Mark Scheme 4766
June 2007

<table>
<tr><td>Q1 (i)</td><td>$\binom{8}{4}$ ways to select $= 70$</td><td>M1 for $\binom{8}{4}$
A1 CAO</td><td>2</td></tr>
<tr><td>(ii)</td><td>4! = 24</td><td>B1 CAO</td><td>1</td></tr>
<tr><td></td><td></td><td>TOTAL</td><td>3</td></tr>
<tr><td>Q2
(i)</td><td><table>
<tr><td>Amount</td><td>0- <20</td><td>20- <50</td><td>50- <100</td><td>100- <200</td></tr>
<tr><td>Frequency</td><td>800</td><td>480</td><td>400</td><td>200</td></tr>
</table></td><td>B1 for amounts

B1 for frequencies</td><td>2</td></tr>
<tr><td>(ii)</td><td>Total ≈
$10\times800+35\times480+75\times400+150\times200=£84800$</td><td>M1 for their midpoints × their frequencies
A1 CAO</td><td>2</td></tr>
<tr><td></td><td></td><td>TOTAL</td><td>4</td></tr>
<tr><td>Q3 (i)</td><td>Mean $= \dfrac{3026}{56} = 54.0$

$S_{xx} = 178890 - \dfrac{3026^2}{56} = 15378$

$s = \sqrt{\dfrac{15378}{55}} = 16.7$</td><td>B1 for mean

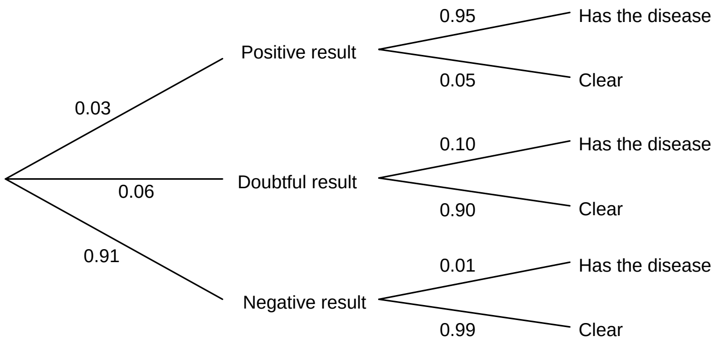
M1 for attempt at S_{xx}

A1 CAO</td><td>3</td></tr>
<tr><td>(ii)</td><td>$\bar{x} + 2s = 54.0 + 2\times16.7 = 87.4$
So 93 is an outlier</td><td>M1 for their $\bar{x}$ +2×their s
A1 FT for 87.4 and comment</td><td>2</td></tr>
<tr><td>(iii)</td><td>New mean = 1.2 × 54.0 – 10 = 54.8
New s = 1.2 × 16.7 = 20.1</td><td>B1 FT
M1A1 FT</td><td>3</td></tr>
<tr><td></td><td></td><td>TOTAL</td><td>8</td></tr>
<tr><td>Q4
(i)</td><td>(A) P(at least one) $=\dfrac{36}{50}=\dfrac{18}{25}=0.72$

(B) P(exactly one) $=\dfrac{9+6+5}{50}=\dfrac{20}{50}=\dfrac{2}{5}=0.4$</td><td>B1 aef

M1 for (9+6+5)/50
A1 aef</td><td>3</td></tr>
<tr><td>(ii)</td><td>P(not paper | aluminium) $=\dfrac{13}{24}$</td><td>M1 for denominator 24 or 24/50 or 0.48
A1 CAO</td><td>2</td></tr>
<tr><td>(iii)</td><td>P(one kitchen waste) $=2\times\dfrac{18}{50}\times\dfrac{32}{49}=\dfrac{576}{1225}=0.470$</td><td>M1 for both fractions
M1 for 2 × product of both, or sum of 2 pairs
A1</td><td>3</td></tr>
<tr><td></td><td></td><td>TOTAL</td><td>8</td></tr>
</table>

