ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2018

$E\,a(X) + E\,b(Y)$

STATISTICS **6046/2**

1 (a) Any three from the following:

- It allows quicker contact with respondents B1
- callbacks can be made if the respondent is not initially available B1
- probing is possible B1
- a larger sample of respondents can be reached in a short space of time

(b) (i)

0	6	7	8	8	8						
1	0	1	2	3	4	6	6	7	7	8	9
2	0	2	3	6	7						
3	3	5	7								
4	0	2	3	6	7						

B1

Correct stem B1

Correct 10 leaves B1

B1 all correct

B1 key

Key 3/ 5 means 35

(ii) Original data is preserved B1 [8]

2 (a) In permutations, order of arrangement is important whilst in combinations, order is not important B1 B1

(b) (i) ${}^{8}C_{2} = \frac{8!}{6!2!}$ M1

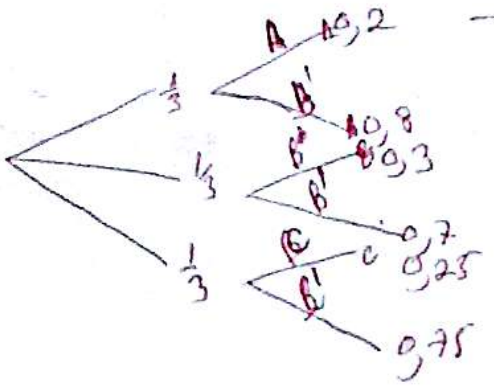
$= 28$ A1

(ii) ${}^{5}C_{1} \times {}^{3}C_{1} = 5 \times 3 = 15$ M1 A1

(iii) P(1 faulty) $= \frac{15}{28}$ M1

$= 0{,}54$ A1 [8]

3 (a)



B1 construction of tree diagram with labels 3 branches (A, B, C)

B1 – correct, either prob set of branch

B1 for all correct prob with $\frac{1}{3}$

(b) (i) $\left(\frac{1}{3}\times 0{,}2\right)+\left(\frac{1}{3}\times 0{,}3\right)+\left(\frac{1}{3}\times 0{,}25\right)$ M1

$= 0{,}25$ A1

(ii) $P\left(\frac{C}{bd}\right) = \frac{P(C\cap bd)}{P(bd)}$

$= \frac{\frac{1}{3}\times 0{,}25}{0{,}25}$ → correct numerator B1; M1 √ for this denominator

$= \frac{1}{3}$ → ans B_3 A1

4 (a)

x	2	3	4	5	6
$P(X = x)$	$\frac{1}{36}$	$\frac{4}{36}$	$\frac{10}{36}$	$\frac{12}{36}$	$\frac{9}{36}$

B1 values of x

B1 Any 2 correct prob

B1 All correct table values

3 | 4 5 6
2 | 3 4 5
1 | 2 3 4
  | 1 2 3

(b) P(Prime) = $\frac{17}{36}$ = 0,4722 — correct answer — B1

(c) (i) E(X) = $2\times\frac{1}{36}+3\times\frac{4}{36}+4\times\frac{10}{36}+5\times\frac{12}{36}+6\times\frac{9}{36}$ ✓ M1

= 4,6667 = $4\frac{2}{3}$

4,6 ≈ 4,7 A1

(ii) Var(X) = $4\times\frac{1}{36}+9\times\frac{4}{36}+16\times\frac{10}{36}+25\times\frac{12}{36}+36\times\frac{9}{36}-(4,6667)^2$ but FW M1

$\frac{10}{9}$ = = 1,11 1, 11 → A1 [8]

5 (a) $\int_0^\infty ke^{-\frac{x}{3}}dt = 1$

$\left[-3ke^{-\frac{x}{3}}\right]_0^\infty = 1$ attempt to $\int$ with correct limits and = 1 → M1

$3k = 1$

$k = \frac{1}{3}$ A1

(b) $\frac{1}{3}\int_0^\infty x.e^{\frac{-x}{3}}dx$ Correct → M1

Let u = x $\frac{dv}{dx} = e^{\frac{-x}{3}}dx$

du = dx $v = -3e^{\frac{-x}{3}}$

$= \frac{1}{3}\left[-3xe^{\frac{-x}{3}}-\int -3e^{\frac{-x}{3}}dx\right]$ attempt to $\int$ by parts M1

