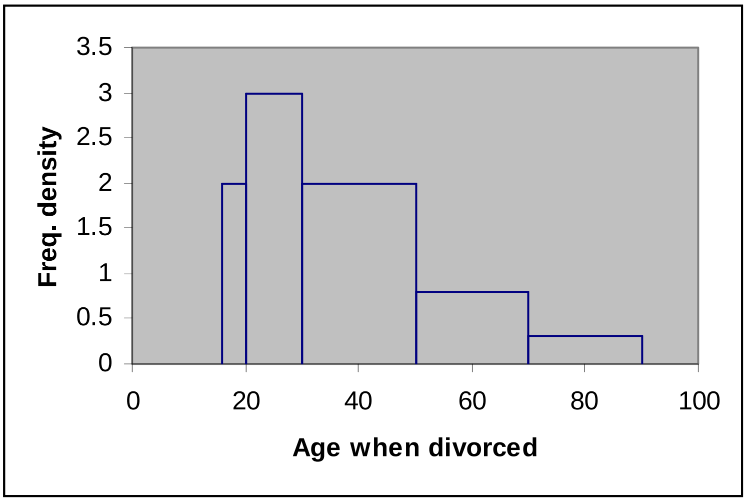
S1 2641/1 Jun 2003 Mark Scheme Post_Coordination

1 **(i)** A B C D E F G Teach. 1 2 4 7 6 3 5 Mod. 2 1 6 7 5 3 4 d –1 1 –2 0 1 0 1 d^2 1 1 4 0 1 0 1	**B1** **M1** **M1** **A1** **4**	Correct ranks (or reversed) Values of d or d^2 found from ranked data. Correct formula for Spearman used with ranked or unranked data Correct answer, a.r.t. 0.857 or $^{6k}/_{7k}$

Now $\Sigma d^2 = 8$ so that $r_s = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$ $= 1 - \frac{6 \times 8}{7 \times 48} = \mathbf{\frac{6}{7}}$ $=$ **0.857**…		
(ii) Since r_s is quite close to 1 you can say that there seems to be good agreement as to order between the teacher and the moderator. However, the individual marks do not seem to agree very well.	**B1** **1**	Comment that states r_s is (quite) close to 1 so there is good agreement **or** that the *actual* marks differ.
2 (i) $P(X = 4) = 0.6^3 \times 0.4 =$ **0.0864 AG**	**M1** **A1** **2**	Use of q^3p Correct answer, 0.0864
(ii) $P(4 \le X < 9) = P(X > 3) - P(X > 8) = 0.6^3 - 0.6^8$ $= 0.199203\ldots =$ **0.199** (3 s.f) ALITER: $P(4 \le X < 9) = 0.4 \times 0.6^3 + \ldots + 0.4 \times 0.6^7 =$ **0.199**	**M1** **M1** **A1** **3**	Attempt at $P(4 \le X < 9)$ Wholly correct method Correct answer, a.r.t. 0.199
(iii) $E(X) = 1/0.4 =$ **2.5**	**B1** **1**	Correct answer, 2.5 or ${}^{5k}/_{2k}$
3(i) No. of different hands $= {}^{52}C_5 =$ **2 598 960**	**B1** **1**	Correct answer, 2 598 960
(ii) No. of hands with 3 spades and 2 clubs $= {}^{13}C_3 \times {}^{13}C_2$ $= 286 \times 78$ $=$ **22 308**	**M1** **A1** **2**	${}^{13}C_3$ *and* ${}^{13}C_2$ seen Correct answer, 22 308
(iii) No. of hands with exactly3 spades $= {}^{13}C_3 \times {}^{39}C_2$ $= 286 \times 741$ $=$ **211 926**	**M1** **A1** **2**	${}^{13}C_3$ *and* ${}^{39}C_2$ seen Correct answer, 211 926
(iv) P(3 spades and 2 clubs) $= {}^{22\,308}/_{2\,598\,960}$ $\frac{5!}{3! \times 2!}$ $\frac{5!}{3! \times 2!}$ $= {}^{143}/_{16660}$ $= 0.008583\ldots$ $=$ **0.00858**(3s.f.) ALITER **(iv)** P(3 spades and 2 clubs) $= \ {}^{13}/_{52} \times {}^{12}/_{51} \times {}^{11}/_{50} \times {}^{13}/_{49} \times {}^{12}/_{48} \times$	**M1** **A1** **2** **M1** **A1** **2**	*Their* **(ii)** ÷ *their* **(i)** Correct answer, a.r.t. 0.00858 or ${}^{143k}/_{16660k}$ ${}^{13}/_{52} \times {}^{12}/_{51} \times {}^{11}/_{50} \times {}^{13}/_{49} \times {}^{12}/_{48}$ **or** × a product of 5 fractions *seen* Correct answer, a.r.t. 0.00858

