or			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ $\left(\sum y^2\right)$			305 14975 281 & **6980** (10173) (all 4 attempted)
	or	(M1)		
	Attempt at S_{xx} & S_{xy}			4638.89 & **–2542.78** (both attempted)
	Attempt at **correct** formula for b (gradient) b (gradient) = –0.5485 to –0.5475 a (intercept) = 49.7 to 49.9	(m1) (A1) (A1)	4	 AWFW AWFW
	Accept a & b interchanged only if identified correctly by a **clearly shown equation** (stated answers are not sufficient) in (b) or (c)			If a and b not identified anywhere in question, then: –0.5485 to –0.5475 ⇒ B1 49.7 to 49.9 ⇒ B1
(b)	C's value of intercept from (a) providing > 47 **or** Value 50 stated even if (a) incorrect or not attempted	B1F	1	Accept value rounded to nearest integer (50)
(c)	13 weeks ⇒ 91 days	B1		Stated or used Accept a descriptive answer that includes 91 and a value in range
	y = –1.1 to + 1.1	B1		AWFW (–0.08254)
	or			
	$y = 0 \Rightarrow x$ = 89 to 93	(B1)		AWFW (90.84942) Accept a descriptive answer that includes a value in range and 13
	⇒ 13 weeks (approximately)	(B1)		Stated
	Note: B1 B1 or (B1) (B1) are available even if (a) not attempted			
	Thus claim appears **justified** **or** Thus tablet likely to have **dissolved**	B1 dep		Or equivalent; ignore reasoning unless contradictory Dependent upon 2nd B1 in (c) or 2nd (B1) in (c)
	or			
	Extrapolation required so cannot comment	(B1)		Not dependent
	Note: If (B1) for extrapolation maximum mark is 2; other mark available is for 91		**3**	

3				
(a)	b (gradient) = **191** b (gradient) = **190 to 192**	B2 (B1)		CAO AWFW *Treat rounding of correct answers as ISW*
	a (intercept) = **115** a (intercept) = **93 to 137**	B2 (B1)	4	CAO AWFW
	OR			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ $\left(\sum y^2\right)$ **or** Attempt at S_{xx} & S_{xy} $\left(S_{yy}\right)$	(M1)		154 3452 30219 & **677042** (133170091) (all 4 attempted) 12224 & **64** (2714668) (both attempted)
	Attempt at **correct** formula for b (gradient) b (gradient) = **191** a (intercept) = **115**	(m1) (A1) (A1)		 CAO CAO
	Accept a & b interchanged only if identified and used correctly in (ii)			If a and b are not identified anywhere in question, then: 190 to 192 ⇒ B1 93 to 137 ⇒ B1
(ii)	$y_{24} = 115 + 191 \times 24$ = **£4699 or £4700** = **£4650 to £4750** **SC:** (4290 + 5057)/2 = 4673 to 4674 ⇒ B1	B2 (B1)	2	Either; ignore units (£4699) AWFW
	If B0 but **clear evidence** of correct use of c's equation with x = 24	(M1)		
(iii)	(Maximum) **temperature** (in February) is likely to be/will be lower/different Must imply a temperature comparison with July	B1	1	Or equivalent; must be **clear indication** that (max) **temperature** is less than/different Extrapolation/not July/not summer/winter/etc ⇒ B0
(iv)	Rainfall amount/wind strength/sunshine hours/ daylight hours/opening times/day of week/ visitor numbers/public holidays/school holidays/ local attractions/etc Allow if at least 1 variable correctly identified	B1	1	Or equivalent Accept any sensible reason; do **not** penalise for dubious 'variable name' so, for example, accept 'rainfall' Minimum/average temp/etc ⇒ B0 Quality or price of food/ staff/etc ⇒ B0

