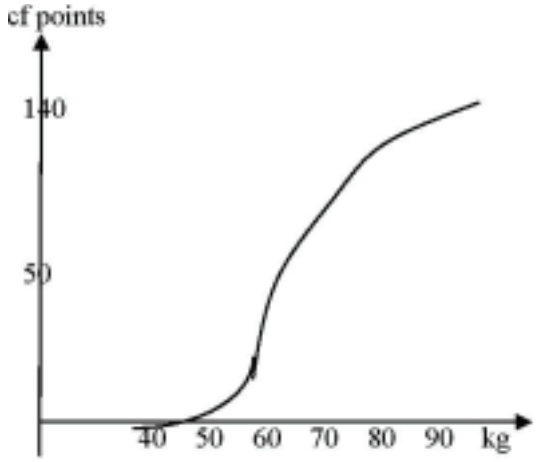
1	$P(Q) = \frac{4}{36}$ or $P(S) = \frac{1}{2}$	B1		oe
	$P(Q \cap S) = \frac{2}{36}$ or $P(S\|Q) = \frac{1}{2}$ or $P(Q\|S) = \frac{2}{18}$	B1		oe
	$P(Q \cap S) = P(Q) \times P(S)$ or $P(S\|Q) = P(S)$ or $P(Q\|S) = P(Q)$	M1		Comparing correct pair of terms $0 \leq$ all probabilities < 1
	Independent	A1	**[4]**	Correct conclusion must have all probs correct
2	P(at least 2) = P(2, 3) or 1 – P(0, 1)	M1		Summing, or 1–, two different three-factor prob expressions, ${}_3C_2$ not needed
	$= \frac{5}{12} \times \frac{4}{11} \times \frac{7}{10} \times {}_3C_2 + \frac{5}{12} \times \frac{4}{11} \times \frac{3}{10}$	M1		12, 11, 10 seen or implied in denominator
		M1		Mult a prob by ${}_3C_2$ or ${}_3C_1$ oe
	$= \frac{4}{11}$ (0.364)	A1	**[4]**	Correct answer
	OR $\frac{({}_5C_3) + ({}_5C_2 \times {}_7C_1)}{{}_{12}C_3}$	M1		${}_5C_3$ seen added in numerator
		M1		${}_5C_2$ seen mult alone or in numerator
		M1		${}_{12}C_3$ seen in denom
		A1		Correct answer
3	**(i)** $P(\text{tall}) = P\left(z > \frac{70-50}{16}\right) = P(z > 1.25)$	M1		+ve/-ve Standardising no cc no sq rt no sq
	$= 1 - 0.8944$ $= 0.106$	A1	**[2]**	Correct answer
	(ii) P(short) = (1 – 0.1056)/3	M1		Subt their **(i)** from 1 or their **(i)** and multiplying by $\frac{1}{3}$ or $\frac{2}{3}$
	$= 0.2981$	A1 ft		Rounding to 0.298, only ft for $\frac{(1 - \textbf{(i)})}{3}$
	$z = -0.53$	A1		± z-value rounding to 0.53, condone ±0.24
	$-0.53 = \frac{x - 50}{16}$	M1		Standardising with their z value (not a probability), no cc sq rt etc.
	$x = 41.5$	A1	**[5]**	Correct answer

