

Question Number	Scheme	Marks
1a)	<p><u>Allocate a number between 1 and N (or equiv) to each pupil.</u></p> <p>Use <u>random number tables, computer or calculator</u> to select 15 <u>different</u> numbers between 1 and 120 (or equiv).</p> <p>Pupils corresponding to these numbers become the sample.</p>	<p>M1</p> <p>B1</p> <p>B1</p> <p>(3)</p>
(b)	<p>Allocate numbers 1 – 64 to girls and 1 – 56 to boys. Idea of different sets for boys and girls</p> <p>Select <math>\frac{64}{120} \times 15 = 8</math> random numbers between 1 – 64 for girls</p> <p>Select 7 random numbers between 1 – 56 for boys.</p>	<p>M1</p> <p>attempt find no</p> <p>M1</p> <p>A1</p> <p>Both 7 and 8</p> <p>(3)</p>
2a)	<p><math>H_0 : \rho = 0 ; H_1 : \rho &gt; 0</math></p> <p><math>\rho</math></p> <p>5% CV – PMCC <u>0.6215</u></p> <p>0.572 &lt; 0.6215 / not in critical region / not significant</p> <p>No evidence of <u>positive</u> correlation</p> <p>Spearman <u>0.6429</u></p>	<p>both and</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>B1</p> <p>(6)</p>
(b)	<p>Evidence of <u>positive</u> correlation</p> <p>No evidence to suggest that as <u>Statistics marks increased</u> <u>Geography marks increased.</u></p> <p>Evidence that students <u>ranked highly in Statistics were also ranked highly in Geography</u></p>	<p>B1</p> <p>Context and not correlation</p> <p>B1</p> <p>ranked</p> <p>(2)</p>

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3a)	<p><math>H_0 : \mu_A = \mu_B ; H_1 : \mu_B &gt; \mu_A</math></p> <p><math>\mu</math></p> $z = \pm \frac{249 - 251}{\sqrt{\frac{2.5^2}{10} + \frac{2.3^2}{15}}}$ <p><math>= \pm 2.0227\dots</math></p> <p><math>CV = \pm 1.6449</math></p> <p>or <math>P(Z \geq 2.02) = 0.0212 - 0.0217,</math>  or <math>P(Z \leq 2.02) = 0.9788 - 0.9783</math></p> <p><math>- 2.0227 &lt; - 1.6449</math> or <math>2.0227 &gt; 1.6449</math> ,  or <math>0.0212 - 0.0217 &lt; 0.05</math>  or <math>0.9788 - 0.9783 &gt; 0.95</math></p> <p>There is evidence that the <u>mean amount of coffee</u> dispensed by B <u>is greater</u> than A.</p>	<p>both and B1</p> <p>249,251 accept M1</p> <p><math>\sqrt{\frac{2.5}{10} + \frac{2.3}{15}}</math> for M A1</p> <p>awrt <math>\pm 2.02</math> A1</p> <p>B1</p> <p>M1</p> <p>comparison and consistency needed</p> <p>A1√ context (7)</p>
b)	<p>Machine B amounts are normally distributed.</p>	<p>B1 (1)</p>

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4a)	$\bar{x} = 75.3$ $s^2 = \frac{1}{9} \left\{ 57455 - \frac{753^2}{10} \right\}$ $= 83.7\dot{8} , 83\frac{71}{90}, 83.8$	B1  M1  awrt 83.8 A1 (3)
b)	$74.8 \pm 1.96\sqrt{\frac{84.6}{100}}$ $(73.0, 76.6)$	1.96 B1 any z value, may use 75.3,83.8 for M M1 A1√ on z only  awrt 73.0,76.6 A1, A1 (5)
c)	Journey times independent  Sample large enough to use central limit theorem  Same distribution / population	any 2 B1,B1 (2)

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5.	<p style="text-align: center;">Never Sometimes Regularly Totals</p> <p style="text-align: center;">Males 30 132 78 240</p> <p style="text-align: center;">Females 26 143 91 260</p> <p style="text-align: center;">56 275 169 500</p> <p>H<sub>0</sub> : No association (independent) between gender and exercise</p> <p>H<sub>1</sub> : association (not independent) between gender and exercise</p> <p>Expected Values</p> <p style="text-align: center;">Never Sometimes Regularly Totals</p> <p style="text-align: center;">Males 26.88 132 81.12 240</p> <p style="text-align: center;">Females 29.12 143</p>	<p>M1 convert % to freq A1 (26, 91, 30, 132)</p> <p>A1 (143, 78)</p> <p>B1</p> <p>B1</p> <p>M1 A1 at least 3sf</p> <p>B1; B1√</p> <p>M1 A1</p> <p>A1√</p> <p style="text-align: right;">(12)</p>

