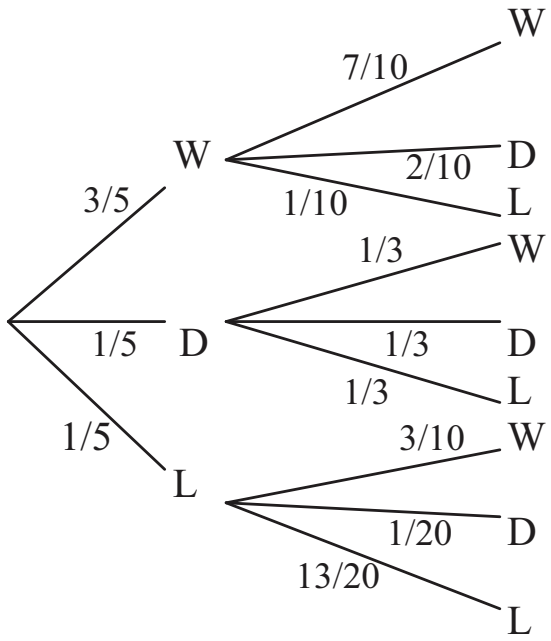
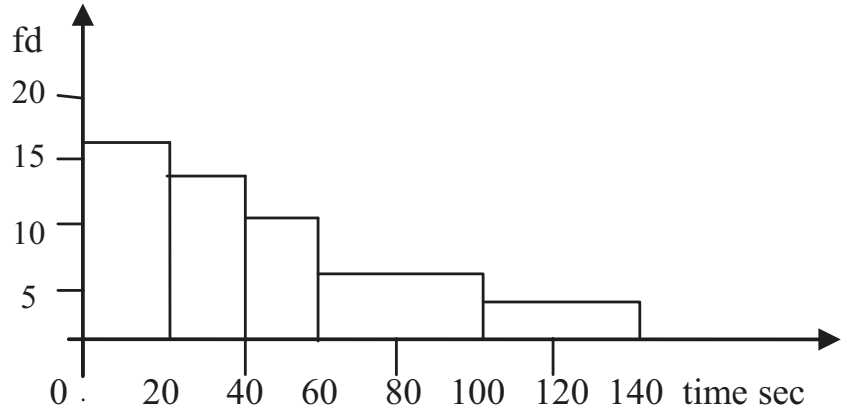
Question	Answer	Marks	Guidance
1(i)	*EITHER:* $\frac{\sum x}{30} - k = \frac{315}{30} = 10.5$	**(M1**	Dividing 315 by ±30 and + or – from 50.5 need both and no more
	$k = 5.5 - 10.5 = 40$	**A1)**	Correct answer from correct working
	OR: $\sum x = 50.5 \times 30 = 1515$, $1515 - 30k = 315$	**(M1**	Mult by 50.5 by 30 and + or – 315 and dividing by ±30 need all these
	$k = 40$	**A1)**	Correct answer from correct working. 1200 gets **M0**
	Total:	**2**	
1(ii)	*EITHER:* var = 4022/30–10.5^2(=23.817)	**(M1**	Subst in correct coded variance formula
	sd = 4.88	**A1)**	
	OR: $\sum x^2 - 2(40)\sum x + 30(40)^2 = 4022$, $\sum x^2 = 77222$ Var = 77222/30 – 50.5^2 (= 23.817)	**(M1**	Expanding with ± 40Σx and ± 30(40)^2 seen
	sd = 4.88	**A1)**	
	Total:	**2**	

Question	Answer	Marks	Guidance
2	P(R) = 4/36 = 1/9	**M1**	Attempt at P(R) by probability space diag or listing more than half the options, must see a prob, just a list is not enough
	$\mathrm{P}(T) = \mathrm{P}(\mathrm{O, E}) + \mathrm{P}(\mathrm{E, O}) = 1/4 + 1/4 = 1/2$ OR $\mathrm{P}(R \mid T) = 1/9$	**M1**	Attempt at P(T) or P(R|T) involving more than half the options
	$\mathrm{P}(R \cap T) = \mathrm{P}(3, 4) + \mathrm{P}(4, 3) = 2/36 = 1/18$ OR $\mathrm{P}(R \mid T) = 1/9$	**B1**	Value stated, not from P(R) × P(T) e.g. from probability space diagram
	As $\mathrm{P}(R) \times \mathrm{P}(T) = \mathrm{P}(R \cap T)$ OR as $\mathrm{P}(R \mid T) = \mathrm{P}(R)$	**M1**	Comparing product values with $\mathrm{P}(R \cap T)$, or comparing P (R|T) with P(R)
	The events are independent.	**A1**	Correct conclusion must have all probs correct
	Total:	**5**	

Question	Answer	Marks	Guidance
3(i)		**M1**	Correct shape i.e. 3 branches then 3 by 3 branches, labelled and clear annotation Condone omission of lines for first match result providing the probabilities are there.
		A1	All correct probs with fully correct shape and probs either fractions or decimals not 1.5/5 etc.
	Total:	**2**	

Question	Answer	Marks	Guidance
3(ii)	$\mathrm{P}(L_1 \text{ given } W_2) = \dfrac{\mathrm{P}(L_1 \cap W_2)}{\mathrm{P}(W_2)}$	**M1**	Attempt at P(L1∩W2) as a two-factor prod only as num or denom of a fraction
	$= \dfrac{1/5 \times 3/10}{3/5 \times 7/10 + 1/5 \times 1/3 + 1/5 \times 3/10}$	**M1**	Attempt at P(W2) as sum of appropriate 3 two-factor probs OE seen anywhere
		A1	Unsimplified correct P(W2) num or denom of a fraction
	$= \dfrac{3/50}{41/75} = 9/82 (0.110)$	**A1**	
	Total:	**4**	