4 **(i)** $(0.8)^n < 0.001$	M1		Eqn or inequ involving 0.8^n or 0.2^n and 0.001 or 0.999
$n > 30.9$	M1		Trial and error or logs (can be implied)
$n = 31$	A1	**[3]**	Correct answer **MR** 0.01, max available M1M1A0
(ii) $\mu = 120 \times 0.2 = 24$	B1		24 and 19.2 or $\sqrt{19.2}$ seen
$\sigma^2 = 120 \times 0.2 \times 0.8 = 19.2$	M1		Standardising with or without cc, must have sq rt in denom
$P(x < 33) = P\times\left(z < \frac{32.5-24}{\sqrt{19.2}}\right)$	M1		Continuity correction 32.5 or 33.5
$= P(z < 1.9398)$ $= 0.974$	A1	**[4]**	Correct answer
5 **(a)** $P(W_2) = P(W_1W_2) + P(L_1W_2)$	B1		0.3×0.6 alone as num or denom of a fraction
$= 0.3 \times 0.6 + 0.7 \times 0.15$	M1		Attempt at $P(W_2)$ as sum of two 2-factor options seen anywhere
$= 0.285$			
$P(W_1\|W_2) = \frac{P(W_1 \cap W_2)}{P(W_2)} = \frac{0.18}{0.285}$	A1		Correct unsimplified $P(W_2)$ as num or denom of a fraction
$= 0.632, \frac{12}{19}$	A1	**[4]**	Correct answer
(b) $x + 4$ oe seen	B1		Seen anywhere
$\frac{10}{15} \times \frac{7}{x+4} = \frac{7}{18}$	M1		Mult two probabilities, one containing x and equating to $\frac{7}{18}$
	A1		Correct unsimplified equation
$x = 8$	A1	**[4]**	Correct answer
6 **(i)** (40, 0), (50, 12) etc. up to (90, 144)	B1		Axes, (cf) and labels (kg), uniform scales from at least 0–140 and 40.5–69.5 either way round
			
	B1	**[2]**	All points correct, sensible scale (not 12), polygon or smooth curve
(ii) 80 weigh less than 67.2 kg	M1		Subt 64 from 144
$c = 67.2$	A1 ft	**[2]**	Accept anything between 67 and 68 ft from incorrect graph

(iii) freqs 12, 22, 30, 28, 52	M1 A1		frequencies attempt not cf Correct freqs
mean wt = (45 × 12 + 55 × 22 + 62.5 × 30 + 67.5 × 28 + 80 × 52) / 144	M1		Using mid points attempt, i.e. 44.5, 45, 45.5, in correct mean formula, unsimplified, no cfs, condone 1 error.
= 9675 / 144 = 67.2 kg	A1		Correct mean
Var $(45^2 \times 12 + 55^2 \times 22 + 62.5^2 \times 30 + 67.5^2 \times 28 + 80^2 \times 52) / 144 - (9675/144)^2 = 127.59$	M1		Substituting their mid-pts squared (may be class widths, lower or upper bound) in correct var formula even with cfs with their mean^2
sd = 11.3, allow 11.2	A1	**[6]**	Correct answer
7 (i)			
S(10) R(14) P(6) 1 2 4 = 10C1×14C2×6C4= 13650 1 3 3 = 10C1×14C3×6C3= 72800 2 2 3 = 10C2×14C2×6C3= 81900 Total = 168350 or 168000	M1 M1 B1 A1	**[4]**	Summing 2 or more 3-factor options perms or combs Mult 3 combs or 4 combs with $\Sigma r=7$ 2 options correct, unsimplified Correct answer
(ii) 2! × 2! × 5!	M1 M1		2! × 2! oe, seen mult by an integer ≥1, no division Mult by 5!, or 5! alone, seen mult by an integer ≥ 1 no division
= 480	A1	**[3]**	Correct answer
If M0 earned $\frac{2!\times 2!}{2!\times 2!}$ or $\frac{5!}{3!}$ or both, seen mult by an integer ≥ 1 Or 2!×2!×5! divided by a value	SCM1		
(iii) spaniels and retrievers in 4! ways gaps in 5P3 or 5 × 4 × 3 ways = 1440	M1 M1 A1	**[3]**	4! seen multiplied by an integer >1 Mult by 5P3 oe Correct answer
If M0 earned $\frac{4!}{2!\times 2!}$ or $\frac{{}_5P_3}{3!}$ or both, seen multiplied by an integer > 1	SCM1		${}_5C_3$ oe
or 7! – 5! × 3! – {(4! × 2 × 4 × 3!) + (4! × 3 × 4 × 3!)} = 1440	M1 M1 A1		oe oe, e.g. 6 × 5 × 4 × 4!
If M0 earned 3! × 2! × 2! used as a denominator in all 4 terms	SCM1		Marks cannot be earned from both methods.