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ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

CONFIDENTIAL

MARKING SCHEME

JUNE 2016

MATHEMATICS **9164/4**

1 $P(X > 2) = 0.03$

$$P\left(Z > \frac{2-\mu}{0.1}\right) = 0.03$$

M1 standardise

$$P\left(Z < \frac{2-\mu}{0.1}\right) = 1 - 0.03 = 0.97$$

B1 Table value

$$\frac{2-\mu}{0.1} = 1.881$$

$$2 - \mu = 0.1881$$

M1 attempt to solve for μ.

$$\mu = 2 - 0.1881$$

$$\mu = 1.8119$$

A1 [4]

2 (a) $2k + \frac{3k}{2} + k = 1$

M1 attempt to find area under the graph & equating to 1

$$\frac{9}{2}k = 1$$

$$k = \frac{2}{9}$$

A1 A.G.

(b)
$$f(x) = \begin{cases} \frac{2}{9} & \text{for } 1 \le x \le 3, \\ \frac{2}{9}x - \frac{4}{9} & \text{for } 3 \le x \le 4 \\ \frac{20}{9} - \frac{4}{9}x & \text{for } 4 \le x \le 5 \\ 0 & \text{otherwise} \end{cases}$$

B2 -1 each error [4]

3/20 x 1/5

3 (a) $P(2 \text{ red}) = \frac{1}{2}\left(\frac{3}{5}\right)\left(\frac{2}{4}\right) + \frac{1}{2}\left(\frac{2}{5}\right)\left(\frac{1}{4}\right)$ M1

$= \frac{1}{5}$ A1

(b) $P(\text{from A}/2 \text{ red}) = \frac{P(\text{from A} \cap 2 \text{ red})}{P(2 \text{ red})}$ B1

$= \frac{\frac{6}{40}}{\frac{1}{5}}$ B1 M1

$= \frac{3}{4}$ A1

[5]

4 (a)

x	2	3	4	5	6	7	8
$P(X=x)$	$\frac{1}{16}$	$\frac{2}{16}$	$\frac{3}{16}$	$\frac{4}{16}$	$\frac{3}{16}$	$\frac{2}{16}$	$\frac{1}{16}$

B1

(b)

X	2,3 or 4	5, 6 or 7	8
$P(X=x)$	$\frac{6}{16}$	$\frac{9}{16}$	$\frac{1}{16}$
Gain / Loss	- 1	1	3

B1 M1

$E(\text{Gain/Loss}) = -1\left(\frac{6}{16}\right) + 1\left(\frac{9}{16}\right) + 3\left(\frac{3}{16}\right)$

$= \$0.375$ or equiv A1 [5]

a(i) median $Q_2 = 28$ 4 B1

5 (a) i $Q_1 : \frac{1}{4}(n+1)^{th} = \frac{1}{4}(25+1)^{th} = 6.5^{th}$ or equiv. ~~M1~~

$Q_1 = 18.5$ hectares

$Q_2 : \frac{1}{2}(25+1)^{th} = 28$ hectares

$Q3 : \frac{3}{4}(25+1)^{th} = 36$ hectares

for all B ~~B2 –1 each error~~

B1 Both correct Q1 & Q3.