Q5 (i)	11^{th} value is 4, 12^{th} value is 4 so median is 4 Interquartile range = 5 – 2 = 3	B1 M1 for either quartile A1 CAO	**3**
(ii)	No, not valid any two valid reasons such as : • the sample is only for two years, which may not be representative • the data only refer to the local area, not the whole of Britain • even if decreasing it may have nothing to do with global warming • more days with rain does not imply more total rainfall • a five year timescale may not be enough to show a long term trend	B1 E1 E1	**3**
		TOTAL	**6**
Q6 (i)	Either P(all 4 correct) $= \frac{4}{7}\times\frac{3}{6}\times\frac{2}{5}\times\frac{1}{4}=\frac{1}{35}$ or P(all 4 correct) $= \frac{1}{{}^7C_4} = \frac{1}{35}$	M1 for fractions, or ${}^7C_4$ seen A1 **NB answer given**	**2**
(ii)	$E(X) = 1\times\frac{4}{35}+2\times\frac{18}{35}+3\times\frac{12}{35}+4\times\frac{1}{35}=\frac{80}{35}=2\frac{2}{7}=2.29$ $E(X^2) = 1\times\frac{4}{35}+4\times\frac{18}{35}+9\times\frac{12}{35}+16\times\frac{1}{35}=\frac{200}{35}=5.714$ $\mathrm{Var}(X) = \frac{200}{35}-\left(\frac{80}{35}\right)^2=\frac{24}{49}$ = 0.490 (to 3 s.f.)	M1 for Σrp (at least 3 terms correct) A1 CAO M1 for Σx^2p (at least 3 terms correct) M1*dep* for – their $E(X)^2$ A1 FT their $E(X)$ provided $\mathrm{Var}(X) > 0$	**5**
		TOTAL	**7**

	Section B		
Q7 **(i)**		G1 probabilities of result G1 probabilities of disease G1 probabilities of clear G1 labels	**4**
(ii)	P(negative and clear) $= 0.91 \times 0.99$ $= 0.9009$	M1 for their 0.91×0.99 A1 CAO	**2**
(iii)	P(has disease) $= 0.03 \times 0.95 + 0.06 \times 0.10 + 0.91 \times 0.01$ $= 0.0285 + 0.006 + 0.0091$ $= 0.0436$	M1 three products M1*dep* sum of three products A1 FT their tree	**3**
(iv)	P(negative | has disease) $= \dfrac{\text{P(negative } \textit{and} \text{ has disease)}}{\text{P(has disease)}} = \dfrac{0.0091}{0.0436} = 0.2087$	M1 for their 0.01×0.91 or 0.0091 on its own or as numerator M1 *indep* for their 0.0436 as denominator A1 FT their tree	**3**
(v)	Thus the test result is not very reliable. A relatively large proportion of people who have the disease will test negative.	E1 FT for idea of 'not reliable' or 'could be improved', etc E1 FT	**2**
(vi)	P(negative or doubtful and declared clear) $= 0.91 + 0.06 \times 0.10 \times 0.02 + 0.06 \times 0.90 \times 1$ $= 0.91 + 0.00012 + 0.054 = 0.96412$	M1 for their 0.91 + M1 for either triplet M1 for second triplet A1 CAO	**4**
		TOTAL	**18**

Q8 (i)	$X \sim B(17, 0.2)$ $P(X \geq 4) = 1 - P(X \leq 3)$ $= 1 - 0.5489 = 0.4511$	B1 for 0.5489 M1 for 1 – their 0.5489 A1 CAO	**3**
(ii)	$E(X) = np = 17 \times 0.2 = 3.4$	M1 for product A1 CAO	**2**
(iii)	$P(X = 2) = 0.3096 - 0.1182 = 0.1914$ $P(X = 3) = 0.5489 - 0.3096 = 0.2393$ $P(X = 4) = 0.7582 - 0.5489 = 0.2093$ So 3 applicants is most likely	B1 for 0.2393 B1 for 0.2093 A1 CAO *dep* on both B1s	**3**
(iv)	(*A*) Let p = probability of a randomly selected maths graduate applicant being successful (for population) H_0: $p = 0.2$ H_1: $p > 0.2$ (*B*) H_1 has this form as the suggestion is that mathematics graduates are <u>more</u> likely to be successful.	B1 for definition of p in context B1 for H_0 B1 for H_1 E1	**4**
(v)	Let $X \sim B(17, 0.2)$ $P(X \geq 6) = 1 - P(X \leq 5) = 1 - 0.8943 = 0.1057 > 5\%$ $P(X \geq 7) = 1 - P(X \leq 6) = 1 - 0.9623 = 0.0377 < 5\%$ So critical region is {7,8,9,10,11,12,13,14,15,16,17}	B1 for 0.1057 B1 for 0.0377 M1 for at least one comparison with 5% A1 CAO for critical region *dep* on M1 and at least one B1	**4**
(vi)	Because $P(X \geq 6) = 0.1057 > 10\%$ Either: comment that 6 is still outside the critical region Or comparison $P(X \geq 7) = 0.0377 < 10\%$	E1 E1	**2**
		TOTAL	**18**