OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MATHEMATICS 4732

Probability and Statistics 1

MARK SCHEME

Specimen Paper

MAXIMUM MARK	72

This mark scheme consists of 4 printed pages.

Registered Charity Number: 1066969
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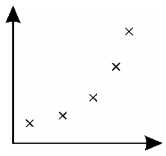
1	**(i)**	Mean is 84.8 minutes	B1	For correct value 84.8
		Standard deviation $= \sqrt{\frac{180044}{25} - 84.8^2}$	M1	For correct formula or calculator use
		$= 3.27$ minutes	A1 **3**	For correct value 3.27
	(ii)	John's average time is about 5 minutes less than Janet's	B1√	For correct comparison of averages
		John's times are more variable than Janet's	B1√ **2**	For correct comparison of variability
			5	
2	**(i)**	Ranks are: $\begin{matrix}1&5&3&4&2\\2&4&1&5&3\end{matrix}$	B2	For correct ranks (or reversed); B1 if 1 error
		Values of d are $-1,\ 1,\ 2,\ -1,\ -1$	M1	For correct values of d or d^2
		$r_s = 1 - \frac{6\times 8}{5\times 24} = 0.6$	M1	For use of the Spearman formula
			A1 **5**	For correct answer 0.6 or fractional equiv
	(ii)	 (e.g.)	B2 **2**	For 5 points, showing any non-linear 'increasing' relationship
			7	
3	**(i)**	$3!\times 3! = 36$	M1	For at least one factor of 3!
			A1 **2**	For correct answer
	(ii)	Ali, Bev and Carla must be in 1st, 3rd, 5th, posns	B1	For identifying this restriction
		Hence number of ways is $3!\times 2! = 12$	M1	For at least one of the factors present
			A1 **3**	For correct answer
	(iii)	Total number of possible arrangements is 5!	B1	For correct statement or use of 5!
		No. of ways with 2 together is $5! - 36 - 12 = 72$	M1	For subtraction of **(i)** and **(ii)** from total
		Hence probability is $\frac{72}{120} = \frac{3}{5}$	A1 **3**	For correct answer
			8	
4	**(i)**	Geometric distribution	B1	For 'geometric' or 'Geo(...)' stated
		$p = \frac{1}{5}$	B1	For correct parameter value
		Each packet is equally likely to contain any of the 5 animals, independently of other packets	B1 **3**	For either 'equally likely' or 'independent'
	(ii)	$\left(\frac{4}{5}\right)^2 \times \left(\frac{1}{5}\right) = \frac{16}{125}$ or 0.128	M1	For any numerical '$q^n p$' calculation
			A1 **2**	For correct answer
	(iii)	$\left(\frac{4}{5}\right)^4$ or $1 - \left\{\frac{1}{5} + \left(\frac{4}{5}\right)\left(\frac{1}{5}\right) + \left(\frac{4}{5}\right)^2\left(\frac{1}{5}\right) + \left(\frac{4}{5}\right)^3\left(\frac{1}{5}\right)\right\}$	M1	Allow M mark even if there is an error of 1 in the number of terms
			A1	For correct expression for the answer
		$\frac{256}{625}$ or 0.4096 or 0.410	A1 **3**	For correct answer
			8	