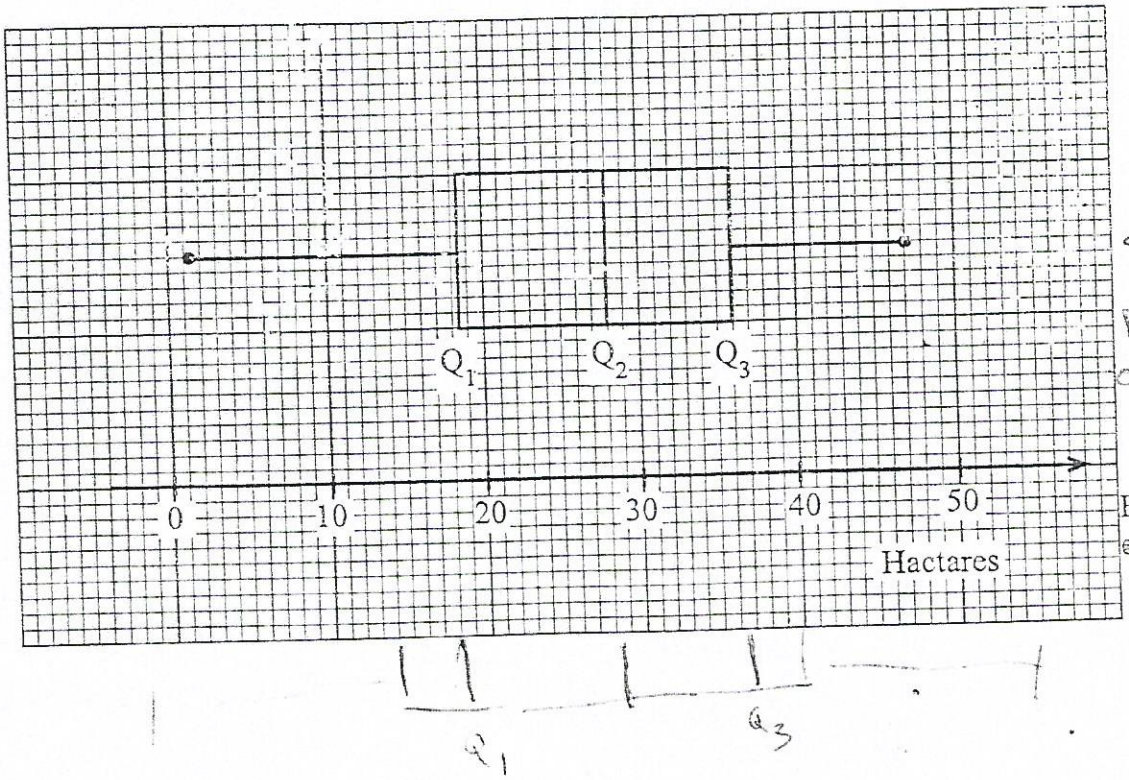
Interquartile range = 36 – 18.5

= 17.5 hectares

M1 subtracting his Q1 from his Q3.

A1

(b)



B1 correct scale.

B1 for complete correct diagram.

B2 –1 each error

Q_1 Q_3

[6]

6 (a) (i) $\bar{x} = \frac{8960}{12} = 746.666$ B1

$= 746.7$ A1

(ii) $\hat{\sigma}^2 = \frac{1}{11}\left[6828956 - \frac{8960^2}{12}\right]$ M1

$= 12\,620.24$ A1

(b) $750 \pm 1.64\sqrt{\frac{10\,816}{50}}$ B1 table value
M1 substituting

$= (725.81; 774.12)$ A1 A1 lower and upper [7]

7 (a) $P(X=0) = \frac{e^{-2}2^0}{0!} = e^{-2}$ M1

$= 0.135$ A1

(b) $P(X>4) = 1 - P(X \le 4)$ B1 Interpreted / seen / implied

$= 1 - e^{-2}\left(1 + 2 + \frac{4}{2!} + \frac{2^3}{3!} + \frac{2^4}{4!}\right)$ M1 at least four terms correct

$= 1 - 0.9473$

$= 0.0527$ A1

(c) $\lambda = 2 \times 2 = 4$ B1

$P(X=2) = \frac{e^{-4}4^2}{2!}$ M1

$= 0.1465$ A1 [8]

8 (a) (i) Large sample size, n.

$np > 5$ B1 B1 For any Two

$nq > 5$

(ii) $X \approx Bin(100, \frac{1}{2})$

$np = 50, npq = 50(1-0.5) = 25$

$X \sim N(50, 25)$

$P(X < 37) = P(X < 36.5)$

$= P\left(Z < \frac{36.5 - 50}{\sqrt{25}}\right)$

$= P(Z < -2.7)$

$= 1 - 0.9965$

$= 0.0035$

A1

(b) $Y \sim \text{Bin}(2\,000, 0.0035)$

$np = 2\,000 \times 0.0035 = 7$

$Y \sim P(7)$

$P(Y > 3) = 1 - P(Y \leq 3)$

$= 1 - e^{-7}\left(1 + 7 + \frac{7^2}{2!} + \frac{7^3}{3!}\right)$

$= 0.918$

A1 [12]

