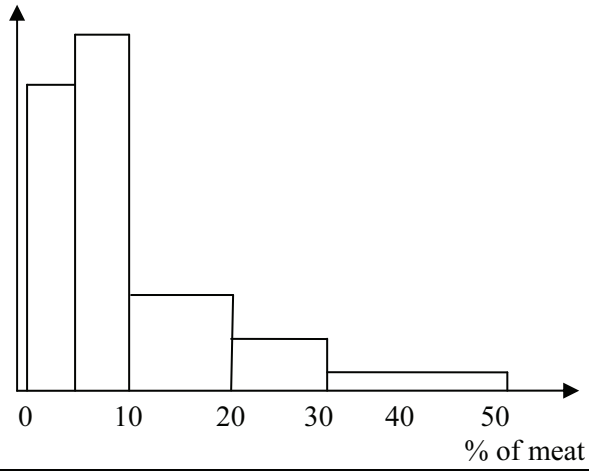
1	$z = -1.036 = \frac{5.6-93}{\sigma}$	B1 M1		± (1.036 to 1.037) seen Equation with 5.6 or 13.0, 9.3, σ and a z value, no cc
	$\sigma = 3.57$	A1	**3**	Correct final answer
2	$-3p + 2r + 4 \times 0.4 = 2.3$ $(-3)^2p + 2^2r + 4^2 \times 0.4 - 2.3^2 = 3.01$ $p + q + r + 0.4 = 1$ $-3p + 2r = 0.7$ $9p + 4r = 1.9$ so $-9p + 6r = 2.1$ or $-6p + 4r = 1.4$ $4r + 6r = 1.9 + 2.1$ or $9p + 6p = 1.9 - 1.4$	B1 B1 B1 M1		Correct unsimplified equation, oe Correct unsimplified equation, oe Correct equation, oe Obtain an equation in 1 unknown
	$r = \frac{2}{5}\ (0.4),\ p = \frac{1}{30}\ (0.0333)$	A1		One correct answer
	$q = 0.6 - 0.4 - 0.0333 = \frac{1}{6}\ (0.167)$	A1	**6**	Remaining two answers correct
3	**(i)** $\frac{74}{170}\left(\frac{37}{85}\right)\ (0.435)$	B1	**1**	Correct answer
	(ii) $\frac{38}{96}\left(\frac{19}{49}\right)\ (0.396)$	B1 B1	**2**	Correct unsimplified numerator or denominator Correct answer
	(iii) P(high GDP and high birth rate) = 0 So they are exclusive	B1* B1dep*	**2**	Correct reason Correct answer, CWO
	(iv) $\frac{42}{74} \times \frac{41}{54}$	M1		Multiplying 2 probabilities with different numerators and denominators, only
	$= \frac{1722}{3996}\left(\frac{287}{666}\right)\ (0.431)$	B1 A1	**3**	One correct probability seen Correct answer
4	**(i)** $(3 \times 59 + 8 \times 67 + 15.5 \times 38 + 25.5 \times 18 + 40.5 \times 11)/193$	M1		Attempt to calculate the mean using midpoints not ends, with frequencies, can be implied
	$= 11.4$	A1		Correct mean
	$\sigma^2 = (3^2 \times 59 + 8^2 \times 67 + \ldots)/193 - (11.43..)^2$	M1		Using $\Sigma x^2 f$ with mean^2 subtracted numerically, can be implied
	$\sigma = 9.78$ or 9.79	A1	**4**	Correct answer, method marks can be implied

	(ii) fd = 11.8, 13.4, 3.8, 1.8, 0.55  	M1 A1 B1 B1 B1	**5**	Attempt at frequency density or scaling Correct heights seen on graph Bar lines correctly located at 5.5, 10.5, 20.5 and 30.5, no gaps, their scale which may be non-linear correct widths of bars, independent of bar lines Both axes uniform, from at least 0 to 14 if fd and 0.5 to 50.5, and labelled (fd or freq per 5% and % meat or % or meat)
5	**(i)** $\Phi\left(\frac{84.5-82}{\sqrt{126}}\right) \Phi\left[\frac{83.5-82}{\sqrt{126}}\right]$ $= \Phi(0.2227) - \Phi(0.1336)$ $= 0.5883 - 0.5533$ $= 0.0350$	M1 M1 A1	**3**	Standardising using 83.5 or 84.5, must have square root Subtracting two probabilities, both > 0.5 or both < 0.5 Correct answer
	(ii) $P(x > 87) = 1 - \Phi\left(\frac{87-82}{\sqrt{126}}\right) = 1 - \Phi(0.445)$ $= 1 - 0.6718 = 0.3282$ $P(0, 1) = (0.6718)^5 + {}_5C_1 (0.3282)(0.6718)^4$ $= 0.471$	M1 A1 M1 A1	**4**	Standardising, no cc, must have square root Correct probability Any binomial term of form ${}_5C_x p^x (1-p)^{5-x}, x \neq 0$ Correct answer
	(iii) $P(x < 87) = 0.6718$ $P(x < k) = 0.9718$ $z = 1.908$ or 1.909 $1.909 = \pm\frac{k-82}{\sqrt{126}}$ $k = 103$	M1 M1 A1 M1 A1	**5**	Finding $P(x < 87)$, value > 0.5 Adding 0.3 to their 0.6718 or equivalent Correct z Equation with k, 82 or 81.5 or 82.5, $\sqrt{126}$, and a z-value Correct answer rounding to 103
6	**(a)** twins in: ${}_6C_2$ twins out: ${}_5C_2 \times {}_6C_2$ Total = 15 + 150 = 165 OR all: ${}_7C_2 \times {}_6C_2$ one twin: $2 \times {}_5C_1 \times {}_6C_2$ Total = 315 − 150 = 165	B1 M1 A1 B1 M1 A1	**3**	${}_6C_2$ alone or ${}_5C_2$ multiplied seen or implied Summing two cases Correct final answer ${}_7C_2 \times {}_6C_2$ alone or ${}_5C_1$ multiplied seen or implied $2 \times {}_5C_1 \times {}_6C_2$ seen, subtracted Correct final answer

(b)				
(i)	ends in 2, 6 or 8: 6!/2! (= 360) ways	B1		Correct option for ending with 2 or 6 or 8.6!/2! seen anywhere, not multiplied
	ends in 4: 6! (= 720) ways	B1		Correct option for ending in 4
	Total = 3 × 360 + 720	M1		Summing 3 or 4 even options
	= 1800 ways	A1	**4**	Correct final answer
				7!/2! seen anywhere, not multiplied
	OR_1 all: 7!/2! (= 2520) ways	B1		6!/2! seen, subtracted
	ends in 1 or 7: 6!/2! (= 360) ways	B1		Subtract 2 odd options from total options
	Total = 2520 − 2 × 360	M1		Correct final answer
	= 1800	A1		
				5 seen, multiplied
	OR_2 (4_A, 4_B) final digit: 5 ways	B1		6! seen and divide by 2! at some stage
	other digits: 6! ways and ÷ by 2!	B1		Multiplying their two numbers
	Total = 5 × 360	M1		Correct final answer
	= 1800	A1		
(ii)	$5\times4\times3\times2$ or ${}_5P_4$ or ${}_5C_4\times4!$ or 5! or ${}_5P_5$ or ${}_6P_5\div6$	M1		One of these oe
	= 120 ways	A1	**2**	Correct final answer
(c)	$\left(\frac{2}{3}\right)^7$	M1		2/3 seen multiplied
		M1		7 probabilities multiplied together
	$=\frac{128}{2187}$ (0.0585)	A1	**3**	Correct final answer