**1.** (a) B1 B1 2

**Note**

1st B1 for at least 4 points correct (allow ± one 2mm square)
2nd B1 for all points correct (allow ± one 2 mm square

(b) The **points** lie reasonably close to a straight **line** (o.e.) B1 1

**Note**

Ignore extra points and lines
Require reference to points and line for B1.

(c) $\sum d = 27.7, \quad \sum f = 146$ (both, may be implied) B1

$S_{dd} = 152.09 - \dfrac{(27.7)^2}{6} = 24.208\ldots..$ **awrt 24.2** M1 A1

$S_{fd} = 723.1 - \dfrac{27.7 \times 146}{6} = 49.06\ldots.$ **awrt 49.1** A1 4

**Note**

M1 for a correct method seen for either – a correct expression
1st A1 for $S_{dd}$ awrt 24.2
2nd A1 for $S_{fd}$ awrt 49.1

(d) $b = \dfrac{S_{fd}}{S_{dd}} = 2.026\ldots$ **awrt <u>2.03</u>** M1 A1

$a = \dfrac{146}{6} - b \times \dfrac{27.7}{6} = 14.97\ldots$ so ***f* = 15.0 + 2.03*d*** M1 A1 4

**Note**

1st M1 for a correct expression for $b$ – can follow through their answers from (c)
2nd M1 for a correct method to find $a$ – follow through their $b$ and their means
2nd A1 for $f$ = .... in terms of $d$ and all values awrt given expressions. Accept 15 as rounding from correct answer only.

(e) A flight costs **£2.03 (or about £2)** for every extra **100km** or about **2p** per **km**. B1ft 1

**Note**

Context of cost and distance required. Follow through their value of $b$

(f) $15.0 + 2.03d < 5d$ so $d > \dfrac{15.0}{(5 - 2.03)} = 5.00 \sim 5.05$ M1

So $t >$ 500~505 A1 2

**Note**

M1 for an attempt to find the intersection of the 2 lines. Value of $t$ in range 500 to 505 seen award M1.
Value of $d$ in range 5 to 5.05 award M1.
Accept $t$ greater than *500* to 505 inclusive to include graphical solution for M 1A1

**[14]**

**2.** (a) $S_{pp} = 106397 - \dfrac{833^2}{7} = 7270$ M1 A1

$S_{pp} = 42948 - \dfrac{341 \times 833}{7} = 2369,$

$S_{tt} = 18181 - \dfrac{341^2}{7} = 1569.42857\ldots.$ or $\dfrac{10986}{7}$ A1 A1 4

**Note**

M1 for at least one correct expression

1st A1 for $S_{pp}$ = 7270, 2nd A1 for $S_{tp}$ = 2369 or 2370,
3rd A1 for $S_{tt}$ = awrt 1570

(b) $r = \dfrac{2369}{\sqrt{7270 \times 1569.42857...}}$ M1 A1ft

$= 0.7013375$ **awrt (0.701)** A1 3

**Note**

M1 for attempt at correct formula and at least one correct value (or correct ft) M0 for $\dfrac{42948}{\sqrt{106397 \times 18181}}$

A1ft All values correct or correct ft. Allow for an answer of 0.7 or 0.70 Answer only: awrt 0.701 is 3/3, answer of 0.7 or 0.70 is 2/3

(c) (Pmcc shows positive correlation.)

Older patients have higher blood pressure B1 1

**Note**

B1 for comment in context that interprets the fact that correlation is positive, as in scheme.

Must mention age and blood pressure in words, not just "*t*" and "*p*".

(d) Points plotted correctly on graph: –1 each error or omission

(within one square of correct position) B2 2

**Note**

Record 1 point incorrect as B1B0 on epen. [NB overlay for (60, 135) is slightly wrong]

(e) $b = \dfrac{2369}{1569.42857...} = 1.509466...$ M1 A1

$a = \dfrac{833}{7} - b \times \dfrac{341}{7} = 45.467413...$ M1

$P = 45.5+1.51t$ A1 4

**Note**

1st M1 for use of the correct formula for *b*, ft their values from (a)