$= -xe^{-\frac{x}{3}}+\int e^{-\frac{x}{3}}dx$ Simplification → M1 A1

$= \left[xe^{-\frac{x}{3}}-3e^{-\frac{x}{3}}\right]_0^\infty$ Attempt to $\int$ M1

$= 3$ CAO → A1

(c) $P(X \geq 60) = \frac{1}{3}\int_{60}^\infty e^{-\frac{x}{3}}dx$

$= \left[-e^{-\frac{x}{3}}\right]_{60}^\infty$ attempt to $\int$ with limits → M1

$= e^{-20}$ or equiv. (exact answer) A1 [8]

or $1-\frac{1}{3}\int_0^{60} e^{-\frac{x}{3}}dx$

6 (a) (i) $X \sim Bin(8; 0.9)$ soi B1

$P(x = 6) = {}^{8}C_{6}(0.9)^{6}(0.1)^{2}$ M1 (his parameters)

$= 0.149$ A1

(ii) $X \sim Bin(20; 0.9)$ soi B1

$P(x < 18) = 1 - [P(x = 18) + P(x = 19) + P(x = 20)]$ M1 Interpretation B1

$= 1 - [0.285 + 0.27 + 0.12)$ soi M1

$= 0.32$ A1

(iii) $X \sim N(180; 18)$ soi Correct parameters B1

$P(X \leqslant 182) = P(X \leqslant 182.5)$ Continuity Correction B1

$= P\left(Z < \frac{182.5 - 180}{\sqrt{18}}\right)$ their values M1

$= P(Z < 0.5892)$

0.7224 to be seen before rounding A1 [11]

0,7221 — 0,7224

(b) (i) $\frac{1-p}{p^2} = 12$ Correct method even with $\neq$ M1

$12p^2 + p - 1 = 0$

$(3p + 1)(4p - 1) = 0$ attempt to solve quadratic M1

$p = \frac{1}{4}$ and $p = -\frac{1}{3}$ (2)

$\therefore p = \frac{1}{4}$ A1

(ii) $P(X > 3) = 1 - P(X \leq 3)$

$= 1 - [P(x = 1) + P(x = 2) + P(x = 3)]$

$= 1 - \left[\frac{1}{4} + \frac{3}{4} \times \frac{1}{4} + \left(\frac{3}{4}\right)^2 \times \frac{1}{4}\right]$ M1

