

Note: "(3 sfs)" means "answer which rounds to ... to 3 sfs". If correct ans seen to ≥ 3 sfs, ISW for later rounding
 Penalise over-rounding only once in paper.

i	590	B1 1	Allow approximately 590
ii	Graph horiz (for ≥ 55 mks) oe	B1 1	or levels off, or grad = 0, grad not increase Allow line not rise, goes flat, plateaus, stops increasing, not increase, doesn't move
iii	39 to 41	B1 1	
iv	Attempt read cf at 26 or 27 Double & attempt read x Max C = 29 to 31.5	M1 M1 A1 3	eg 26 mks \rightarrow 150 th 27 mks \rightarrow 180 th eg read at cf = 300 or 360 Indep of first M1 May be implied by ans Answer within range, no working, M1M1A1 32 without working, sc B1
v	LQ = 25.5-26.5 or UQ = 34-35.5 IQR = 8-10 (German) more spread	M1 A1 B1ft 3	M1 for one correct quartile dep ≥ 1 correct quartile or no working or less consistent, less uniform, less similar, more varied, more variable, greater variance, more spaced apart, further apart ft their IQR; must be consistent with IQR Correct comment with no working: M0A0B1
Total		9	
2i	Opposite orders or ranks or scores or results or marks $r_s = -1$	B1 1	or reversed, or backwards, or inverse or as one increases the other decreases Needs reason AND value
ii	Attempt Σd^2 (= 6) $1 - \frac{6 \times \Sigma d^2}{3(3^2 - 1)}$ $= -\frac{1}{2}$ oe	M1 M1 A1 3	dep 1 st M1 Allow use wrong table for M1M1
iii	3! or 3P_3 or 6 1 \div their '6' $\frac{1}{6}$ oe eg $\frac{6}{36}$	M1 M1 A1 3	r attempt list possible orders of 1,2,3 (≥ 3 orders) 2 nd M1 for fully correct method only or $\frac{1}{3} \times \frac{1}{2} (\times 1)$: M1M1
Total		7	
3i	If x is contr (or indep) or y depend't, use y on x If neither variable contr'd (or indep) AND want est y from x : use y on x	B1 B1 2	Allow x increases constantly, is predetermined, you choose x , you set x , x is fixed, x is chosen Allow y not controlled AND want est y from x Ignore incorrect comments
iiia	$S_{xx} = 510000 - \frac{1800^2}{9}$ (= 150000) $S_{xy} = 4080 - \frac{1800 \times 14.4}{9}$ (= 1200) $b = \frac{1200}{150000}$ (= 0.008) $y - \frac{14.4}{9} = 0.008(x - \frac{1800}{9})$ $y = 0.008x (+ 0)$	M1 M1 M1 A1 4	or $\frac{510000}{9} - 200^2$ (= 16666.7) or $\frac{4080}{9} - 200 \times 1.6$ (= 133.33) M1 for either S $b = \frac{133.33}{16666.7}$ dep correct expressions both S's or $a = \frac{14.4}{9} - 0.008 \times \frac{1800}{9}$ (= 0) Must be all correct for M1 CAO
iib	312.5 or 313	B1ft 1	ft their equn in (iia)
iic	-0.4	B1ft 1	ft their equn in (iia)

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iid	Contraction oe Unreliable because extrapolated oe	B1(ft) B1 2	or length decreased, shorter, pushed in, shrunk, smaller or not in the range of x or not in range of previous results
Total		10	
4ia	0.299 (3 sf)	B1 1	
ib	0.2991 – 0.1040 = 0.195 (3 sf) or $\frac{1280}{6561}$ oe	M1 A1 2	Must subtract correct pair from table
iii	${}^{15}C_4 \times (1-0.22)^{11} \times 0.22^4$ = 0.208 (3 sf)	M1 A1 2	Allow M1 for ${}^{15}C_4 \times 0.88^{11} \times 0.22^4$
iib	(15 × 0.22 ⇒) 3.3 15 × 0.22 × (1 – 0.22) or ‘3.3’ × (1 – 0.22) = 2.57 (3 sf)	B1 M1 A1 3	Allow M1 for 15 × 0.22 × 0.88
Total		8	
5i	$\frac{1}{2} \times \frac{1}{3}$ or $\frac{2}{4} \times \frac{1}{3}$ or $\frac{1}{4C_2}$ or $\frac{2}{12}$ (= $\frac{1}{6}$ AG) $\frac{1}{4} \times \frac{2}{3}$ or $2 \times \frac{1}{4} \times \frac{1}{3}$ or $\frac{1}{2} \times \frac{1}{3}$ or $\frac{2}{4} \times \frac{1}{3}$ Add two of these or double one (= $\frac{1}{3}$ AG)	B1 B1 B1 3	or 1 out of 6 or 2 out of 12 or $\frac{2!}{4!} \times 2$ or $\frac{2}{12}$ or $\frac{1}{6}$ or $\frac{1}{3!}$ or $\frac{1}{4C_2}$ or $\frac{2!}{4!} \times 2$ or $\frac{2}{4C_2}$ or $4 \times \frac{1}{4} \times \frac{1}{3}$ or $\frac{2}{4} \times \frac{2}{3}$ or $\frac{4}{12}$ or $\frac{2!}{4!} \times 4$ B1B1 or $\frac{2}{6}$ or $2 \times \frac{1}{6}$ or $\frac{2}{3!}$ or $\frac{2!}{3!}$ B1B1
ii	$X = 3, 4, 5, 6$ only, stated or used $P(X=5)$ wking as for $P(X=4)$ above or $1 - (\frac{1}{6} + \frac{1}{3} + \frac{1}{6})$ or $\frac{1}{3}$ $P(X=3)$ wking as for $P(X=6)$ above or $1 - (\frac{1}{3} + \frac{1}{3} + \frac{1}{6})$ or $\frac{1}{6}$ $\begin{matrix} 3 & 4 & 5 & 6 \\ \frac{1}{6} & \frac{1}{3} & \frac{1}{3} & \frac{1}{6} \end{matrix}$ oe	B1 M1 M1 A1 4	Allow repetitions Allow other values with zero probabilities. or M1 for total of their probs = 1, dep B1 or $P(X=3)=\frac{1}{6}$, $P(X=4)=\frac{1}{3}$, $P(X=5)=\frac{1}{3}$, $P(X=6)=\frac{1}{6}$ Complete list of values linked to probs
iii	$\sum xp$ = $4\frac{1}{2}$ $\sum x^2p$ (= $21\frac{1}{6}$) – ‘ $4\frac{1}{2}$ ’, ² = $\frac{11}{12}$ or 0.917 (3 sf)	M1 A1 M1 M1 A1 5	≥ 2 terms correct ft ≥ 2 terms correct ft Independent except dependent on +ve result
Total		12	