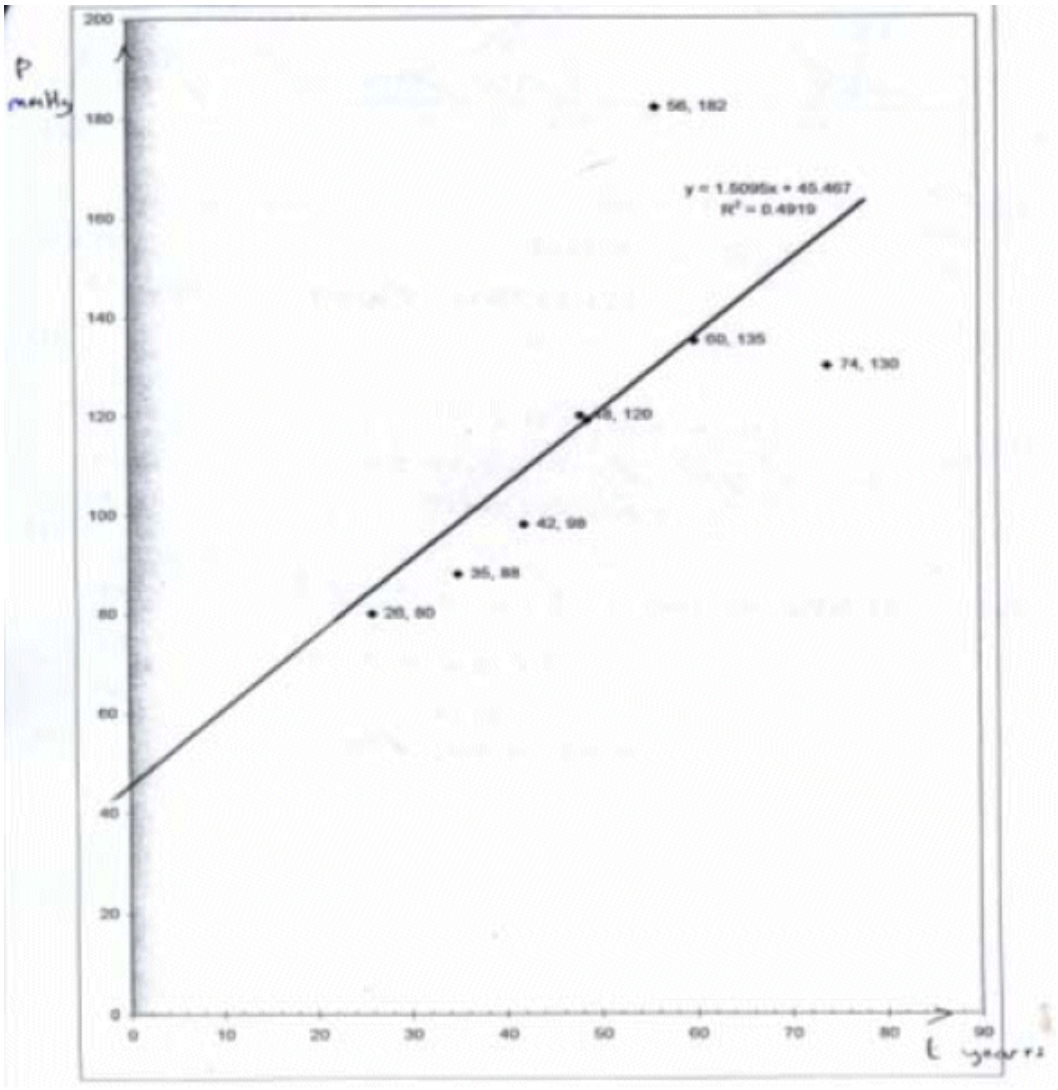
1st A1 allow 1.5 or better

2nd M1 for use of $\bar{y} - b\bar{x}$ with their values

2nd A1 for full equation with *a* = awrt 45.5 and *b* = awrt 1.51. Must be *p* in terms of *t*, not *x* and *y*.

(f) Line drawn with correct intercept, and gradient B1ft B1 2

Diagram for (d) + (f)




**Note**

1st B1ft ft their intercept (within one square). You may have to extend their line.

2nd B1 for correct gradient i.e. parallel to given line (Allow 1 square out when $t = 80$)

(g) $t = 40$, $p = 105.84...$ from equation or graph. **awrt 106** M1 A1 2

**Note**

M1 for clear use of their equation with $t = 40$ or correct value from their graph.

A1 for awrt 106. Correct answer only (2/2) otherwise look for evidence on graph to award M1

**[18]**

**3.** (a) $b = \dfrac{59.99}{33.381}$ M1

$= 1.79713…..$ 1.8 or awrt 1.80 A1

$a = 32.7 – 1.79713… \times 51.83$ M1

$= – 60.44525…$ awrt –60 A1

$w = – 60.445251… + 1.79713… l$ $l$ and $w$ required and awrt 2sf A1ft 5

**Note**

Special case

$b = \dfrac{59.99}{120.1} = 0.4995$ M0A0

$a = 32.7 – 0.4995 \times 51.83$ M1A1

$w = 6.8 + 0.50l$ at least 2 sf required for A1

(b) $w = – 60.445251… + 1.79713… \times 60$ M1

$= 47.3825…$ In range 47.3 – 47.6 inclusive A1 2

**Note**

Substitute into their answer for (a) for M1

(c) It is extrapolating so (may be) unreliable. B1 B1dep 2

**Note**

'Outside the range on the table' or equivalent award first B1

**[9]**

**4.** (a) $S_{xx} = 57.22 - \frac{(21.4)^2}{10} = 11.424$ M1

A1

$S_{xy} = 313.7 - \frac{21.4 \times 96}{10} = 108.26$ A1 3

**Note**

M1 for a correct expression
1st A1 for AWRT 11.4 for $S_{xx}$
2nd A1 for AWRT 108 for $S_{xy}$
Correct answers only: One value correct scores M1 and appropriate A1, both correct M1A1A1

(b) $b = \frac{S_{xy}}{S_{xx}} = 9.4765...$ M1 A1

M1

$a = \bar{y} - b\bar{x} = 9.6 - 2.14b = (-10.679...)$ M1 4

$y = -10.7 + 9.48x$

**Note**

1st M1 for using their values in correct formula

1st A1 for AWRT 9.5

2nd M1 for correct method for $a$ (minus sign required)

