1 (i)

Adults		Children
	4	3
8 6 5 4 3	5	4
7 4 3 3 2 1	6	1 2 7 8
8 4 3 1	7	2 7
	8	1 3 4 6 9
	9	2 5

key 3 | 5 | 4 represents 53 seconds for adults and 54 seconds for children

B1 Single stem and key correct – including adults, children and seconds

B1 Right hand leaves correct shape

B1 **3** Left hand leaves correct shape

(ii) Two from:
Children's estimates more spread out
Adults estimates lower
Adults are symmetrical whereas children are skewed

oe
B1 oe
B1 oe
2

2 (i) $np = 252 \times 1/7 = 36$,
$npq = 252 \times 1/7 \times 6/7 = 30.857$

B1 Unsimplified 36 and 30.857 seen, oe

$$P\left(z < \left(\frac{29.5-36}{\sqrt{30.857}}\right)\right) + P\left(z > \left(\frac{44.5-36}{\sqrt{30.857}}\right)\right)$$

M1 any standardising, sq rt needed
M1 any continuity correction either 29.5, 30.5, 43.5, 44.5

$= P(z < -1.170) + P(z > 1.530)$

$= 1 - 0.8790 + 1 - 0.9370$

M1 correct area $2 - (\Phi_1 + \Phi_2)$

$= 0.184$

A1 **5** correct answer

(ii) *np* and *nq* are both > 5

B1 **1** must have both

3 (i) $P(2) = {}^6C_3 \times {}^3C_2/{}^9C_5$
OR

$$\frac{{}^6C_3 \times {}^3C_2}{{}^6C_5 + {}^6C_4 \times {}^3C_1 + {}^6C_3 \times {}^3C_2 + {}^6C_2 \times {}^3C_3}$$

OR
$3/9 \times 2/8 \times 6/7 \times 5/6 \times 4/5 \times {}^5C_2 = 10/21$

$= 60/126$ **AG**

M1 Using combinations ${}^aC_b \times {}^cC_d/{}^eC_f$
OR
M1
OR
M1 Mult 5 probs with a ${}^pC_q$
If ${}^5C_2$ replace by 10, oe must be justified
A1 **2** Legit method, as answer given

(ii)

x	0	1	2	3
Prob	2/42	15/42	20/42	5/42

B1 0, 1, 2, 3 only seen in table.
Condone $x = 4,5$ in table if $P(x) = 0$ or blank and values in table for $x = 0,1,2,3$

$P(0) = {}^6C_5/{}^9C_5 = 6/126$
$P(1) = {}^6C_4 \times {}^3C_1/{}^9C_5 = 45/126$
$P(3) = {}^6C_2 \times {}^3C_3/126 = 15/126$

B1 Any correct prob other than P(2)
B1 Any other correct prob
B1√ **4** $\Sigma P(x) = 1$, $3 < n(x) < 6$

4	**(i)**	new mean $\frac{172.6\times 28-161.8}{27}=173$	M1 A1	**2**	Mult by 28, subt 161.8 and dividing by 27 or 28 Correct ans
	(ii)	original $\Sigma x^2 = (4.58^2 + 172.6^2) \times 28$	M1		Subst in formula to find Σx^2 and attempt to make Σx^2 subject, with 2 terms both squared
		$= 834728.6$ (835000)	A1		Correct answer
		Remaining $\Sigma x^2 = 834728.6 - 161.8^2$ $= 808549.36$	M1		Subtract 161.8^2 from their original Σx^2
		sd of remaining $= \sqrt{\frac{808549.36}{27}-173^2}$ $= 4.16$	A1	**4**	Correct ans, accept 4.15 or 3.93
5	**(i)**	$z = -1.282$	B1		Rounding to ± 1.28 seen
		$-1.282 = \frac{t-6.5}{1.76}$	M1		Standardising, no cc, no sq or sq rt, $z \neq \pm 0.9, \pm 0.1$
		$t = 4.24$	A1	**3**	Correct answer, accept 4.25
	(ii)	$P(z < 1) = 0.8413$	M1		$z = 1$ used to find a probability
		P(within 1sd of mean) $= 2\Phi - 1$ $= 0.6826$	B1		correct prob, accept answer rounding to 0.66, 0.67, 0.68, not from wrong working. If quoted, then implies first M1.
		P(8, 9) $= {}^9C_8(0.6826)^8(0.3174) + (0.6826)^9$	M1 M1		Binomial term $p^r(1-p)^{9-r}{}^9C_r$, ${}^9C_r$ must be seen Binomial expression for P(8)+P(9), any p
		$= 0.167$	A1	**5**	Correct ans
6	**(i)**	P(B champ) = 0.7× 0.7 = 0.49	B1	**1**	
	(ii)	P (B champ) = P(WW) + P(WLW) + P(LWW) = (0.7×0.7) + (0.7×0.3×0.7) + (0.3×0.7×0.7)	M1		Summing at least 2 options, at least one of which is 3-factor
		= 0.49 + 0.147 + 0.147	B1		0.147 seen, unsimplified
		= 0.784	A1	**3**	Correct answer
	(iii)	$P(T2 \mid T) = \frac{P(T2 \cap T)}{P(T)}$	M1		Attempt P(T2∩T) seen anywhere sum of 2 terms
		$= \frac{0.3\times 0.3 + 0.7\times 0.3\times 0.3}{0.216}$	A1		Correct unsimplified num of a fraction
			M1		Dividing by their (1 – **(ii)** $\surd$) oe
		$= 0.708$	A1	**4**	Correct answer

7 **(i)** **(a)**	6! (×) 4! **OR** (×) 4 × 3 ÷ 2!2!3! **OR** ÷ 2!3! Total 720 ways	M1 M1 M1 A1	**4**	Seen in a single term expression as numerator Seen in a single term expression as numerator (denominator may be 1) Seen in a single term expression as denominator Correct ans
(i) **(b)**	1*******3 = $\frac{7!}{3!2!}$ = 420 3*******1= 420 3*******3= 420 Total = 1260 ways	B1 M1 A1	**3**	$\frac{7!}{3!2!}$ seen oe Attempting to evaluate and sum at least 2 of 1***3, 3***1, 3***3 Correct ans
(ii) **(a)**	5 × 4 × 3 = 60 ways ($^5P_3$)	M1 A1	**2**	$^5P_3$ or $^5C_3$ ×3! (can be implied) Correct ans
(ii) **(b)**	2** in 212, 213, 214, 216, 221, 223, 224, 226, 231, 232, 233, 234, 236, 241, 242, 243, 246 261, 262, 263, 264, 266 Total = 22 ways **Alternative Methods:** $3 \times {}^4C_1 + 2 \times {}^5C_1$ **OR** $^5P_2 + {}^2C_1$ **OR** $^4P_2 + 2 \times {}^4P_1 + {}^2C_1$	M1 A1 M1 **OR** M1 **OR** M1	**2**	Listing attempt starting with 2, at least 10 correct entries Correct ans $p \times {}^4C_1 + q \times {}^5C_1$, oe $p + q > 2$ $^5P_2$ seen Any 2 terms added