4 (i)

Class	Width	freq	Freq. Density = Freq÷ class width
$16 \le a < 20$	4	8	2
$20 \le a < 30$	10	30	**3**
$30 \le a < 50$	20	40	**2**
$50 \le a < 70$	20	16	**0.8**
$70 \le a < 90$	20	6	**0.3**



B1	At least 3 correct new frequency densities
B1	All frequency densities correct (dep. on first B1)
B1	Correct scales
B1	At least 3 bars correct
B1	Histogram completely correct
5	

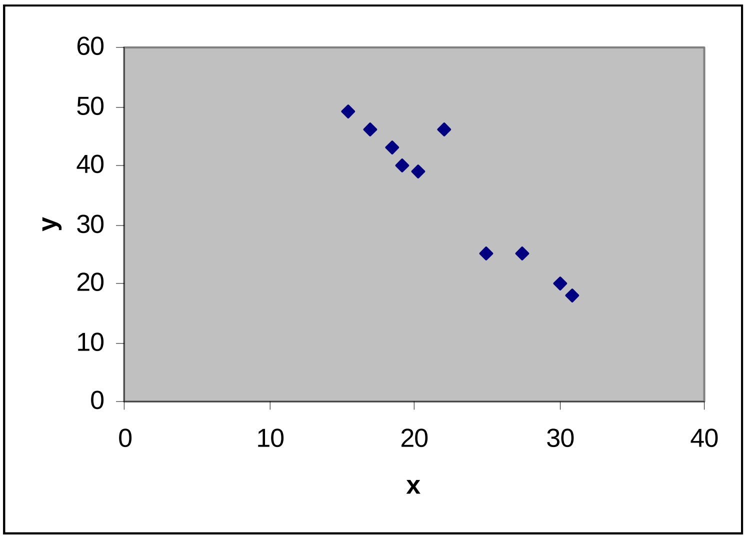
(ii)

Lcb	ucb	freq(f)	centre(x)	xf	$x^2 f$
16	20	8	18	144	2592
20	30	30	25	750	18750
30	50	40	40	1600	64000
50	70	16	60	960	57600
70	90	6	80	480	38400

M1	*Their* $\Sigma xf/\Sigma f$
A1	Correct answer, a.r.t. 39.3
M1	*Their* $\Sigma x^2 f/\Sigma f$,
M1	$\sqrt{[}$*Their* $\Sigma x^2 f/\Sigma f$ – (*their* mean)^2]
A1	Correct answer, a.i.r. 16.3 –16.4
5	Use of calculator can gain full marks

100 3934 181342 Mean = $\Sigma xf/\Sigma f$ = 3934/100 = **39.34** = **39.3** (3 s.f) Standard deviation = $\sqrt{[181342/100 - (39.34)^2]}$ = $\sqrt{265.7844}$= **16.3** (3 s.f.)		