2nd A1 for equation with $a$ and $b$ AWRT 3 sf (e.g. $y = -10.68 + 9.48x$ is fine)
Must have a full equation with $a$ and $b$ correct to awrt 3 sf

(c) Every (extra) hour spent using the programme produces about 9.5 marks improvement B1ft 1

**Note**

B1ft for comment conveying the idea of *b* marks per hour. Must mention value of $b$ but can ft their value of $b$. No need to mention "extra" but must mention "marks" and "hour(s)" e.g. "…9.5 times per hour …" scores B0

(d) $y = -10.7 + 9.48 \times 3.3, = 20.6$ awrt 21 M1, A1 2

**Note**

M1 for sub $x = 3.3$ into their regression equation from the end of part (b)
A1 for awrt 21

(e) Model may not be valid since [8h is] outside the range [0.5 – 4]. B1 1

**Note**

B1 for a statement that says or implies that it may not be valid because outside the range.
They do not have to mention the values concerned here namely 8 h or 0.5 – 4

**[11]**

**5.** (a) $S_{tt} = 10922.81 - \frac{401.3^2}{15} = 186.6973$ awrt 187 M1A1

$S_{vv} = 42.3356 - \frac{25.08^2}{15} = 0.40184$ awrt 0.402 A1

$S_{tv} = 677.971 - \frac{401.3 \times 25.08}{15} = 6.9974$ awrt 7.00 A1 4

M1 any one attempt at a correct use of a formula.
Award full marks for correct answers with no working.
Epen order of awarding marks as above.

(b) $r = \frac{6.9974}{\sqrt{186.6973 \times 0.40184}}$ M1A1ft

$= 0.807869$ awrt 0.808 A1 3

M1 for correct formula and attempt to use
A1ft for their values from part (a)
NB Special Case for $\frac{677.971}{\sqrt{10922.81 \times 42.3356}}$ M1A0
A1 awrt 0.808
Award 3 marks for awrt 0.808 with no working

(c) *t* is the explanatory variable as we B1
can control temperature but not frequency of noise or
equivalent comment B1 2

Marks are independent.
Second mark requires some interpretation in context and can be statements such as 'temperature effects / influences pitch or noise'
B1 'temperature is being changed' BUT B0 for 'temperature is changing'

(d) High value of *r* or *r* close to 1 or Strong correlation B1 1

(e) $b = \frac{6.9974}{186.6973} = 0.03748$ awrt 0.0375 M1A1

$a = \frac{25.08}{15} - b \times \frac{401.3}{15} = 0.6692874$ awrt 0.669 M1A1 4

M1 their values the right way up
A1 for awrt 0.0375
M1 attempt to use correct formula with their value of $b$
A1 awrt 0.669

