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

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

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

Question Number	Scheme	Marks
5.		M1 convert % to freq
	Never	A1 (26, 91, 30, 132)
	Sometimes	
	Regularly	A1 (143, 78)
	Totals	
	Males	B1
	30	
	132	B1
	78	
	240	
	Females	
	26	
	143	
	91	M1
	260	A1 at least 3sf
	56	
	275	
	169	
	500	B1; B1√
	H_0 : No association (independent) between gender and exercise	
	H1 : association (not independent) between gender and exercise	M1 A1
	Expected Values	A1√
		(12)
	Never	
	Sometimes	
	Regularly	
	Totals	
	Males	
	26.88	
	132	
	81.12	
	240	
	Females	
	29.12	
	143	
	87.88	

260

56
275
169
500

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

$\Sigma \frac{(O-E)^2}{E} OR \ \Sigma \frac{O^2}{E} - N = 0.9271$ 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~ B(3,1/6)		bino 3, 1/6	B1 B1 (2)
b)	X	Prob	Expected freq	prob – must show working and use B(3,p) or may be implied by correct answer M1
	0	$\left(\frac{5}{6}\right)^3$	144.68	expected M1
	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 B2 (-1 ee)
	3	$\left(\frac{1}{6}\right)^3$	1.15 (1.16)	
	H_0 : Binomial model is a good fit H_1 : Binomial model is not a good fit		both, no ditto	B1
	Amalgamate 3 with another group			M1
	$\alpha = 0.01$ $\nu = 2$; CR $\chi^2 > \underline{9.210}$			B1 ; B1√
	$\Sigma\frac{(O-E)^2}{E}$ OR $\Sigma\frac{O^2}{E} - N = 8.6894...$		answers in range 8.67 – 8.70 or	M1 A1
	Evidence that Binomial is a good model.			A1√ (11)

Question Number	Scheme	Marks
6.c)	Estimate p Degrees of freedom reduced by 1 <u>Special case</u> Use of B(3,0.192) in part (b) Expected frequencies 131.8785 94.01242 22.339 1.769 H_0 : Binomial model is a good fit H_1 : Binomial model is not a good fit Amalgamate 3 with another group $\alpha = 0.01$ $\nu = 1$; CR $\chi^2 > 6.635$ $\Sigma\frac{(O-E)^2}{E}$ *OR* $\Sigma\frac{O^2}{E} - N$ in range 5.45 -5.50 Evidence that Binomial is a good model.	B1 B1 (2) M1 M1 B0 both, no ditto B1 M1 B1 ; B1√ M1 A1 A1√ (11)

Question Number	Scheme	Marks
7a)	$E(D) = E(A) - 3E(B) + 4E(C)$	M1
	$= 20$	A1
	$Var(D) = Var(A) + 9Var(B) + 16Var(C)$ Use of a^2Var X	M1
	Adding 3 Var ie 4 +…	M1
	$=341$	A1
	$P(D < 44) = P\left(z < \frac{44-20}{\sqrt{341}}\right)$ standardising their mean and sd	M1, A1√
	$= P(z < 1.30)$ awrt 1.30	A1
b)	$= \underline{0.9032}$	A1 (9)
	$E(X) = 20$	B1
	$Var(X) = Var(A) + 3Var(B) + 16\ Var(C)$ + and 16	M1
	3 Var (B)	M1
	$= 287$	A1
	$P(X > 0) = P\left(z > \frac{-20}{\sqrt{287}}\right)$ standardising their mean and sd	M1
	$= P(z > -1.18)$ awrt -1.18	A1
	$= 0.8810$	A1 (7)