1	$z = 1.452$ $1.452 = \dfrac{20-\mu}{\mu/5}$ $\mu = 15.5$	B1 B1 B1	**[3]**	Rounding to ± 1.45 $\dfrac{20-\mu}{\mu/5}$ or $\dfrac{20-5\sigma}{\sigma}$ seen oe rounding to correct answer
2	$\bar{x} = 50 + 81.4/22 = 53.7$ var = $671/22 - 3.7^2 = 16.81(16.8)$ $16.81 = \Sigma x^2/22 - 53.7^2$ $= 63811(63800)$ OR $\Sigma x - 22\times50 = 81.4$ ($\Sigma x = 1181.4$) $\Sigma x^2 - 100\Sigma x + 22\times50^2 = 671$ $\Sigma x^2 = 671 + 118140 - 55000 = 63811$ Var = $\Sigma x^2/22 - (\Sigma x/22)^2 = 16.81$	M1 A1 M1 A1 M1 M1 A1 A1	**[4]**	Attempt to find variance using coding in both, correct formula Correct answer using their var and their mean with uncoded formula for both correct answer expanded eqn with 22×50 seen expanded eqn with 2 or 3 terms correct correct answer correct answer
3 (i)	P($x < 440$) $= \text{P}\left(z < \dfrac{440-445}{3.6}\right) = 1 - \Phi(1.389)$ $= 1 - 0.9176$ Ans = 0.0824	M1 M1 A1	**[3]**	Standardising no cc no sq or sq rt Correct area (1 – Φ) oe (indep) Rounding to correct answer accept 0.0825
(ii)	$z = 1.881$ $\dfrac{c}{3.6} = 1.881$ $c = 6.77$	M1 M1 A1	**[3]**	±1.88 or 1.881 or 1.882 or 1.555 seen± Equation with ± $c/3.6$ or $2c/3.6$ only = z or prob (can be implied) Correct answer accept 6.78
4 (i)	$p = 4/9$ or $5/9$ P(at least 2) = 1 – P(0, 1) $= 1 - (5/9)^5 - (4/9)(5/9)^4\ {}_5C_1$ $= 0.735$	B1 M1 A1	**[3]**	Binomial term ${}_5C_x p^x(1-p)^{5-x}$ seen Correct answer
(ii)	$np = 96$ $npq = 32$ $p = \text{P}(\leq k)$ $p = 2/3$ $q = 1/3$ $n = 144$ $k = 6$ $n = 144$	M1 A1 A1ft A1	**[4]**	Using $np = 96$ $npq = 32$ to obtain eqn in 1 variable 1/3 or 2/3 seen or implied Correct k ft $k = 9p$ correct n

5 **(i)**	Stem | leaf 0 | 1 4 6 8 1 | 0 3 4 4 4 5 5 5 6 6 6 6 7 8 8 2 | 0 1 5 7 8 3 | 1 4 | 5 5 | 7	B1 B1		Correct stem condone a space under the 1 Correct leaves must be single digits and one line for each stem value or 2 lines each stem value
	Key 1 | 4 represents \$140	B1ft	**[3]**	Correct key must have \$, ft 2 special cases
(ii)	Median = 160 LQ = 140 UQ = 210 IQ range = UQ - LQ = 70	B1 M1 A1	 **[3]**	 Subt their LQ from their UQ Correct answer cwo
(iii)	1.5 × IQ range = 105 Lower outlier is below 35 Upper outlier is above 315 Outliers 10, 450, 570	M1 A1ft A1	 **[3]**	Mult their IQ range by 1.5 can be implied Correct limits ft their IQ range and quartiles Correct outliers
6 **(i)**	H J O 1. 2 8 2 = 4C2×9C8×2C2 = 54 3 7 2 = 4C3×9C7×2C2 = 144 4 6 2 = 4C4×9C6×2C2 = 84 Total = 282 ways	 M1 M1 A1 A1	 **[4]**	Mult 3 combs, 2C2 may be implied 4Cx×9Cy×2Cz Summing 2 or 3 three-factor options 2 options correct unsimplified Correct answer
(ii)	4! × 6! × 2! × 3! = 207360 (207000)	M1 M1 A1	 **[3]**	4! × 6! × 2! oe seen multiplied by int ≥ 1 3! seen mult by int ≥ 1 Correct answer
(iii)	8 J and O trees in 8! = 40320 ways 9 gaps × 8 × 7 × 6 = 121,927,680 (122,000,000)	B1 M1 A1	 **[3]**	8! seen mult by int ≥ 1 no division 9P4 oe or 7P4 or 8P4 seen mult by int ≥ 1 no division Correct answer
(i)	SR 4C2×9C2×2C2×9C6	M1		
(ii)	SR $\frac{4!\times6!\times2!}{4!\times6!\times2!}$ or 3! or both M1	M1		

(iii)	SR1 12! – 9! 4! SR2 $\frac{9P4}{4!}$ or $\frac{8!}{6!\,2!}$ or both	M1 M1		
7 **(i)**	$P(T,B) = \frac{5}{12} \times \frac{2}{10} = \frac{1}{12}\ (0.0833)$	M1 A1	**[2]**	Mult their P(T) by 2/9 or 2/10 only Correct answer
(ii)	$P(C_S \cap C_A) = \frac{7}{12} \times \frac{4}{10} = \frac{28}{120}\ (0.2333)$	M1		Mult their P(C_S) by 3/9 or 4/10 seen as num or denom of a fraction
	$P(C_A) = \frac{7}{12} \times \frac{4}{10} + \frac{5}{12} \times \frac{3}{10} = \frac{43}{120}\ (0.3583)$	M1		Summing 2 two-factor products to find P(C_A) seen anywhere
	$P(C_S \mid C_A) = \frac{P(C \cap C)}{P(C_A)} = \frac{28/120}{43/120}$	A1		Correct unsimplified P(C_A) seen as num or denom of a fraction
	$= \frac{28}{43}\ (0.651)$	A1	**[4]**	Correct answer
(iii)	<table><tr><td>x</td><td>0</td><td>1</td><td>2</td></tr><tr><td>Prob</td><td>7/24</td><td>19/40</td><td>7/30</td></tr></table>	B1		x = 0, 1, 2, can be implied from table or working
	$P(X = 0) = P(T, B) + P(T, T)$	M1		1 or 2 two-factor products, denoms 12 and 10 or 12 and 9, implied if ans is correct
	$= \frac{5}{12} \times \frac{2}{10} + \frac{5}{12} \times \frac{5}{10} = \frac{7}{24}\ (0.292)$	A1		One correct unsimplified
	$P(X = 2) = P(C, C) = \frac{7}{12} \times \frac{4}{10} = \frac{28}{120}\ (0.233)$	B1		One other correct unsimplified
	$P(X = 1) = 1 - 7/24 - 28/120 = \frac{19}{40}\ (0.475)$	B1ft	**[5]**	Third correct ft 1 – P(2 of their probs))