5	**(i)**	*EITHER*: $P(X=0)=\binom{7}{3}\Big/\binom{12}{3}=\frac{35}{220}=\frac{7}{44}$	M1	For ratio of relevant $\binom{n}{r}$ terms
			A1	For showing the given answer correctly
		OR: $P(X=0)=\frac{7}{12}\times\frac{6}{11}\times\frac{5}{10}=\frac{7}{44}$	M1	For multiplication of relevant 'girl' probs
			A1 **2**	For showing the given answer correctly
	(ii)	*EITHER*: $P(X=2)=P(2\text{ boys and }1\text{ girl})$	M1	For use of three $\binom{n}{r}$ terms relevant to the 2B, 1G case
		$=\binom{7}{1}\times\binom{5}{2}\Big/\binom{12}{3}$		
		$=\frac{7\times10}{220}=\frac{7}{22}$	B1	For both $\binom{5}{2}$ and $\binom{12}{3}$ correct
			A1	For showing the given answer correctly
		OR: $P(X=2)=P(2\text{ boys and }1\text{ girl})$	M1	For three probabilities multiplied relevant to the 2B, 1G case
		$=\frac{5}{12}\times\frac{4}{11}\times\frac{4}{10}\times3=\frac{7}{22}$	B1	For inclusion of factor 3
			A1 **3**	For showing the given answer correctly
	(iii)	$E(X)=0\times\frac{7}{44}+1\times\frac{21}{44}+2\times\frac{7}{22}+3\times\frac{1}{22}=\frac{5}{4}$	M1	For correct calculation process
			A1	For correct answer
		$E(X^2)=0\times\frac{7}{44}+1\times\frac{21}{44}+4\times\frac{7}{22}+9\times\frac{1}{22}=\frac{95}{44}$	B1	For correct numerical expression for $\Sigma x^2 p$
		$\text{Var}(X)=\frac{95}{44}-\left(\frac{5}{4}\right)^2=\frac{105}{176}$ or 0.597 (to 3dp)	M1	For correct overall method for variance
			A1√ **5**	For correct answer
			10	
6	**(i)**	Medians correspond to 1000 candidates	M1	For reading off at 1000; may be implied
		$m_1=38,\ m_2=63$	A1	For correct value for either median
			A1 **3**	For both correct
	(ii)	Paper 2 was easier	B1	For a correct statement
		Marks were higher on paper 2	B1 **2**	For a correct justification
	(iii)	66 marks on paper 1 corresponds to 1700 cands,	M1	For reading off at 66; may be implied
		1700 cands on paper 2 corresponds to 82 marks	A1	For stating the correct mark
		Proportion is $\frac{2000-1700}{2000}$, i.e. 15%	M1	For relevant subtraction from 2000
			A1 **4**	For correct answer 15% or equivalent
	(iv)	Possible valid comments include:		
		Box plots give quick direct comparisons of medians and IQRs		
		Box plots don't include all the information that CF graphs do		
		CF graphs can be used to read off values both ways round	B1	For any one valid comment
		etc	B1 **2**	For any other valid comment
			11	

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7	**(i)**	**(a)**	$1 - 0.7899 = 0.210(1)$	M1 A1 **2**	For complement of relevant tabular value For correct answer
		(b)	$0.9209 - 0.7899 = 0.131$	M1 A1 **2**	For subtracting relevant tabular values For correct answer
	(ii)	**(a)**	$0.790^5 + 5\times0.790^4\times0.210 + 10\times0.790^3\times0.210^2$ $= 0.934$	M1 M1 A1√ A1 **4**	For recognition of B(5, 0.210) For identification of correct three cases For correct expression for the required prob For correct answer
		(b)	Expectation is $5\times0.210 = 1.05$	M1 A1 **2**	For relevant use of *np* For correct answer
				10	
8	**(i)**		$r = \dfrac{1837.78 - \frac{43.3\times471.9}{12}}{\sqrt{\left(164.69 - \frac{43.3^2}{12}\right)\left(20915.75 - \frac{471.9^2}{12}\right)}}$ $= 0.956$ The value is close to $+1$, and the points in the diagram lie (fairly) close to a straight line with positive gradient	M1 A1 B1 B1 **4**	For correct formula or calculator use For correct value For relating the value to 1 For a reasonable comment about linearity
	(ii)		Gradient of regression line is $\dfrac{1837.78 - \frac{43.3\times471.9}{12}}{164.69 - \frac{43.3^2}{12}} = 15.9789$ $y - \frac{471.9}{12} = 15.9789\left(x - \frac{43.3}{12}\right)$ $y = 16.0x - 18.3$	M1 A1 M1 A1 **4**	For correct formula or calculator use For correct value for the regression coeff For correct form of equn (may be implied) For correct (simplified) equation
	(iii)		$y = 16.0\times4.2 - 18.3$ Current is $48.8\,\text{cm s}^{-1}$ Comments could include: Diagram indicates some uncertainty High value of pmcc suggests fairly reliable	M1 A1√ B1 **3**	For substitution into equation from **(ii)** For correct answer For any one reasonable comment
	(iv)		As extrapolation is involved, the prediction would be (very) unreliable	M1 A1 **2**	For identifying extrapolation For correct conclusion
				13	