5(i) P(D =2) = P($R_1\cap W_2$) = P(R_1) × P($W_2\|R_1$) = $^{3}/_{5} \times {}^{2}/_{4} = \mathbf{^{3}/_{10}}$ **AG.**	**M1** **A1 2**	Multiplication of $^{3}/_{5} \times p$ Correct answer with correct method clearly shown
(ii) P(D = 3) = P($R_1\cap R_2\cap W_3$) = $^{3}/_{5} \times {}^{2}/_{4} \times {}^{2}/_{3}$ = $\mathbf{^{1}/_{5}}$ P(D = 4) = P($R_1\cap R_2\cap R_3\cap W_4$) = $^{3}/_{5} \times {}^{2}/_{4} \times {}^{1}/_{3} \times {}^{2}/_{2} = \mathbf{^{1}/_{10}}$ Therefore the distribution table is as follows: D 1 2 3 4 P(D=d) $^{2}/_{5}$ $^{3}/_{10}$ $\mathbf{^{1}/_{5}}$ $\mathbf{^{1}/_{10}}$	**M1** **M1** **A1 3**	Substantially correct attempt at *either* P(D =3) *or* P(D =4). Wholly correct attempt at one of P(D =3) *or* P(D =4). Correct answers, P(D =3) = $^{1}/_{5}$ *and* P(D =4) = $^{1}/_{10}$
(iii) E(D) = Σxp = $1 \times {}^{2}/_{5} + 2 \times {}^{3}/_{10} + 3 \times {}^{1}/_{5} + 4 \times {}^{1}/_{10}$ = **2** E(D^2) = $\Sigma x^2 p$ = $1^2 \times {}^{2}/_{5} + 2^2 \times {}^{3}/_{10} + 3^2 \times {}^{1}/_{5} + 4^2 \times {}^{1}/_{10} = 5$ Var(D) = E(D^2) – [E(D)]^2 = 5 – 4 = **1**	**M1** **A1** **M1** **M1** **A1** **5**	Σx × *their p* Correct answer, 2 Σx^2 × *their p* $\Sigma x^2 p$ – [*their* mean]^2 Correct answer, 1
6 (i) S ~ B(7, 0.88)	**B1** **B1** **2**	'Binomial' stated n = 7 *and* p = 0.88
(ii) Prob. of being able to log-on at the first attempt is constant from one day to the next. Whether I can log-on at the first attempt any given day is not affected by whether I have been able (or not) to log-on at the first attempt on any other day	**B1** **B1** **2**	One correct assumption in context Another correct assumption in context
(iii) P(S = 4) = $^{7}C_{4} \times 0.88^{4} \times 0.12^{3}$ = **0.0363** (3 s.f.)	**M1** **M1** **A1** **3**	Use of $^{7}C_{4} \times p^{4} \times q^{3}$ Wholly correct working with $^{7}C_{4} \times 0.88^{4} \times 0.12^{3}$ Correct answer, a.r.t. 0.0363
(iv) E(S) = np = 7 × 0.88 = 6.16 Therefore P(S > E(S)) = P(S = 7) = 0.88^{7} = **0.409** (3 s.f.)	**B1** **M1** **A1** **3**	E(S) = 6.16 seen Attempt to find P(S > *their* E(S)) Correct answer, a.r.t. 0.409

7 (i)  	**B1** **B1** **B1** **3**	Correct scales and labels. Correct general "shape" and 10 points plotted The points with coordinates (22, 46); (25, 25); (27.5, 25) and (30, 20) plotted accurately
(ii) $S_{xy} = \Sigma xy - (\Sigma x) \times (\Sigma y)/n = 7372.8 - (225.8 \times 351)/10$ $= -552.78$ $S_{xx} = \Sigma x^2 - (\Sigma x)^2/n = 5368.9 - (225.8)^2/10$ $= 270.336$ $S_{yy} = \Sigma y^2 - (\Sigma y)^2/n = 13577 - (351)^2/10$ $= 1256.9$ $r = \dfrac{S_{xy}}{\sqrt{S_{xx} \times S_{yy}}} = \dfrac{-552.78}{\sqrt{(270.336 \times 1256.9)}} = -0.948309..$ $=$ **–0.948** (3 s.f.)	**M1** **A1** **2**	Calculator or formula correctly applied Correct answer, a.r.t. –0.948
(iii) There seems to be a strong negative correlation since *r* is close to –1	**B1** **B1** **2**	Strong negative correlation, because *r* is near –1 *or* my graph shows points in a straight line
(iv) $b = S_{xy}/ S_{xx} = -552.78/270.336 = -2.0447\ldots$ $a = \bar{y} - b\bar{x}$ $=$ **–2.04** (3 s.f.) $a = \bar{y} - b\bar{x} = 35.1 - (-2.04\ldots) \times 22.58 = \ldots$ $=$ **81.3** (3 s.f.) So the equation of the line is ***y* = 81.3 – 2.04*x***	**M1** **M1** **A1** **3**	Use of S_{xy}/ S_{xx} (may be implied if calc. used) Using with *their b* (may also be implied) $y = a + bx$, where *a* is a.r.t.81.2 or 81.3 and *b* is a.i.r. (– 2.05) to (– 2.04)
(v) When $x = 28.1$, $y = 81.3 - 2.04\ldots \times 28.1 = 23.81\ldots$ $=$ **23.8**	**B1** **1**	Correct answer, a.i.r 23.75 to 24.0 or 24
(vi) Since the product moment correlation coefficient is unchanged by linear transformations, $r_{uv} = r_{xy} =$ **–0.948**	**B1** **1**	Realising $r_{uv} = r_{xy} =$ –0.948√ if $-1 \le r \le 1$

