ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

1 of 13

CONFIDENTIAL

MARKING SCHEME

NOVEMBER 2019

MATHEMATICS 6046/1

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All 5 questions) = $\frac{C_3^2}{C_3^{10}}$ M1

= $\frac{6}{252}$ A1 (2)

= $\frac{1}{42}$ = 0,0238 A0 [2]

It retains the original data B1

Or

It shows the shape of the distribution B1

Median = $\frac{1}{2}(22+1)^{th}$ observation or equiv method B1

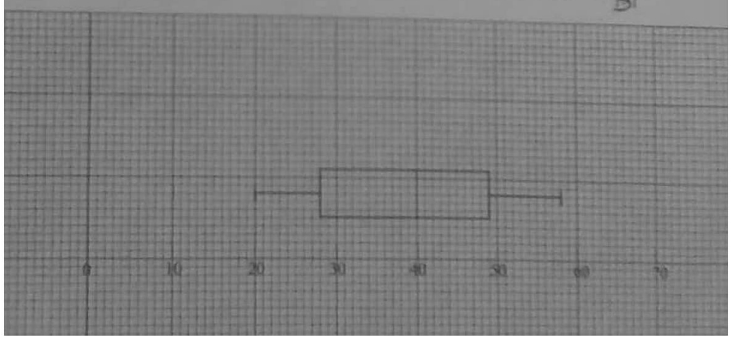
= 11.5th item

= 40

Lower quartile = 28 or 29 B1

Upper quartile = 49 or 49.5 B1

B1



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3 (a)

x	f	xf	x^2f
22.5	6	135	3 037.5
28	8	224	6 272
33	7	231	7 623
38	5	190	7 220
43.5	10	435	189 225

or equiv.

$\Sigma f = 36$ $\Sigma xf = 1\,215$

$\bar{X} = \frac{\Sigma xf}{\Sigma f} = \frac{1\,215}{36}$ M1

$= 33.75$ A1 [2]

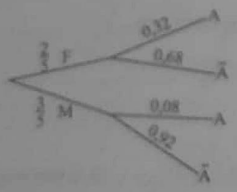
(b) $\Sigma x^2 f = 43\,075$ B1 (s.o.i) for $\Sigma x^2 f$

$\sigma = \sqrt{\frac{43\,075}{36} - (33.75)^2}$ M1 for use of formula

$= 7.58058$ A1 [3]

[5]

4



(a) $P(absent) = \frac{2}{5} \times 0.32 + \frac{3}{5} \times 0.08$ M1 Addition of products.

$= 0.176$ A1 [2]

(b) $P(F/A) = \frac{P(F \cap A)}{P(A)} = \frac{\frac{2}{5} \times 0.32}{0.176}$ B1 M1 for correct numerator for dividing by his part (a)

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5 (a) $\bar{X} \sim N\left(68, \frac{64}{100}\right)$ — B1

$P(\bar{X} < 66) = P\left(Z < \frac{66-68}{\sqrt{\frac{64}{100}}}\right)$ — M1

$= P(Z < -1.541)$

$= 1 - \Phi(1.541)$

$= 1 - 0.9383$

$= 0.0617$ — A1

[3]

(b) $P(67 < \bar{X} < 71)$

$P\left(\frac{67-68}{\sqrt{\frac{64}{100}}} < Z < \frac{71-68}{\sqrt{\frac{64}{100}}}\right)$ — M1

$= P(-0.772 < Z < 2.312)$

$= \Phi(0.772) + \Phi(2.312) - 1$ — M1

$= 0.7803 + 0.9897 - 1$

$= 0.7697$ — A1

[3]

[6]

6 (a) $\frac{1}{a} + a + \frac{5}{18} + b = 1$ ... (i) — At least one correct — B1

$\frac{1}{b} + 2a + \frac{5}{a} + 4b = \frac{25}{9}$ ... (ii)

$9a + 9b = 5$

$9a + 18b = 8$

$9b = 3$ — M1

$b = \frac{1}{3}$ $\quad a = \frac{2}{9}$ — A1√A1√

[4]