(f) $t = 19$, $v = 0.6692874 + 0.03748 \times 19 = 1.381406$ awrt 1.4 B1 1

awrt 1.4

**[15]**

**6.** (a) $\sum x = \sum t = 337.1, \quad \sum y = 16.28$ B1 B1

*Can be implied*

$S_{xy} = 757.467 - \frac{337.1 \times 16.28}{8} = 71.4685$ M1 A1

*either method, awrt 71.5*

$S_{xx} = 15965.01 - \frac{337.1^2}{8} = 1760.45875$ A1 5

*awrt 1760*

(b) $b = \frac{71.4685}{1760.45875} = 0.04059652$ M1 A1

*÷ correct way up, awrt 0.0406*

$a = \frac{16.28}{8} - b \times \frac{337.1}{8} = 0.324364$ M1 A1

*using correct formula, awrt 0.324*

$y = 0.324 + 0.0406x$ A1ft 5

*3 sf or better but award for copying from above*

(c) At $t = 40$, $x = 40$, $y = 1.948$, $l = 2461.948$ M1 A1 A1ft 3

*sub x = 40, awrt 1.95, awrt 2461.95*

(d) $l - 2460 = 0.324 + 0.0406t$ M1

*LHS required*

$l = 2460.324 + 0.0406t$ A1 2

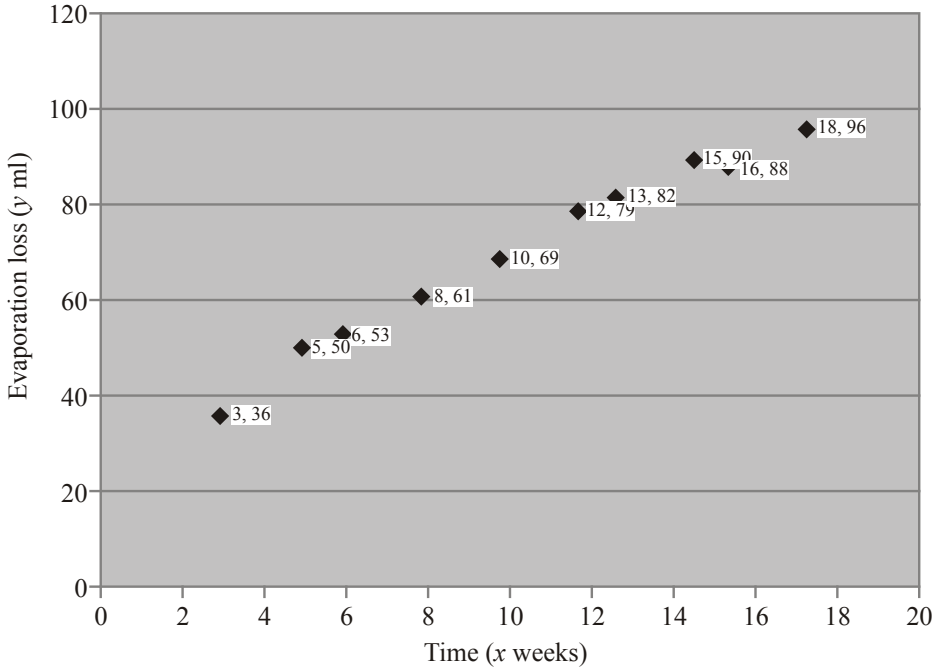
*awrt 2460.32 f.t. their 0.0406, l and t*

(e) at $t = 90$, $l = 2463.978$ B1 1
*awrt 2464*

(f) 90 °C outside range of data B1
unlikely to be reliable B1 2

**[18]**

**7.** (a) Sensible graph scales, labels, shape B1, B1, B1 3




(b) Points lie close to a straight line B1 1

(c) $S_{xy} = 8354 - \frac{106 \times 704}{10} = 891.6$ B1

$S_{xx} = 1352 - \frac{106^2}{10} = 228.4$ B1

$b = \frac{891.6}{228.4} = 3.903677 \ldots$ awrt 3.9 M1 A1

$a = \frac{704}{10} - b\ \frac{106}{10} = 29.021015 \ldots$ awrt 29 M1 A1

29.02, 3.90 A1ft 7

(d) For every extra week in storage, another 3.90 ml of chemical evaporates B1 1

(e) (i) 103.12
(ii) 165.52 B1 B1 2

(f) (i) Close to range of $x$ , so reasonably reliable B1, B1

(ii) Well outside range of $x$, B1
could be unreliable since no evidence that model will
continue to hold B1 4

**[18]**

**8.** (a) $S_{xy} = 8880 - \frac{130 \times 48}{8} = (8100)$ B1

*may be implied*

$S_{xx} = 20487.5$

$b = \frac{S_{xy}}{S_{xx}} = \frac{81000}{20487.5} = 0.395363\ldots$ M1 A1

*Allow use of their $S_{xy}$ for M*
*awrt 0.395*

$a = \frac{48}{8} - (0.395363...)\frac{130}{8} = -0.424649\ldots$ M1 A1

*allow use of their b for M*
*awrt –0.425*

$y = -0.425 + 0.395x$ B1ft 6

*3s.f.*
*Special case answer only B0 M0 B1 M0 B1 B1*
*(fully correct 3sf)*
*(≡ to B0 M0 A1 M0 A1 B1 on the epen)*

(b) $f - 100 = -0.424649\ldots + 0.395\ldots (m - 250)$ M1 a1ft

*subst $f - 100$ & $m - 250$*

$f = 0.735 + 0.395m$ A1 3

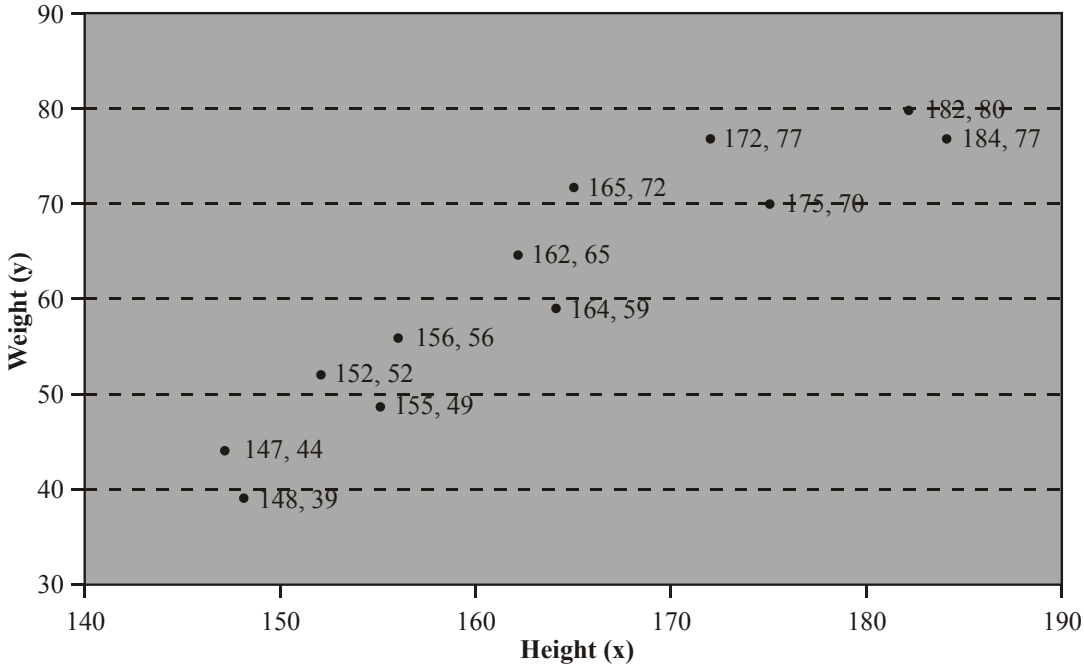
*3 s.f.*

(c) $m = 235 \Rightarrow f = 93.64489\ldots$ B1 1

*awrt 93.6/93.7*

**[10]**

**9.** (a)




| | | | |
|---|---|---|---|
| | sensible scales | B1 | |
| | labels | B1 | |
| | shape | B1 | 3 |