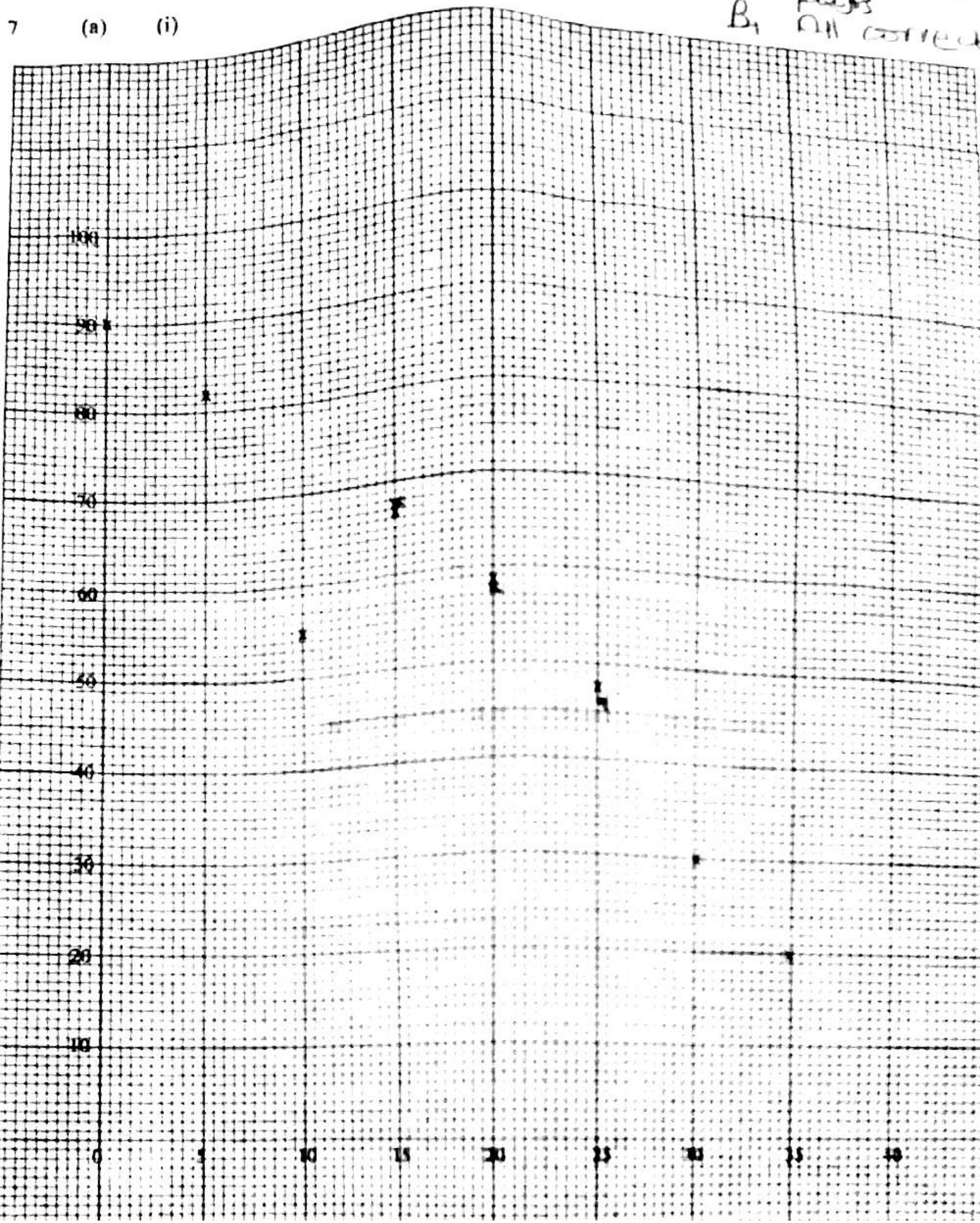
$= 0.422$ A1 [5]

OR $P(X > 3) = q^3 = \left(\frac{3}{4}\right)^3 = \frac{27}{64} = 0,422$

M_1 A_1

B_1 Scale and La
Any 4 cor
plots
B_1 All correct

7 (a) (i)



$= -0,9576$ A1

(ii) There is a very strong negative linear correlation B1B1 [4]

(c) (i) $m = \frac{8(5\,900)-(140)(450)}{8(3\,500)-140^2}$ M1

$= -1,88$ A1

$M - 56,25 = -1,88(D - 17,5)$ M1A1 [4]

(ii) (a) When $D = 12$, $M = -1,88(12 - 17,5) + 56,25$ M1

$= 66,59$ A1

(b) Not possible, it is out of range. B1B1 [4]

8 (a) (i) $\bar{x} = 50 + \frac{123,5}{100}$ M1

$= 51,235$ A1

$\hat{\sigma}^2 = \frac{1}{99}\left(238,4 - \frac{123,5^2}{100}\right)$ M1

$= 0,867$ A1

(ii) $51,235 \pm 2,17.\frac{\sqrt{0,867}}{\sqrt{100}}$ B1M1

$51,235 \pm 0,202$

$(51,033 - 51,437)$ A1A1 [10]

(iii) $P(\bar{x} > 51) = P\left(Z > \frac{51-51,235}{\sqrt{0,867}}\right)$ M1

$= P(Z > -0,2524)$

$= 0,5994$ A1

(b) (i) $X \sim Po(6)$

$P(X \leq 2) = P(X = 0) + P(X = 1) + P(X = 2)$ B1

$= \frac{e^{-6}6^0}{0!} + \frac{e^{-6}6^1}{1!} + \frac{e^{-6}6^2}{2!}$ M1

$= e^{-6}(1 + 6 + 18)$

$= 0,0619$ A1

(ii) $X \sim Po(3)$ B1

$P(X = 0) = \frac{e^{-3}3^0}{0!}$ M1

$= 0,0498$

9 (a) $L_1 + L_2 + L_3 + \ldots + L_5 \sim N(2\,100; 67,08^2)$ A1 [6]