3	**No MR or MC in this question**			
(a)	b (gradient/slope) = **0.85** b (gradient/slope) = **0.8 to 0.9**	B2 (B1)		AWRT (0.85055) AWFW
	a (intercept) = **94.6 to 94.8** a (intercept) = **93 to 97**	B2 (B1)		AWFW (94.69602) AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ **or** Attempt at S_{xx} & S_{xy} Attempt at **correct** formula for b b = **0.85** (AWRT) a = **94.6 to 94.8** (AWFW)	(M1) (m1) (A1 A1)	**4**	254 6924 1163 & **29942** (all 4 attempted) ($\sum y^2$ = 135693) 472.4 & **401.8** (both attempted) (S_{yy} = 436.1) ($\overline{x}$ = 25.4 & $\overline{y}$ = 116.3)
Notes	**1** Treat rounding of correct answers as ISW **2** Written form of equation is **not** required **3** Award 4 marks for y = (94.6 to 94.8) + 0.85 or for (94.6 to 94.8) + 0.85x **4** Values of a and b interchanged and equation $y = ax + b$ stated in (b) ⇒ max of 4 marks **5** Values of a and b interchanged and equation $y = a + bx$ stated in (b) ⇒ 0 marks **6** Values are **not** identified or simply b/a = # and a/b = #, then 0.8 to 0.9 ⇒ B1 and 93 to 97 ⇒ B1 but accept, for example, as identification, [b = #, a = # with $y = a + bx$ but no substitution for b & a] **or** [slope/gradient(b) = #, intercept(a) = #] **7** Answers in fractions can score at most M1 m1 **8** Some/all of marks can be scored in (b) & (d), even if some/all of marks are lost in (a), but marks lost in (a) **cannot** be recouped by subsequent working in (b) or (d)			
(b)	y_{30} = **120 to 120.5** y_{30} = **117 to 123**	B2 (B1)	**2**	AWFW (120.21253) AWFW
Note	**1** If, and only if, B0, then award M1 for seen use of $y = a + b \times 30$			
(c)(i)	**Extrapolation** **BMI** is **outside/above range** **45 is outside/above range** of **BMI** or x	B1		OE; accept references to sample/data but not to population
(ii)	**Extrapolation** **Age** is **outside/above range** **50** is **outside/above range** of **age**	B1	**2**	OE; accept references to sample/data but not to population
Notes	**1** Extrapolation only stated in each of (i) & (ii) ⇒ B1 B0 **2** Two debateable answers ⇒ B1 max			
(d)	r_{20} = 117 − (a + b×20) = **5.3** = **5 to 6**	B2 (B1)	**2**	AWRT; do not ignore sign (5.29297) AWFW; ignore sign
Note	**1** If, and only if, B0, then award M1 for seen use of ±[117 − (a + b×20)]			
(e)	As 2.71/(mean) value is small (in comparison to y-values), estimate is likely to be (quite/fairly/very/extremely) accurate	B1	**1**	OE; justification & conclusion

5(a) (i)	b (gradient/slope) = **0.372 to 0.373** b (gradient/slope) = **0.3 to 0.4** a (intercept) = **6.94 to 6.95** a (intercept) = **6 to 9**	B2 (B1) B2 (B1)		AWFW (0.37235) AWFW AWFW (6.94648) AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ **or** Attempt at S_{xx} & S_{xy} Attempt at substitution into correct corresponding formula for b b = **0.372 to 0.373** a = **6.94 to 6.95**	(M1) (m1) (A1 A1)	**4**	324 8922.70 204 & **5573.05** (all 4 attempted) $(\sum y^2 = 3493.64)$ 174.70 & **65.05** (both attempted) $(S_{yy} = 25.64)$ AWFW $(\bar{x} = 27$ & $\bar{y} = 17)$
Notes	**1** Written form of equation is **not** required **2** Award 4 marks for $y = (6.94 \text{ to } 6.95) + (0.372 \text{ to } 0.373)x$ **or** for $(6.94 \text{ to } 6.95) + (0.372 \text{ to } 0.373)x$ **3** Values of a and b interchanged and equation $y = ax + b$ **stated or used in (b) or (c)** $\Rightarrow$ max of 4 marks **4** Values of a and b interchanged and equation $y = a + bx$ **stated or used in (b) & (c)** $\Rightarrow$ 0 marks **5** Values are **not** identified, then $\Rightarrow$ B0 B0 **6** Some/all of marks can be scored in (a)(ii), (a)(iii), (b) & (c)(i), even if some/all of marks are lost in (a)(i), but marks lost in (a)(i) **cannot** be recouped by subsequent working in (a)(ii), (a)(iii), (b) or (c)(i) but see **Note 3**			
(ii)	**Each/every/one degree** (°C) **rise** in ground temperature results in or **increase per degree** (°C) is (on average) ***b* vibrations** per second	B1 BF1	**2**	 F on b providing $\mathbf{0.3 \le b \le 0.4}$
Notes	**1** To score any marks, an explanation must indicate change in x affecting change in y, **not** change in y affecting change in x **2** Accept, for example, 10°C and 10b vibrations **3** Reference **only** to correlation $\Rightarrow$ B0 BF0			
SC	**1** As x/temperature increases (by c) then y/vibrations increases by b (OE; value of b ($0.3 \le b \le 0.4$) must be stated but context and/or units are **not** required) $\Rightarrow$ B1			
(iii)	Given: When temperature/x < **15** °C **or** = **0** °C value of y = **0** Equation: When temperature/x = **0** °C vibrations/value of y = **6 to 9**	B1 BF1	**2**	**Must be stated clearly** AWFW F on a providing $\mathbf{6 \le a \le 9}$
Notes	**1** B1 is for a **clear statement** of information given in the question in terms of temperature/x and y **2** BF1 is for a **clear statement** of the value of vibrations/y shown by the equation when temperature/x = 0			