(b) Positive; as $x$ increases, $y$ increases B1;B1g 2

*context OK*

(c) $S_{xy} = 122783 - \dfrac{1962 \times 740}{12} = 1793$ M1A1 2

*use of formula, cao*

(1793 only M1A1)

(d) $b = \dfrac{S_{xy}}{S_{xx}} = \dfrac{1793}{1745} = 1.027507\ldots$ M1A1 2

*division, 1.028*

(**SR** 1.028 B1 only)

(e) $\bar{y} = \frac{740}{12} = 61\frac{2}{3}$ B1

*$61\frac{2}{3}$ or $61.\dot{6}$ or 61.7*

$s = \sqrt{\frac{47746}{12} - \left(\frac{740}{12}\right)^2} = 13.26859$ M1A1 3

*Use of formula including root, 13.3 or 13.9*

(**SR** 13.3 or 13.9 B1 only)

(f) 34-36, 87-89 B1B1 2

*strict limits,3sf or better*

(g) All values between their 35.7 and their 87.7 so could be normal.
Reason required B1 1

**[15]**

**10.** (a) $b = \frac{S_{xy}}{S_{xx}} = \frac{3477.6}{4402} = 0.7900\ldots$ B1

*awrt0.79*

$a = \bar{y} - b\bar{x} = 28.6 - (0.7900\ldots) \times 36 = 0.159836\ldots$ B1

*awrt 0.16*

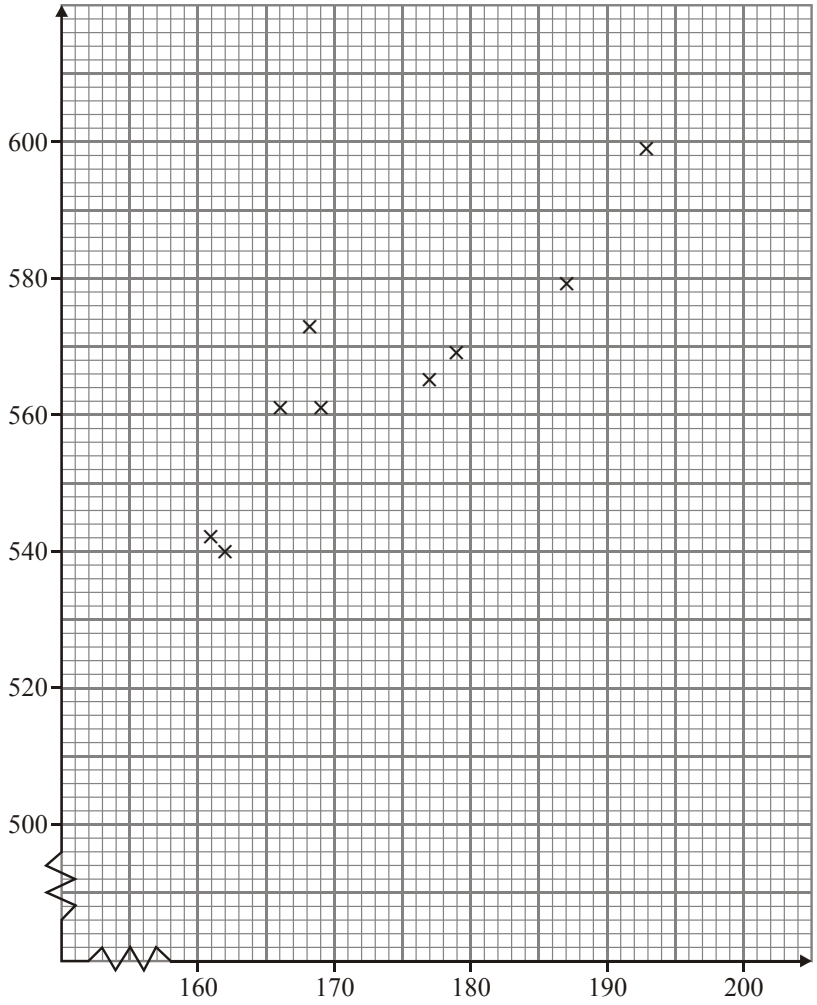
$y = 0.16 + 0.79x$ B1ft 3

*or equivalent*

(b) **OR** just answer B1 ONLY
$y = 0.16 + 0.79 \times 45 = 35.71$ awrt 35.7 B1 1