87.88

260

56

275

169

500

$$\alpha = 0.05 \quad \nu = 2; \quad CV \chi^2 > \underline{5.991}$$

$$\sum \frac{(O - E)^2}{E} \text{ OR } \sum \frac{O^2}{E} - N = 0.9271$$

answers in range 0.90 – 0.95

Not in critical region – no evidence of association between  
gender and exercise

Question Number	Scheme	Marks																				
6a)	$X \sim B(3, 1/6)$	bino 3, 1/6 B1 B1 (2)																				
b)	<table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%; text-align: left;">X</th> <th style="width: 20%; text-align: left;">Prob</th> <th style="width: 20%; text-align: left;">Expected freq</th> <th style="width: 55%;"></th> </tr> </thead> <tbody> <tr> <td>0</td> <td><math>\left(\frac{5}{6}\right)^3</math></td> <td>144.68</td> <td>prob – must show working and use B(3,p) or may be implied by correct answer  expected</td> </tr> <tr> <td>1</td> <td><math>3 \times \left(\frac{5}{6}\right)^2 \left(\frac{1}{6}\right)</math></td> <td>86.81</td> <td></td> </tr> <tr> <td>2</td> <td><math>3 \times \left(\frac{5}{6}\right) \left(\frac{1}{6}\right)^2</math></td> <td>17.36</td> <td>awrt 145,86.8,17.4,1.15/1.16</td> </tr> <tr> <td>3</td> <td><math>\left(\frac{1}{6}\right)^3</math></td> <td>1.15 (1.16)</td> <td></td> </tr> </tbody> </table> <p><math>H_0</math> : Binomial model is a good fit  <math>H_1</math> : Binomial model is not a good fit</p> <p>both, no ditto</p> <p>Amalgamate 3 with another group</p> <p><math>\alpha = 0.01 \quad v = 2 \quad ; \quad CR \chi^2 &gt; \underline{9.210}</math></p> <p><math>\sum \frac{(O - E)^2}{E} \text{ OR } \sum \frac{O^2}{E} - N = 8.6894...</math>                      answers in range 8.67 – 8.70 or</p> <p>Evidence that Binomial is a good model.</p>	X	Prob	Expected freq		0	$\left(\frac{5}{6}\right)^3$	144.68	prob – must show working and use B(3,p) or may be implied by correct answer  expected	1	$3 \times \left(\frac{5}{6}\right)^2 \left(\frac{1}{6}\right)$	86.81		2	$3 \times \left(\frac{5}{6}\right) \left(\frac{1}{6}\right)^2$	17.36	awrt 145,86.8,17.4,1.15/1.16	3	$\left(\frac{1}{6}\right)^3$	1.15 (1.16)		M1 M1 B2 (-1 ee) B1 M1 B1 ; B1√ M1 A1 A1√ (11)
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6.c)	<p>Estimate p Degrees of freedom reduced by 1</p> <p><u>Special case</u></p> <p>Use of B(3,0.192) in part (b)</p> <p>Expected frequencies</p> <p>131.8785 94.01242 22.339 1.769</p> <p><math>H_0</math> : Binomial model is a good fit <math>H_1</math> : Binomial model is not a good fit</p> <p>Amalgamate 3 with another group</p> <p><math>\alpha = 0.01 \quad v = 1 \quad ; \text{CR } \chi^2 &gt; 6.635</math> <math>\sum \frac{(O - E)^2}{E} \text{ OR } \sum \frac{O^2}{E} - N</math> in range 5.45 -5.50</p> <p>Evidence that Binomial is a good model.</p>	<p>B1 B1 (2)</p> <p>M1 M1 B0 B1 M1 B1 ; B1√ M1 A1 A1√ (11)</p> <p style="text-align: center;">both, no ditto</p>

Question Number	Scheme	Marks
7a)	$E(D) = E(A) - 3E(B) + 4E(C)$ $= 20$ $\text{Var}(D) = \text{Var}(A) + 9\text{Var}(B) + 16\text{Var}(C)$ $= 341$	M1 A1 M1 M1 A1
b)	$P(D < 44) = P\left(z < \frac{44 - 20}{\sqrt{341}}\right)$ $= P(z < 1.30)$ $= \underline{0.9032}$ $E(X) = 20$ $\text{Var}(X) = \text{Var}(A) + 3\text{Var}(B) + 16\text{Var}(C)$ $= 287$ $P(X > 0) = P\left(z > \frac{-20}{\sqrt{287}}\right)$ $= P(z > -1.18)$ $= 0.8810$	standardising their mean and sd awrt 1.30 A1 A1 B1 + and 16 3 Var (B) M1 M1 A1 standardising their mean and sd awrt -1.18 A1 A1 (9) (7)