Question	Answer	Marks	Guidance
4(i)	fd 16, 14, 11, 505, 2.5	**M1**	Attempt at fd (must be at least 3 freq/cw) – may be implied by graph
		**A1**	Correct heights seen on graph i.e. must see a gap for fd = 2.5 etc.
		B1	Correct end points of bars and correct widths
		B1	labels fd, sec. Time can be optional. Linear axes, condone $0 \leqslant t < 20$ etc.
	Total:	**4**	

Question	Answer	Marks	Guidance
4(ii)	$(10 \times 320 + 30 \times 280 + 50 \times 220 + 80 \times 220 + 120 \times 100) / 1140$	**M1**	using $\Sigma fx / n$ with mid-point attempt ±0.5, not ends not class widths
	$= 45.8$	**A1**	
	Total:	**2**	
5(i)	$p = 0.07$	**B1**	
	$\mathrm{P}(2) = {}^{20}\mathrm{C}_2 (0.07)^2 (0.93)^{18}$	**M1**	Bin term ${}^{20}\mathrm{C}_x p^x (1-p)^{20-x}$ their p
	$= 0.252$	**A1**	
	Total:	**3**	
5(ii)	P(at least 1 cracked egg)=1–$(0.93)^{20}$=1–0.2342	**M1**	Attempt to find P(at least1 cracked egg) with their p from (i) allow 1 – P(0, 1) OE
	$= 0.766$	**A1**	Rounding to 0.766
	Total:	**2**	
5(iii)	$(0.7658)^n < 0.01$	**M1**	Eqn or inequal containing (their 0.766)^n or (their 0.234)^n, together with 0.01 or 0.99
	$n = 18$	**A1**	
	Total:	**2**	

Question	Answer	Marks	Guidance
6(a)(i)	$z = 0.674$	**B1**	rounding to ±0.674 or 0.675
	$0.674 = \frac{6.8 - \mu}{0.25\mu}$	**M1**	standardising, no cc, no sq rt, no sq, σ may still be present on RHS
		M1	subst and sensible solving for μ must collect terms, no z-value needed can be 0.75 or 0.7734 need a value for μ
	$\mu = 5.82$	**A1**	
	Total:	**4**	
6(a)(ii)	$\mathrm{P}(X < 4.7) = \mathrm{P}\left(z < \frac{4.7 - 5.819}{1.4548}\right)$	**M1**	± standardising no cc, no sq rt, no sq unless penalised in (a)(i)
	$= \phi(-0.769) = 1 - 0.7791$	**M1**	correct side for their mean i.e. 1–ϕ (final solution)
	$= 0.221$	**A1**	
	Total:	**3**	
6(b)	$\mathrm{P}(<15.75) = \mathrm{P}\left(z < \frac{15.75 - 16}{0.2}\right) = 1 - \mathrm{P}(z < 1.25) = 1 - 0.8944 = 0.1056$ and P(>16.25) = 0.1056 by sym	***M1**	Standardising for 15.75 or 16.25 no cc no sq no sq rt unless penalised in (a)(i) or (a)(ii)
	P(usable) = 1 – 0.2112 = 0.7888	**B1**	2ϕ– 1 OE for required prob, (final solution)
	Usable rods=1000 × 0.7888 =	**DM1**	Mult their prob by 1000 dep on recognisable attempt to standardise
	788 or 789	**A1**	
	Total:	**4**	

Question	Answer	Marks	Guidance
7(a)	*EITHER:* e.g. xxxxx =5! for the other children	**(B1**	5! OE seen alone or mult by integer k ⩾ 1, no addition
	Put y in 6 ways, then 5 then 4 for the youngest children	**B1**	Mult by 6P3 OE
	Answer 5! × 6P3 = 14400	**B1)**	Correct answer
	OR: total – 3 tog – 2 tog = 8! – 6!3! – 6! × 2 × 5 × 3 = 14400	**(B1**	8! – 6! × k ⩾ 1seen
		B1	6!3! or 6! × 2 × 5 × 3 seen subtracted
		B1)	Correct answer
	Total:	**3**	
7(b)	D W M 2 2 1 = 6C2 × 4C2 × 1 = 90	**B1**	One correct unsimplified option
	3 1 1 = 6C3 × 4 × 1 = 80	**M1**	Summing 2 or more 3-factor options which can contain perms or 3 factors added. The 1 can be implied
	1 3 1 = 6 × 4C3 × 1 = 24	**M1**	Summing the correct 3 unsimplified outcomes only
	Total=194 ways	**A1**	
	Total:	**4**	

Question	Answer	Marks	Guidance
7(c)	C D S 2 1 1 = $^{26}C_2 \times 9 \times 5 \times 4!$ = 351 000	**M1**	summing 2 or more options of the form (2 1 1), (1 2 1), (1 1 2), can have perms, can be added
	1 2 1 = $26 \times {}^{9}C_2 \times 5 \times 4!$ = 112 320	**M1**	4 relevant products seen excluding 4! e.g. $26 \times 9 \times 8 \times 5$ or $26 \times {}^{9}P_2 \times 5$ for 2nd outcome, condone $26 \times 9 \times 5 \times 37$ as being relevant
	1 1 2 = $26 \times 9 \times {}^{5}C_2 \times 4!$ = 56 160	**M1**	mult all terms by 4! or 4!/2!
	Total = 519 480	**A1**	
	Total:	**4**	