**[4]**

**11.** (a)




| | | |
|---|---|---|
| Labels (not $x$, $y$) | B1 | |
| Sensible scales allow axis interchange | B1 | |
| Points | B2 | 4 |

*(–1 ee)*

(b) $S_{hc} = 884484 - \dfrac{1562 \times 5088}{9} = \underline{1433\frac{1}{3}}$ M1

*correct use of S*

$1433\frac{1}{3}$; $1433.\dot{3}$ A1

$S_{hh} = 1000\frac{2}{9}$ ; $S_{cc} = 2550$ A1; A1 4

*$1000\frac{2}{9}$, $1000.\dot{2}$ ; 2550*

*(NB: accept :- 9; i.e.:- $159\frac{7}{27}$ ; $111\frac{11}{81}$ ; $283\frac{1}{3}$)*

(c) $r = \dfrac{1433\frac{1}{3}}{\sqrt{1000\frac{2}{9} \times 2550}}$ M1

*substitution in correct formula*

$= \underline{0.897488\ldots}$ A1 ft A1 3

*AWRT 0.897(accept 0.8975)*

(d) Taller people tend to be more confident B1 1

*context*

(e) $b = \dfrac{1433.\dot{3}}{1000.\dot{2}} = \underline{1.433014\ldots..}$ M1

$a = \dfrac{5088}{9} - \dfrac{1433.\dot{3}}{1000.\dot{2}} \times \dfrac{1562}{9} = \underline{316.6256\ldots}$ M1

*allow use of their b*

$\therefore \underline{c = 317 + 1.43h}$ (3sf) A1 3

(f) $h = 180 \Rightarrow c = 574.4$ or $574.5683\ldots$ M1

*subt. of 180*

574 – 575 A1 2

(g) $161 \leq h \leq 193$ B1 1

**[18]**

*NB (a) No graph paper ⇒ 0/4*

**12.** (a) $\Sigma m = 150$; $\Sigma m^2 = 5500$

$\Sigma t = 71.6$; $\Sigma t^2 = 930$; $\Sigma mt = 2147$ B1

*5500 & 2147 seen*

$S_{mt} = 2147 - \dfrac{150 \times 71.6}{6} = \underline{357}$ M1 A1

*Accept* $\dfrac{357}{60} = 59.5$

$S_{mm} = 5500 - \dfrac{150^2}{6} = \underline{1750}$ A1 4

*Accept* $291.\dot{6}$

No working shown SR: B1 B1 only

(b) $b = \frac{357}{1750} = \underline{0.204}$ M1

$a = \frac{71.6}{6} - 0.204 \times \frac{150}{6} = \underline{6.8\dot{3}}$ M1

$\therefore \underline{t = 6.83 + 0.204\ m}$

No working seen SR: t = 6.83 + 0.204m B1 only A1 3

*Accept* $6.8\dot{3}$, *6.83,* $6\frac{5}{6}\%$

(c) $7.35 \Rightarrow m = 35$

$\therefore t = 6.8\dot{3} + 0.204 \times 35 = \underline{13.97\dot{3}}$ M1 A1 2

*14.0 AWRT*

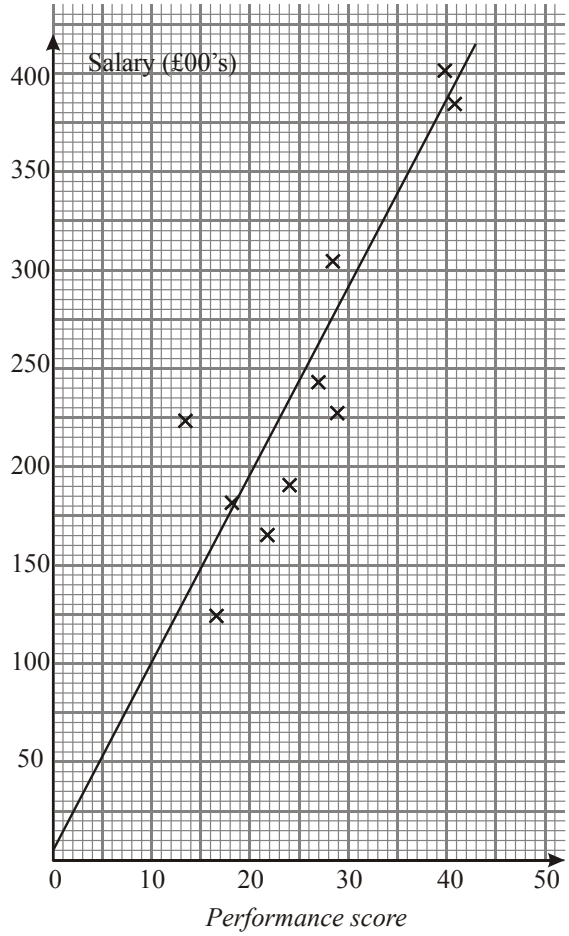
(d) (i) $9.00 \Rightarrow m = 120$

No; outside range of data (after 7.50 am) B1; B1

(ii) No; No evidence model will apply one month later B1; B1 4

**[13]**

**13.** (a)




Scales and labels B1
Accept x, y points B3 4
*(–1e.e.)*

(b) $S_{xy} = 69798 - \dfrac{256 \times 2465}{10} = \underline{6694}$

*256, 2465 in (b)* B1
$S_{xy}$ *or* $S_{xx}$ M1

$S_{xx} = 7266 - \dfrac{256^2}{10} = \underline{712.4}$

*6694* B1
*712.4* B1

SR: No working ⇒ B0 M0 B1 B1 4

(c) (i) $b = \frac{6694}{712.4} = \underline{9.3964\ldots}$ M1 A1

*(their $S_{xy}$ and $S_{xx}$) AWRT 9.40*

$a = \frac{2465}{10} - \frac{6694}{712.4} \times \frac{256}{10} = \underline{5.95199}\ldots$ M1