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6	$m = (9 \times 6 + 3) \div 10$ $= 5.7$ $2 = \frac{\Sigma x^2}{9} - 6^2$ $\Sigma x^2 = 2 \times 9 + 6^2 \times 9$ or 342 $v = \frac{(342 + 3^2)}{10} - 5.7^2$ $= 2.61$ oe	M1 A1 M1 A1 M1 A1 6	or $((\text{Sum of any 9 nos totalling 54}) + 3) \div 10$ or $\frac{\Sigma(x-6)^2}{9} = 2$ M1 or $\Sigma x^2 = 18 + 12 \times 54 - 36 \times 9$ or 342 A1 dep Σx^2 attempted, eg $(\Sigma x)^2 (= 3249)$ or just state ' Σx^2 '; allow $\sqrt{\quad}$ CAO
Total		6	
7i	${}^4C_2 \times {}^6C_3 \times {}^5C_4$ or $6 \times 20 \times 5$ $= 600$	M1M1 A1 3	M1 for any 2 correct combs seen, even if added
ii	$\frac{2}{4}$ or $\frac{{}^3C_1}{{}^4C_2}$ or $\frac{{}^3C_1 \times {}^6C_3 \times {}^5C_4}{{}^4C_2 \times {}^6C_3 \times {}^5C_4}$ or $\frac{{}^3C_1 \times {}^6C_3 \times {}^5C_4}{'600'}$ $= \frac{1}{2}$ oe	M1 A1 2	or $\frac{1}{4} \times 1 + \frac{3}{4} \times \frac{1}{3}$ or $\frac{1}{4} \times 2$ or $\frac{1}{4} + \frac{1}{4}$
iii	${}^3C_1 \times {}^6C_3 (\times {}^4C_4) + {}^3C_2 \times {}^6C_3 \times {}^5C_4$ 360	M1M1 A1 3	M1 either product seen, even if \times or \div by something
Total		8	

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8ia	Geo(0.3) stated or implied $0.7^3 \times 0.3$ $= 0.103$ (3 sf)	M1 M1 A1 3	by $0.7^n \times 0.3$
b	0.7^3 or 0.343 $1 - 0.7^3$ $= 0.657$	M1 M1 A1 3	0.7^3 must be alone, ie not $0.7^3 \times 0.3$ or similar allow $1 - 0.7^4$ or 0.7599 or 0.76 for M1 only or $0.3 + 0.7 \times 0.3 + 0.7^2 \times 0.3$: M1M1 1 term wrong or omitted or extra M1 or $1 - (0.3 + 0.7 \times 0.3 + 0.7^2 \times 0.3)$ or 0.343: M1
8ia	State or imply one viewer in 1 st four ${}^4C_1 \times 0.7^3 \times 0.3$ (= 0.412) $\times 0.3$ $= 0.123$ (3 sf)	M1 M1 M1 A1 4	or B(4, 0.3) stated, or 4C_1 used, or YNNNY dep 1st M1
b	$0.7^5 + {}^5C_1 \times 0.7^4 \times 0.3$ $= 0.528$ (3 sf)	M1 A1 2	or $1 - (0.3^2 + 2 \times 0.3^2 \times 0.7 + 3 \times 0.3^2 \times 0.7^2 + 4 \times 0.3^2 \times 0.7)$ Not ISW, eg $1 - 0.528$: M1A0
Total		12	

Total 72 marks