Supplementary Notes

Question 1

(i) **B1** is for the correct ranks given or for both sets of ranks consistently reversed. The reversed ranks are:

	A	B	C	D	E	F	G
Teacher	7	6	4	1	2	5	3
Moderator	6	7	2	1	3	5	4
d	1	–1	2	0	–1	0	–1

M1 is for an attempt to find d or d^2 from **ranked** data.
M1 is for a correct formula for Spearman **used**. This can be allowed for unranked data as long as it leads to an r_s value such that $|r_s| \le 1$.

A1 is for the correct answer only; either anything rounding to (abbreviated to a.r.t.) 0.857 or a fraction of the form ${}^{6k}/_{7k}$ (where k is assumed to be a positive integer).

Candidates might do this question by applying the P.M.C.C. formula to the ranks. If they decide to do this they get:

$\Sigma x = \Sigma y = 28$, $\Sigma x^2 = \Sigma y^2 = 140$ and $\Sigma xy = 136$, where x denotes the teacher's rank and y denotes the moderator's rank.

This gives $S_{xx} = S_{yy} = 140 - \dfrac{28^2}{7} = 140 - 112 = 28$,

and $S_{xy} = 136 - \dfrac{28^2}{7} = 136 - 112 = 24$

From which $r_s = \dfrac{24}{\sqrt{28 \times 28}} = {}^6/_7 = 0.857...$, as before.

The alternative scheme for this method is:
B1 for wholly correct ranks (as before).
M1 for any one of S_{xy}, S_{xx}, S_{yy} correct (and this could be gained for unranked data).
M1 is for a wholly correct method involving ranks.
A1 is for correct answer only, a.r.t. 0.857 or ${}^{6k}/_{7k}$.

(ii) **B1** is for an appropriate comment which relates the size of **their** r_s to **their** conclusion. If an r_s value has been calculated the statement the candidate makes must be consistent with that value. The only exception is if the candidate refers sensibly to the table and to the differences in the table. If no r_s value is found they must make a sensible comment about the differences between the entries in the table. A value of $|r_s| > 1$ will not be able to score this

B1 if they refer to the value of r_s. Statements such as "good correlation" score **B0**.

Question 2

(i) **M1** is for the geometric probability "pattern" q^3p. q and p may be correct or the reverse of the correct values or indeed **any** p, q pair such that $p > 0$, $q > 0$ and $p + q = 1$.

A1 is for a wholly correct demonstration that $P(X = 4) = 0.0864$ with no wrong working seen.

(ii) **M1** is for **either** an attempt at $P(X > 3)$ or $P(X > 8)$ or $P(X \leq 3)$ or $P(X \leq 8)$ and this will usually appear as q^3 or q^8 or $1 - q^3$ or $1 - q^8$ **or** for those who decide to answer the question by simply adding $P(X = 4) + \ldots P(X = 8)$, **M1** is obtained for at least two of the correct five geometric terms added together. Allow follow through here from an incorrect p, q pair as long as it is consistent with their previous answers.

M1 is for a wholly correct method with only the **correct** p and q scoring.

A1 is for the correct answer, a.r.t. 0.199 or $^{77814k}/_{390\,625k}$.