*Using their values*

$\therefore \underline{y = 5.95 + 9.40x}$ A1 ft

*3.s.f.*

(ii) Line on graph B1 5

By eye Not through origin. Accept broken scales

(d) Salary increases by £940 for every 1 point performance increase B1 ft 1

(e) $x = 35 \Rightarrow y = 334.95$ M1

*Evidence – calculation or graph*

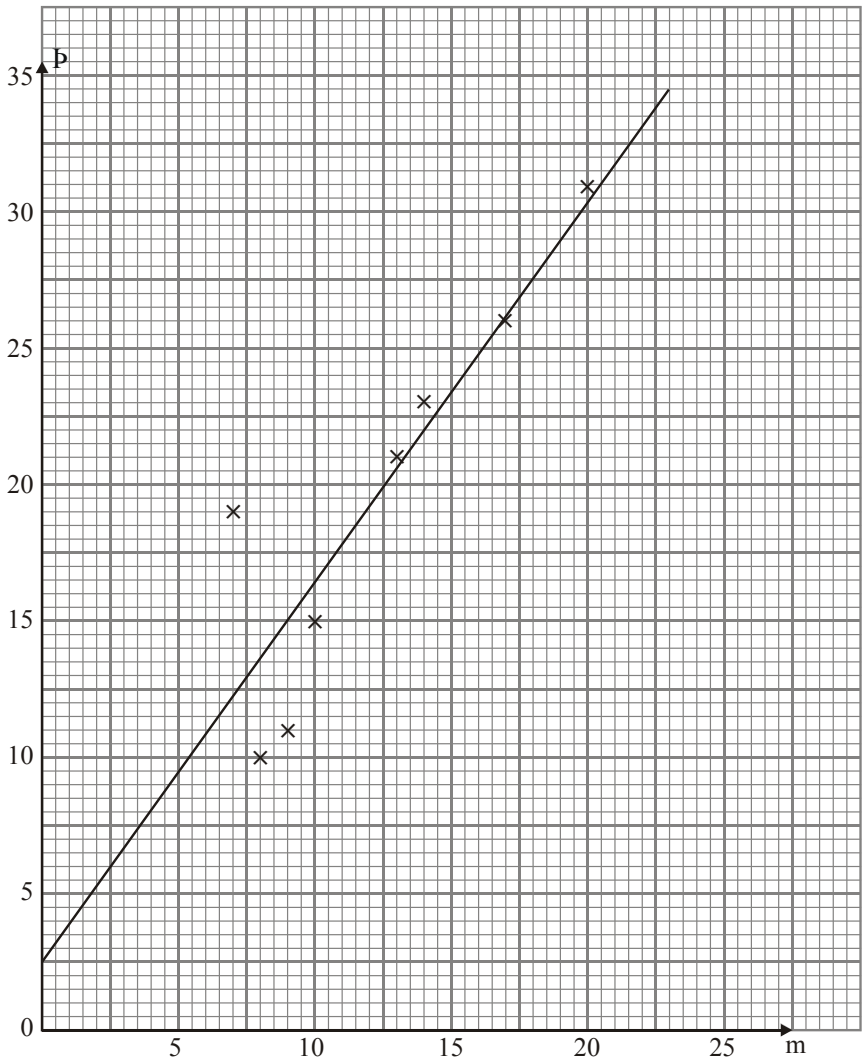
Salary is £33,495 A1 2

*33,000 – 34,000*

**[16]**

**14.** (a) *m* is explanatory variable B1 1

(b)




scales and labels B1
points B2
(6,7 points) B1 3

Line M1 A1

(c) $\Sigma m = 98$; $\Sigma p = 156$; $\Sigma m^2 = 1348$; $\Sigma mp = 2119$

$S_{mp} = 2119 - \frac{98 \times 156}{8} = 208$ M1 A1

$S_{mm} = 1348 - \frac{98^2}{8} = 147.5$ A1

$\therefore b = \frac{S_{mp}}{S_{mm}} = \frac{208}{147.5} = 1.410169$ (awrt 1.41) M1 A1

$a = \frac{156}{8} - (1.410169\ldots) \times \frac{98}{8} = 2.225429$ (awrt 2.23) M1 A1

$\therefore$ p = 2.23 + 1.41m A1 ft 8

(d) Line on graph M1 A1 2

(e) $p = 2.23 + 1.41 \times 15 = 23.38$ M1 A1 2

**[14]**

**15.** (a)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $x$ | 20 | 26 | 32 | 34 | 37 | 44 | 48 | 50 | 53 | 58 |
| $y$ | 24 | 38 | 42 | 44 | 43 | 52 | 59 | 66 | 70 | 79 |