9 (a) (i) For M contents – X Packaging – Y

$X \sim N(500, 8^2)$, $Y \sim N(20, 2^2)$

$X + Y \sim N(520, 8^2 + 2^2)$

$P(X + Y > 525) = P\left(Z > \frac{525 - 520}{\sqrt{68}}\right)$

$= P(Z > +0.6063)$

$= 1 - 0.7276 = 0.2724$

A1

(ii) Let $W = X_1 + X_2 + X_3$

$W \sim N(1500, 3 \times 8^2)$

$P(W > 1515) = P\left(Z > \frac{1515 - 1500}{\sqrt{192}}\right)$

$= P(Z > 1.083)$

$= 1 - 0.8606$

M1 B1

(b) ~~Contents of N → U~~

~~$U \sim N(450, 10^2)$~~ ~~B1~~

$V = U_1 ... + U_5 - (X_1 ... + X_4)$

$V \sim N(5 \times 405 - 4 \times 500, 5 \times 6^2 + 4 \times 8^2)$ ~~B1 B1~~

$V \sim N(25, \sqrt{436})$ B1 ~~μ and σ^2~~ μ M1 A1 for σ^2

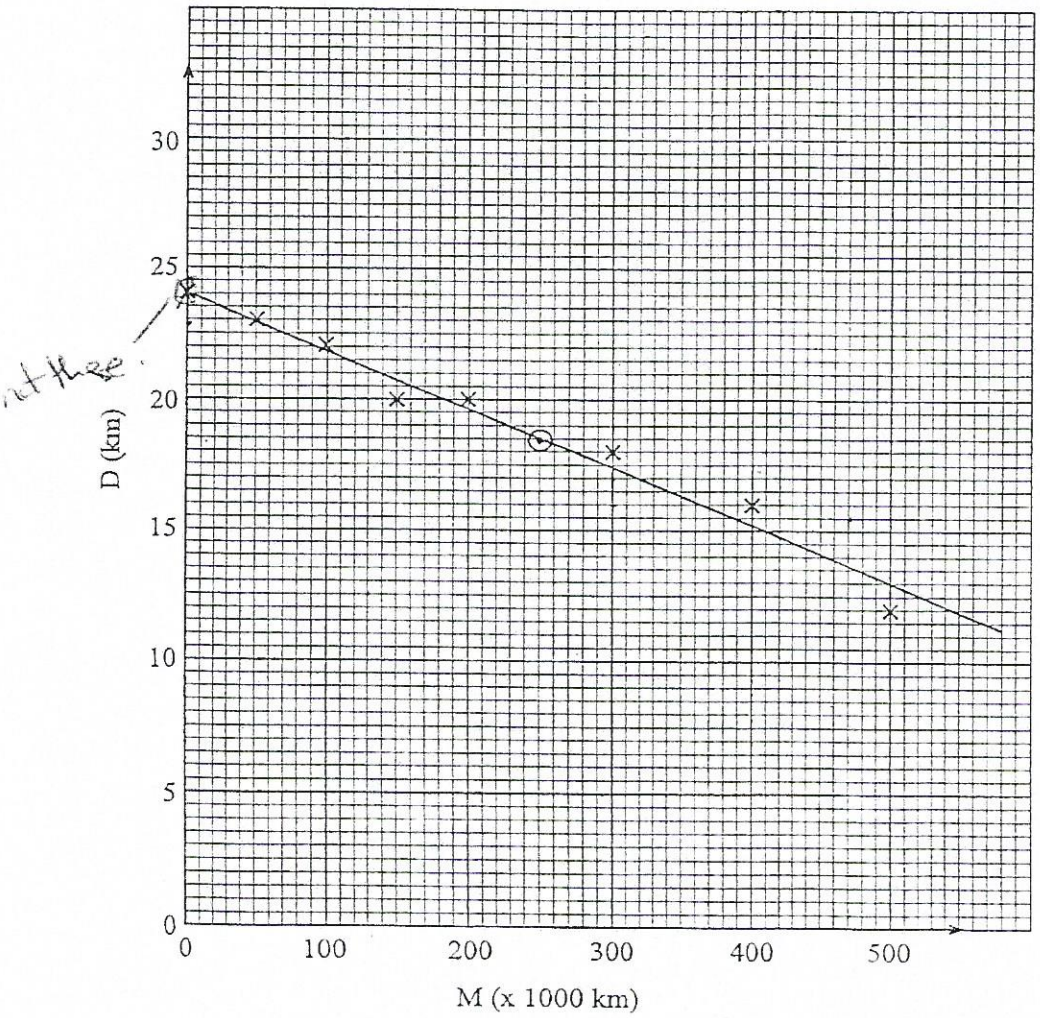
$P(V > 0) = P\left(Z > \frac{0-25}{\sqrt{436}}\right)$ M1 Std stn.

$= P(Z > -1.197)$

$= 0.8844$ A1

[14]

10 (a)



at three

(a) (i) correct scale and labels B1
any 4 correct plots B1
all correct plots B1

(ii) strong negative B1 all 3 terms
linear relationship B1

(c) (i) Line passing thru
$\bar{x}; \bar{y}$ and any M1
~~$\neq$ intercept~~ ✓ other point B1
~~correct line~~ A1

interpolation M1
D = 14.25 A1

use of diagram
14 ± 0.5
for the value of D.