(iii) **B1** is for 2.5 c.a.o. or $^{5k}/_{2k}$ (where k is assumed to be a positive integer). Unresolved answers such as $\frac{1}{0.4}$ are **not** acceptable.

Question 3

(i) **B1** is for correct answer only 2 598 960. $^{52}C_5$ is **not** acceptable.

(ii) **M1** is for $^{13}C_3$ **and** $^{13}C_2$ **seen**. This would obviously also be awarded for sight of their numerical equivalents 286 and 78.

A1 is for 22 308 c.a.o.

(iii) **M1** is for $^{13}C_3$ **and** $^{39}C_2$ **seen**. This would obviously also be awarded for sight of their numerical equivalents 286 and 741.

A1 is for 211 926 c.a.o.

In this case if the candidate decides to break the problem down into separate cases such as:

3 spades and 2 diamonds : $^{13}C_3 \times {}^{13}C_2$
3 spades and 1 club and 1 diamond : $^{13}C_3 \times {}^{13}C_1 \times {}^{13}C_1$ etc. then there must be at least 2 cases added together for the award of the **M1**.
[There are 6 cases:

3 spades and 2 diamonds: $^{13}C_3 \times {}^{13}C_2 = 286 \times 78 = 22\ 308$
3 spades and 2 hearts: $^{13}C_3 \times {}^{13}C_2 = 286 \times 78 = 22\ 308$
3 spades and 2 clubs: $^{13}C_3 \times {}^{13}C_2 = 286 \times 78 = 22\ 308$
3 spades and 1 club and 1 diamond: $^{13}C_3 \times {}^{13}C_1 \times {}^{13}C_1$
$= 286 \times 13^2 = 48\ 334$
3 spades and 1 club and 1heart: $^{13}C_3 \times {}^{13}C_1 \times {}^{13}C_1$
$= 286 \times 13^2 = 48\ 334$
3 spades and 1 heart and 1 diamond: $^{13}C_3 \times {}^{13}C_1 \times {}^{13}C_1$
$= 286 \times 13^2 = 48\ 334$]
So total = 3 × 22 308 + 3 × 48 334 = 66924 + 145 002 =211 926 as before.

(iv) **M1** is for **their (ii) ÷ their (i)** (as long as it leads to an answer ≤ 1).
They cannot score this **M1** for simply **stating** that the answer is part **(ii)** ÷ part**(i).** You need to see a calculation.

A1 is for c.a.o. a.r.t. 0.00858 or $^{143k}/_{16\ 660k}$.

ALITER
M1 for either $^{13}/_{52} \times {}^{12}/_{51} \times {}^{11}/_{50} \times {}^{13}/_{49} \times {}^{12}/_{48}$ (or equivalent) or for $^{5}C_3 \times p_1 \times p_2 \times p_3 \times p_4 \times p_5$ where $0 \leq p_i \leq 1$ for $i = 1, 2, 3, 4, 5$.

A1 is for c.a.o. a.r.t. 0.00858 or $^{143k}/_{16\ 660k}$ (as before).

Some candidates may decide to do part **(iv)** before part **(ii)** and then to use part **(iv)** to answer part **(ii)**. This is acceptable as long as each part is clearly labelled.
In this case use the mark scheme as written to mark part **(iv)** and then in part **(ii)** award **M1** for their part **(iv)** × their part **(i)** and **A1** as before.

Question 4

(i) **B1** is for at least 3 new correct frequency densities.

B1 (a second **B1** dependent on the first) is for all of the frequency densities correct.

Both of these **B1**s may be implied from the graph if you do not see the frequency densities written down explicitly.

B1 is for both scales correct and both axes labelled.

Acceptable labels for the horizontal axis are *a*, *age*, *years* but **not** *x* and **not** "*class*". Acceptable labels for the vertical axis are frequency density, freq. dens.,"fd" but **not "**frequency", **not** freq., **not** *f* and **not** *y*.

B1 for at least 3 bars at the correct heights and placed at the correct horizontal position. (Allow follow through here from incorrect frequency densities)

B1 is for a completely correct histogram (**not** allowing any follow through).

The last **B1** can be scored for a graph in which the only "error" is the omission of a label.