B1

Change in cost of advertising influences number of new car sales B1

Graph: Scale and labels B1

Points all correct B2 5

(b) $S_{xy} = 22611 - \frac{402 \times 517}{10} = 1827.6$ M1 A1

$S_{xx} = 17538 - \frac{402^2}{10} = 1377.6$ A1

$b = \frac{S_{xy}}{S_{xx}} = \frac{1827.6}{1377.6} = 1.326655\ldots$ M1 A1

$a = \frac{517}{10} - (1.326655\ldots) \times \frac{402}{10} = -1.63153\ldots$ B1

$\therefore y = -1.63 + 1.33x$ B1 ft 7

(c) $\frac{c - 4000}{10} = -1.63 + 1.33(p - 100)$ M1 A1 ft

$c = 2653.7 + 13.3p$ A1 3

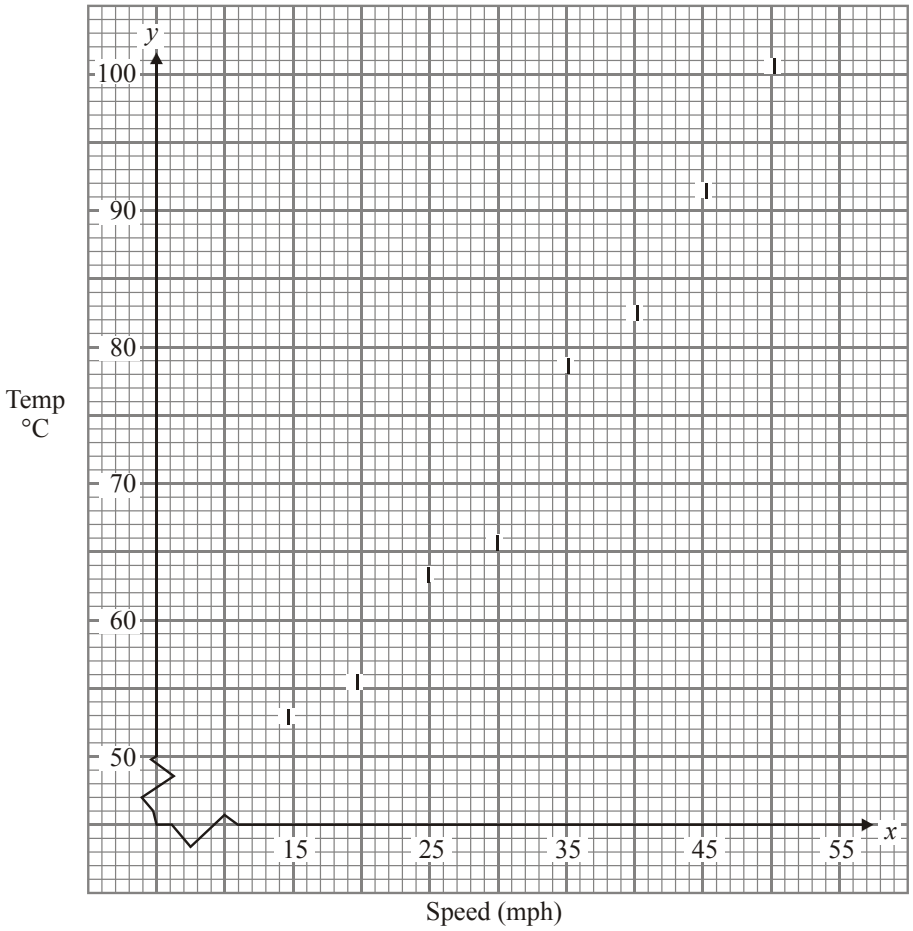
(d) No. sold if no money spent on advertising B1

$p = 0$ is well outside valid range – meaningless B1 2

(e) $2 \times 13.3 = 27$ extra cars sold B1
Only valid in range of data for 1990s B1 2

**[19]**

**16.** (a)




Scales & labels B1
Points B2, 1, 0 3

(b) Points lie reasonably close to a straight line B1 1

(c) $b = \dfrac{8 \times 20615 - 260 \times 589}{8 \times 9500 - (260)^2} = \dfrac{11780}{8400} = 1.40238\ldots$

(accept awrt 1.40) M1 A1

$a = \dfrac{589}{8} - (1.40238\ldots)\left(\dfrac{260}{8}\right) = 28.0476175\ldots$

(accept awrt 28.0) M1 A1 4

$\therefore \quad y = 28.0 + 1.40\,x$

(d) $a \Rightarrow$ surrounding air temperature when tyre is stationary B1

$b \Rightarrow$ for every extra mph, temperature rises by 1.40 °C B1 2

(e) $y = 28.0 + 1.40 \times 50 = 98$ B1

Regression line is only a line of best fit and does not necessarily pass through all points B1 2

12 mph – reasonable to use line; 12 is just below lowest $x$-value B1; B1

85 mph – not reasonable to use line; 85 is well outside range of values B1; B1 4

**[16]**