

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

**Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education**

MATHEMATICS

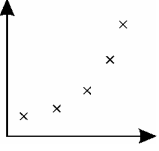
4732

Probability and Statistics 1

MARK SCHEME

Specimen Paper

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

<p>5 (i) EITHER: $P(X = 0) = \frac{\binom{7}{3}}{\binom{12}{3}} = \frac{35}{220} = \frac{7}{44}$</p> <p>OR: $P(X = 0) = \frac{7}{12} \times \frac{6}{11} \times \frac{5}{10} = \frac{7}{44}$</p>	<p>M1 A1 M1 A1</p>	<p>For ratio of relevant $\binom{n}{r}$ terms For showing the given answer correctly For multiplication of relevant 'girl' probs 2 For showing the given answer correctly</p>
<p>(ii) EITHER: $P(X = 2) = P(2 \text{ boys and } 1 \text{ girl})$</p> $= \binom{7}{1} \times \binom{5}{2} / \binom{12}{3}$ $= \frac{7 \times 10}{220} = \frac{7}{22}$ <p>OR: $P(X = 2) = P(2 \text{ boys and } 1 \text{ girl})$</p> $= \frac{5}{12} \times \frac{4}{11} \times \frac{4}{10} \times 3 = \frac{7}{22}$	<p>M1 B1 A1 M1 B1 A1</p>	<p>For use of three $\binom{n}{r}$ terms relevant to the 2B, 1G case For both $\binom{5}{2}$ and $\binom{12}{3}$ correct For showing the given answer correctly For three probabilities multiplied relevant to the 2B, 1G case For inclusion of factor 3 3 For showing the given answer correctly</p>
<p>(iii) $E(X) = 0 \times \frac{7}{44} + 1 \times \frac{21}{44} + 2 \times \frac{7}{22} + 3 \times \frac{1}{22} = \frac{5}{4}$</p> $E(X^2) = 0 \times \frac{7}{44} + 1 \times \frac{21}{44} + 4 \times \frac{7}{22} + 9 \times \frac{1}{22} = \frac{95}{44}$ $\text{Var}(X) = \frac{95}{44} - \left(\frac{5}{4}\right)^2 = \frac{105}{176} \text{ or } 0.597 \text{ (to 3dp)}$	<p>M1 A1 B1 M1 A1✓</p>	<p>For correct calculation process For correct answer For correct numerical expression for $\sum x^2 p$ For correct overall method for variance 5 For correct answer</p>
<p>10</p>		
<p>6 (i) Medians correspond to 1000 candidates $m_1 = 38, m_2 = 63$</p> <p>(ii) Paper 2 was easier Marks were higher on paper 2</p> <p>(iii) 66 marks on paper 1 corresponds to 1700 cand, 1700 cand on paper 2 corresponds to 82 marks Proportion is $\frac{2000 - 1700}{2000}$, i.e. 15%</p>	<p>M1 A1 A1 B1 B1 M1 A1</p>	<p>For reading off at 1000; may be implied For correct value for either median 3 For both correct For a correct statement 2 For a correct justification For reading off at 66; may be implied For stating the correct mark For relevant subtraction from 2000 4 For correct answer 15% or equivalent</p>
<p>(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 etc</p>	<p>B1 B1</p>	<p>For any one valid comment 2 For any other valid comment</p>
<p>11</p>		

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) $0.790^5 + 5 \times 0.790^4 \times 0.210 + 10 \times 0.790^3 \times 0.210^2$ $= 0.934$	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 $5 \times 0.210 = 1.05$	M1 A1	2	For relevant use of np For correct answer
10				
8	(i) $r = \frac{1837.78 - \frac{43.3 \times 471.9}{12}}{\sqrt{\left(164.69 - \frac{43.3^2}{12}\right)\left(20915.75 - \frac{471.9^2}{12}\right)}}$ $= 0.956$ 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 $\frac{1837.78 - \frac{43.3 \times 471.9}{12}}{164.69 - \frac{43.3^2}{12}} = 15.9789$ $y - \frac{471.9}{12} = 15.9789\left(x - \frac{43.3}{12}\right)$ $y = 16.0x - 18.3$	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) $y = 16.0 \times 4.2 - 18.3$ Current is 48.8 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			