If a candidate does not use graph paper then the first two B1 marks are available for giving the correct frequency densities but none of the last three **B1** marks can score.

SR **B1** for a perfect histogram drawn with the incorrect scales **or** for a graph which is the correct shape but for which no horizontal scale is given.

(ii) **M1** is for the use of Σ (their midpoints × *f*)/ Σ*f*. So this would not be gained, for example, for $\Sigma xf/5$.

A1 is for a.r.t. 39.3. Do not accept for this accuracy mark an unresolved fraction of the form $^{3934k}/_{100k}$. You may see 39.3 or 39.34 with no working whatsoever because the candidate has done the entire calculation on their calculator. This still scores **M1, A1**. Anything outside the range scores **0**.

M1 is for the use of Σ ([their midpoints]^2 × *f*)/Σ*f*. So this would not be gained, for example, for $\Sigma x^2 f/5$.

M1 is independent of the first and is for √{**their** version of $\Sigma x^2 f/\Sigma f$ – [their mean]^2}. Essentially this method mark is for subtraction of the mean as long as it leads to an answer > 0 and as long as the first term at least resembles a sum of squares. So, for example, $\sqrt{\{[18^2 + 25^2 + \ldots + 80^2]/5 - 39.34^2\}}$would score this **M1**. Note that the square root must be present to score.

A1 is for anything in the range 16.3 to16.4 inclusive. As with the mean you may see no working, but anything in the range score **3** marks otherwise the score is **0**.

ALITER: for those who use the $\dfrac{\sum (x-\bar{x})^2 f}{\sum f}$ formula:

M1 for one term of the form $(x-\bar{x})^2 f$ with a consistent *x*, *f* pair.

M1 for a wholly correct method.

A1 is for anything in the range 16.3 to16.4 inclusive.

Question 5

(i) **M1** is for $^{3}/_{5} \times p$ seen. So, for example, $^{3}/_{5} \times {}^{2}/_{5}$ would score this mark.
A1 is for $^{3}/_{5} \times {}^{2}/_{4}$ seen with no wrong working.

(ii) **M1** is for **either** a triple product of probabilities with at most one incorrect in an attempt at $P(D = 3)$ or for a quadruple product of probabilities with at most one incorrect in an attempt at $P(D = 4)$.
M1 is for one or other of the answers completely correct
A1 is for both answers completely correct.
For both answers completely correct with no working allow all **3** marks. For one answer correct corresponding to the appropriate x value, give **M1,M1** by implication.

(iii) **M1** is for a substantially correct attempt at $\Sigma(x \times$ **their** $p)$. This is lost if the candidate divides this by "n". There must be a sum of at least 2 products to score this mark. It is not necessary for **their** probabilities to sum to 1.
A1 is for the correct answer, 2.

M1 is for a substantially correct attempt at $\Sigma(x^2 \times$ **their** $p)$. This is lost if the candidate divides this by "n". There must be a sum of at least 2 products to score this mark. It is not necessary for **their** probabilities to sum to 1.
M1 is for **their** $\Sigma x^2 p$ – **[their** mean$]^2$ as long as this is > 0.
A1 is for the correct answer, 1.
Beware, the incorrect method

$$\frac{\sum x^2 p}{n} - \left(\frac{\sum xp}{n}\right)^2 = {}^{5}/_{4} - ({}^{2}/_{4})^2 = 1.$$

this should score **M0,M0** but the answer is correct, so you need to be careful that you check the working**.**

ALITER for those using the formula $\Sigma(x - \mu)^2 p$.

M1 for a single, non zero $(x -$ **their** $\mu)^2 p$ with a consistent x, p pair.
M1 for a wholly correct method.
A1 for a correct answer.

Question 6

(i) **B1** is for “binomial” stated or for a recognisable abbreviation B(or Bin(
B1 (dependent) for $n = 7$ **and** $p = 0.88$ (or equiv.) stated. Be generous here unless you are convinced that the parameters are wrong. So, for example, allow B(0.88, 7) to score **B1, B1**.

(ii) **B1** is for one assumption in context.
B1 is for a **clearly distinct** second assumption**.**
The three assumptions allowed are independence, constant probability and two mutually exclusive outcomes but they must be stated in context. “Fixed” trials is given and so does not qualify as an assumption.