$P(L_1 + L_2 \ldots L_5 > 2\,100) = P(z > 0)$ B1

$= 0,5$ M1 A1 [3]

(b) $P(L_1 + L_2 \ldots + L_5 < S_1 + S_2 \ldots + S_{10})$

$P(Y - X < 0)$

$Y - X \sim N(-100, 5\,500)$ B1 B1

$P(z < \frac{0 + 100}{\sqrt{5\,500}})$ M1

$= P(z < 1,348)$

$= 0,9113$ A1 [4]

(c) $Y + X \sim N(4\,300, \sqrt{5\,500^2})$ B1

$P(4\,250 < Y + X < 4\,400)$

$= P(\frac{4\,250 - 4\,300}{\sqrt{5\,500}} < z < \frac{4\,400 - 4\,300}{\sqrt{5\,500}})$ M1

$= P(-0,67 < z < 1,34)$

$= \Phi(1,34) + \Phi(0,67) - 1$ M1

$= 0,9099 + 0,7486 - 1$

$= 0,6585$ A1 [4]

(d) $P(L \geq 2S) = P(L - 2S \geq 0)$

$L - 2S \sim N(-20; 1\,300)$ B1B1

$P(L - 2S \geq 0) = P(z \geq \frac{20}{\sqrt{1\,300}})$ M1

$= P(z \geq 0,015)$

$= 1 - \Phi(0,5547)$

$= 1 - 0,7102$ M1

$= 0,2898$ A1 [5]

10 (a) (i) A one tailed test looks for an increase or decrease whilst a two tailed test looks for a change in the mean — B1 B1

(ii) A statistic is a measure from a sample whilst a parameter is a measure from a population — B1 B1

(iii) A population is the entire group under study whilst a sample is part of a population — B1 B1

(b) $\bar{x} = 4,978$ — B1 [6]

$S^2 = 0,019^2$

$\frac{1}{9}\left(\sum x^2 - \frac{(\sum x)^2}{10}\right) = \frac{1}{9}\left(\text{?} - \frac{49,78^2}{10}\right)$ → M1A1

$\frac{1}{9}(247,802 - \frac{49,78^2}{10})$ anw → B2

$= 9,000373\ldots$

$H_0: \mu = 5$

$H_1: \mu \neq 5$ — B1

$T_{cal} = \frac{4,978 - 5}{\frac{0,019}{\sqrt{10}}}$ — M1

$= -3,47$ $-3,6616$ → A1

$T_{99,5}(8) = 3,355$ $3,250$ B1 B1

$3,6616 > 3,250$

Since $3,47 < 3,355$, we reject Ho and conclude its not in good working order. — M1A1

[10]

11 (a) (i) A time series is a set of observations of a random variable in chronological (time) order. — B2