(b) $\bar{x} = 242.86$ $\bar{y} = 18.57$

$$m = \frac{7 \times 27\,850 - 1\,700 \times 130}{7 \times 575\,000 - (1700)^2}$$ M1

$$= -\frac{26\,050}{1\,135\,000}$$

$$= -0.02295$$ A1

$y - 18.33 = -0.02295\,(x - 258.33)$ M1 A1

$y = 24.143 - 0.023x$ ~~A1~~ [14]

11

(a)

Class centre	163	168	173	178	183	188
Frequence	4	18	37	26	10	5

167,5 172,5 177,5 182,5 187,5 ~~B1~~

(i) $\mu = \bar{x} = 174.75$ 174.27 ~~B1~~ M1 A1

(ii) $\hat{\sigma} = 5.7899$ $\hat{\sigma}^2 = 33.52$ 32,7271. M1 A1

class centers multiplied by frequency

(iii) 5.721

O	E	
4	3.73	
18	16.00	
37	31.11	~~B1~~
26	30.05 29.07	B1
10	14.39 12.80	B1
5	4.73 7.29	B1

Revised Table No observ^{n} ~ N distb^{n} B1

(b)

O	E	$\frac{(O-E)^2}{E}$	
22	19.73	0.261	
37	31.11	1.161	~~B4 – 1 each error~~
26	30.05	0.533	B1 ft pooling
15	19.12	0.888	
10	12.8	0.6125	M1 A1 Any correct x^2
5	7.29	0.719	

$\chi^2_{cal} = 2.843$ 3.29 M1 A1

$\chi^2_{5\%}(2) = 3.841$ 5.991 ~~M1~~ B1

3.29 < 5.991

Since 2.843 < 3.841 we fail to reject H0 and conclude that the Normal distribution with the above parameters is an adequate model. ~~B2~~ M1 A1 [17]

12 (i) $\theta = \tan^{-1} 2 = 63.4°$ B1 [1]

(ii) $\frac{9.81(2^2+1)}{2V^2} = 0.01$ M1

$V = \sqrt{\frac{9.81(5)}{0.02}} = 49.5\ ms^{-1}$ A1 [2] [3]

13 $7 + 6\cos 50° - 5\cos 30°$

$6 \sin 50 - 5 \sin 30$ } ~~for both~~ B1 Any 1 correct

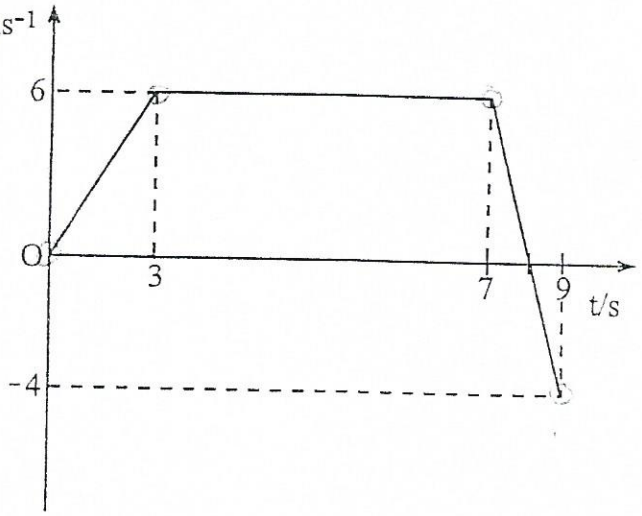
$R = \sqrt{6.53^2 + 2.096^2}$ M1

$= 6.858 \approx 6.9$ N A1

$\theta = \tan^{-1}\left(\frac{2.096}{6.53}\right)$ M1

$= 17.79° \approx 18°$ A1 [5]

14 (a)



B1 for labelled axes

B1 for correct shape

B1 for ~~correct times~~ any correct point } all

B1 for correct ~~velocities~~ point

[4]

(b) (i) Distance = $\frac{1}{2}(8 + 4)6 + \frac{1}{2}(4)$ (0.8) — M1

= ~~38 m~~ 38.2 m / 191/5 — A1 [2]

(ii) Displacement = 36 − 2 — 21,6 — M1

= 34 m — A1 [2]

= 35m. [8]

15 (i) $T - 0.2\,g = 0.2\,a$ } for both — B1 Both correct

$-T + 0.28\,g = 0.28\,a$

$0{,}28g - 0{,}2\,g = 0{,}28\,a + 0{,}2\,a$ — M1 Attempt to solve for a or T

$a = \dfrac{0.08g}{0.48}$ — ~~M1~~

$= 1{,}635\ ms^{-2}$ — A1 ~~[3]~~

~~(ii)~~ $T = 0.2\,(1.635) + 0.2\,(9.81)$ — M1

$= 2.289$ N — A1 ~~[2]~~

(iii) $0.08\,g - R = 0.08\,(1.635)$ — B1 ✓M1 using Newton's second law using his acceleration (i).

$R = 0.654$ N — A1 ~~[3]~~

[8].