(iii) **M1** is for the use of the binomial probability pattern ${}^7C_4 \times p^4 \times q^3$. q and p may be correct or the reverse of the correct values or indeed **any** p, q pair such that $p > 0$, $q > 0$ and $p + q = 1$.
M1 is for a wholly correct method using ${}^7C_4 \times 0.88^4 \times 0.12^3$.
A1 is for a.r.t. 0.0363.

(iv) **B1** is for E(S) = 6.16 seen.
M1 is for a substantially correct attempt at P(S > **their** E(S)).
A1 is for a correct answer, a.r.t. 0.409.

The first **B1** mark can be implied by the calculation of P($S = 7$) but if you do not see an attempt to calculate P($S = 7$), then you must see 6.16 explicitly for this **B1**.

Those who give the geometric as the model in part **(i)** can score a maximum of the two **B1** marks in part **(ii)** and the **M1** mark in part **(iv).**

Question 7

(i) **B1** for a regular scale on both axes sufficient to accommodate all of the points **and** for both axes labelled. The x-axis must be horizontal.
B1 for the graph having the correct general "shape" and all 10 points plotted. You should give this unless you can notice some problem "visually".
B1 for the following points correctly plotted:
(22, 46) (25, 25) (27.5, 25) (30, 20).
Ignore any joining of the points or any lines of best fit plotted.

(ii) **M1** for any of S_{xy}, S_{xx}, S_{yy} correct as long as they appear in a formula which has the structure $\dfrac{a}{\sqrt{(b \times c)}}$

You can also allow terms such as nS_{xy} or $S_{xy} \div n$. Hopefully the three terms would be consistent but they do not have to be. Sight any one of the figures, 270336 or 12569 or 55278 together with a formula of the correct structure would imply **M1.**
A1 is for a.r.t. -0.948.
Candidates may do this entirely on their calculator, in which case they score **M1 A1** for a.r.t. -0.948 and **M0 A0** otherwise.

(iii) **B1** for either saying "strong negative correlation" (and they must have both "strong" and "negative" to score **B1** here) **or** for saying in context something to the effect that, "The more TV you watch the lower your GCSE points score seems to be."
B1 this is awarded for a justification **either** from the size of r **or** from the fact that the points on the scatter diagram lie close to a straight line.
For incorrect r values where the candidate uses the size of r as justification, allow follow through to apply only if $r < -0.8$. Otherwise candidates with incorrect r values can only score this **B1** for justification by referring to their scatter diagram.

(iv) **M1** for their $S_{xy} \div S_{xx}$ or equivalent.
M1 for use of $a = 35.1 -$ **their** $b \times 22.58$
A1 for correct answer $y = a + bx$, where a is a.r.t.81.2 or 81.3 and b is a.i.r. (– 2.05) to (– 2.04)
You can accept for all **3** marks an equation of the form $(y - \bar{y}) = b(x - \bar{x})$ as long as $\bar{y} = 35.1$, $\bar{x} = 22.58$ **or** 22.6 and b is a.i.r. (– 2.05) to (– 2.04).

For candidates who find the x on y line, $x = a' + b'y$, allow **M1**, **M1**, **A0** for those who find a' and b' consistently by using $b' = S_{xy} \div S_{yy}$ and $a' = 22.58 -$ **their** $b' \times 35.1$.
Again candidates may do this on their calculator and show no working. Award all the marks if the answer is in the given range and none if it falls outside this range.

ALITER: for use of the normal equations
M1 for one correct normal equation
M1 (a further **M1**) for a second correct normal equation
A1 for the correct answer with the ranges for *a* and *b* as given before.
The two normal equations are:

$\Sigma y = na + b\Sigma x$	$351 = 10a + 225.8b$
$\Sigma xy = a\Sigma x + b\Sigma x^2$	$7372.8 = 225.8a + 5368.90b$

(v) **B1** for a.i.r 23.75 to 24.0 **or** 24 with no incorrect working seen in this part or in part **(iv)**.

(vi) **B1** for correct answer -0.948 or follow through from part **(ii)** (√) if $-1 \leq r \leq 1$.