(ii) A trend is a general increase or decrease — B1

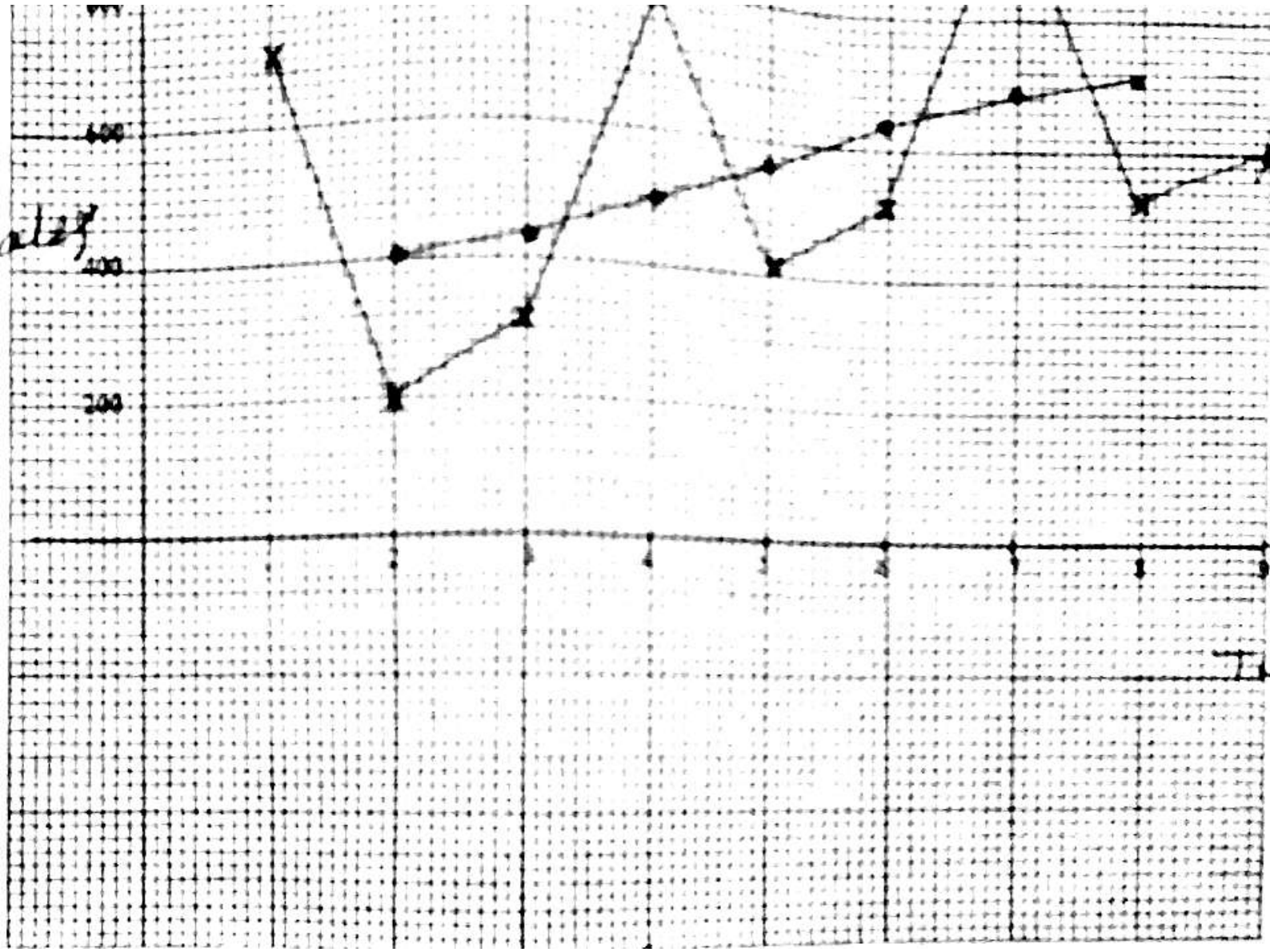
[3]

(b) (i)

	Sales	3 point M.A
1.	700	
2.	200	400
3.	300	433
4.	800	500
5.	400	566
6.	500	633
7.	1 000	666
8.	500	700
9.	600	766
10.	1 200	

M1 Any one correct
A1 all correct
A1 any 4 correct
** All correct
B1 → Centering correctly

(ii) There was a general increase in sales — B1 B2



12 H_0: the observations follow a Normal distribution with mean 163 — B1

H_1: the observations does not follow a Normal distribution with mean 163 — B1

O	E
4	2,65
18	18,18
40	36,9
20	22,8
3	4,47

M1A1 Any one correct for [2]

A1 — All correct [2]

O	E	$\frac{(O-E)^2}{E}$
22	20,8	0,069
40	36,9	0,260
23	27,2	0,648
		0,977

B1 pooling

M1A1 → Any one correct

A1 → All correct

M1A1 → Any one correct

B1B1 → Adjusted

$\chi^2_{5\%}{}^{(2)} = 5,991$

Since 0,977 < 5,59 we accept Ho and conclude that it follows a Normal distribution with a mean of 163.

B1 M_1 Comparison

B1 A_1 Conclusion

[16]