5	**Continued**			
	Part (a)	**Total**	**8**	
(b)	$y(23)$ = **15.4 to 15.6**	B1	**1**	AWFW (15.51059)
Note	**1** Ignore any method shown			
(c) (i)	res(28.6) = $17.0 - a - b \times 28.6$ = **–0.55 to –0.65** = **0.5 to 0.7**	B2 (B1)	**2**	AWFW; do **not** ignore sign (–0.59576) AWFW; ignore sign
Note	**1** If, and only if, B0, then attempted use of $\pm(17.0 - a - b \times 28.6) \Rightarrow$ M1 providing $0.3 \le b \le 0.4$ and $6 \le a \le 9$			
(ii)	Value will be/is always: **0 or zero or nought or nothing or nil**	B1	**1**	CAO; accept nothing else, but ignore zeros after decimal point (eg 0.00) Ignore any explanation

2				
(a)	b (gradient/slope) = **–0.574 to –0.575** b (gradient/slope) = **–0.5 to –0.6**	B2 (B1)		AWFW (–0.574515) AWFW
	a (intercept) = **50.9 to 51.0** a (intercept) = **46 to 53**	B2 (B1)		AWFW (50.947359) AWFW
	y = (46 to 53) – (0.5 to 0.6)x	B1		
	OR			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ **or** Attempt at S_{xx} & S_{xy}	(M1)		570 32825.1 182 & **10181.48** (all 4 attempted) $\left(\sum y^2 = 3441.64\right)$ 335.1 & **–192.52** (both attempted) (S_{yy} = 129.24)
	Attempt at substitution into correct corresponding formula for b	(m1)		
	b = **–0.574 to –0.575** a = **50.9 to 51.0**	(A1 A1)		AWFW $\left(\bar{x} = 57 \text{ & } \bar{y} = 18.2\right)$
	y = (46 to 53) – (0.5 to 0.6)x	B1	**5**	
Notes	**1** Values of a and b interchanged or not identified but equation $y = ax + b$ **stated** ⇒ max of 5 marks **2** Values of a and b interchanged or not identified and equation $y = a + bx$ **stated** ⇒ 0 marks			
(b) **(i)**	$y_{(60.0)}$ = **16.3 to 16.6**	B1	**1**	AWFW (16.476455)
(ii)	Women/sample selected could be: Under 45 **or** Over 65 **or** Not between 45 and 65	B1		OE; must reference age/years
	No previous browsing/IT experience **or** No internet/IT access	B1	**2**	Accept "less experience" OE Accept "limited access"

5				
(a)	x is the **independent/controlled** variable x are **set values/percentages** y is the **response/dependent** variable y are **measured values/degrees** y **depends** on x **or** x **does not depend** on y	B1	**1**	OE
(b)				
(i)	b (gradient/slope) = **–0.485** b (gradient/slope) = **–0.47 to –0.50** a (intercept) = **0.278 to 0.729** **or** $\sum x = 105 \quad \sum x^2 = 2275 \quad \left(\sum y^2 = 487.5\right)$ $\sum y = -47.4 \quad \sum xy = -1050.5$ or $S_{xx} = 700 \quad S_{xy} = -339.5 \quad \left(S_{yy} = 166.53429\right)$ b (gradient/slope) = **–0.485** a (intercept) = **0.278 to 0.729**	B2 (B1) B1 M1 A1 A1	**3**	CAO AWFW AWFW (0.50357) Correct attempt at 4 summations Correct attempt at 2 summations CAO AWFW
Notes	**1** Values of a and b interchanged or not identified but equation $y = ax + b$ **stated** ⇒ max of 3 marks **2** Values of a and b interchanged or not identified and equation $y = a + bx$ **stated** ⇒ 0 marks **3** $y = 0.504 - 0.485$ or $0.504 - 0.485x$ stated without working ⇒ 2 marks **4** $x = 1.20 - 2.04y$ (OE) or $y = 1.20 - 2.04x$ (OE) ⇒ 0 marks			
(ii)	For each **unit increase** in (concentration of) **antifreeze** **freezing point decreases** by $\lvert b\rvert$°C **or** **freezing point increases** by b°C	B1 Bdep1	**2**	OE OE; dep on $-0.47 \le b \le -0.50$
SC	**1** As the percentage of antifreeze increases, the freezing point decreases ⇒ B1 (must be in context, not simply x and y)			
(c)				
(i)	Res (15, –6.3) = –6.3 – (a + b × 15) = **+0.46 to +0.48** = (**+0.02 to +0.93**) **or** (**–0.02 to –0.93**)	B2 (B1)	**2**	AWFW; do not ignore sign (0.47143) AWFW; either
(ii)	Sum_5 = 0 – [–0.65 + (c)(i)] = **+0.17 to +0.19** = **–0.17 to –0.19 or +1.11 to +1.13**	B2 (B1)	**2**	Or **sum** of remaining 5 residuals (–0.504, –0.179, 0.246, 0.896, –0.279) AWFW; do not ignore sign (0.18214) AWFW; do not ignore sign
SC	**1** Use of $\text{Sum}_7 = 0$ to obtain (realistic)$\text{Sum}_5 = -\text{Sum}_2$ ⇒ M1			