(b) $Var(X) = E(X^2) - [E(X)]^2$

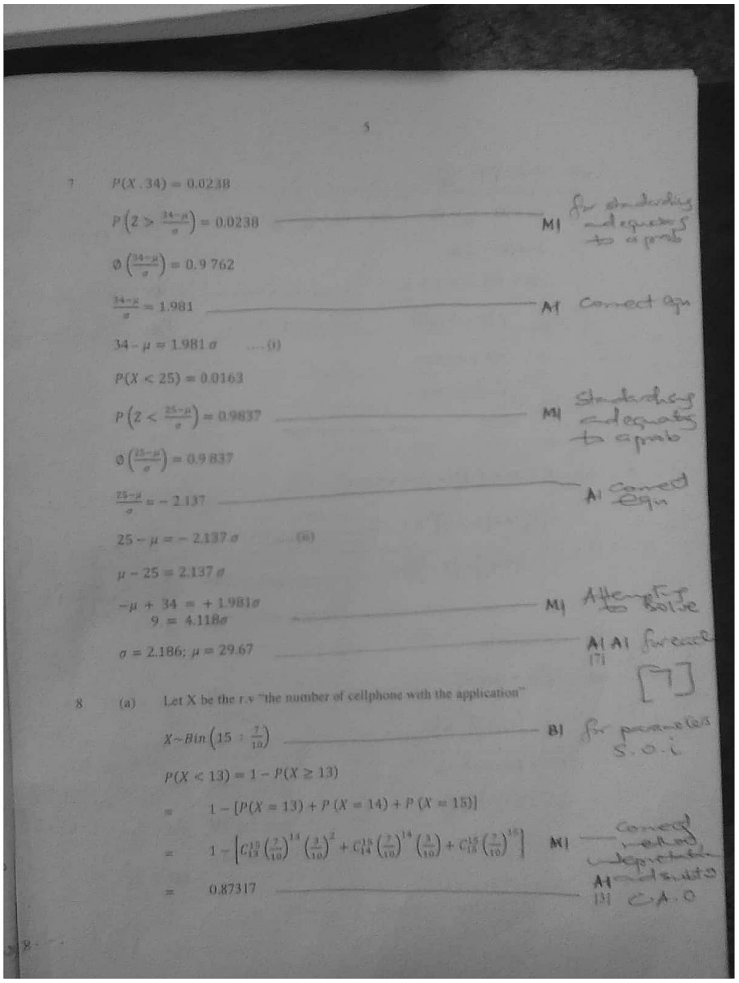
$= \frac{160}{18} - \left(\frac{25}{9}\right)^2$ — M1

$= \frac{95}{81}$ or equiv. — A1

[3]

[7]

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5

7 $P(X < 34) = 0.0238$

$P\left(Z > \frac{34-\mu}{\sigma}\right) = 0.0238$ — M1 for standardising and equating to a prob

$\Phi\left(\frac{34-\mu}{\sigma}\right) = 0.9762$

$\frac{34-\mu}{\sigma} = 1.981$ — A1 Correct eqn

$34 - \mu = 1.981\sigma$ ....(i)

$P(X < 25) = 0.0163$

$P\left(Z < \frac{25-\mu}{\sigma}\right) = 0.9837$ — M1 Standardising and equating to a prob

$\Phi\left(\frac{25-\mu}{\sigma}\right) = 0.9837$

$\frac{25-\mu}{\sigma} = -2.137$ — A1 Correct Eqn

$25 - \mu = -2.137\sigma$ ....(ii)

$\mu - 25 = 2.137\sigma$

$-\mu + 34 = +1.981\sigma$
$9 = 4.118\sigma$ — M1 Attempt to solve

$\sigma = 2.186;\ \mu = 29.67$ — A1 A1 for each [7]

[7]

8 (a) Let X be the r.v "the number of cellphone with the application"

$X \sim Bin\left(15 : \frac{7}{10}\right)$ — B1 for parameters S.O.I

$P(X < 13) = 1 - P(X \geq 13)$

$= 1 - [P(X = 13) + P(X = 14) + P(X = 15)]$

$= 1 - \left[C_{13}^{15}\left(\frac{7}{10}\right)^{13}\left(\frac{3}{10}\right)^{2} + C_{14}^{15}\left(\frac{7}{10}\right)^{14}\left(\frac{3}{10}\right) + C_{15}^{15}\left(\frac{7}{10}\right)^{15}\right]$ — M1 Correct method Expression

$= 0.87317$ — A1 [3] C.A.O

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(b) $X \sim B\left(60, \frac{7}{10}\right)$

$np = 60 \times \frac{7}{10} = 42$ ✓ $npq = 60 \times \frac{7}{10} \times \frac{3}{10} = 12.6$ ✓ B1B1 Correct parameters

$X \sim N(42, 12.6)$

$P(X > 45) \rightarrow P(X > 45.5)$ ——— B1 for c.c

$= P\left(Z > \frac{45.5-42}{\sqrt{12.6}}\right)$ ——— √M1 for standardising

$= P(Z > 0.9860)$

$= 1 - \Phi(0.9860)$

$= 0.162$ Accept use of other tables ——— A1 C.A.O

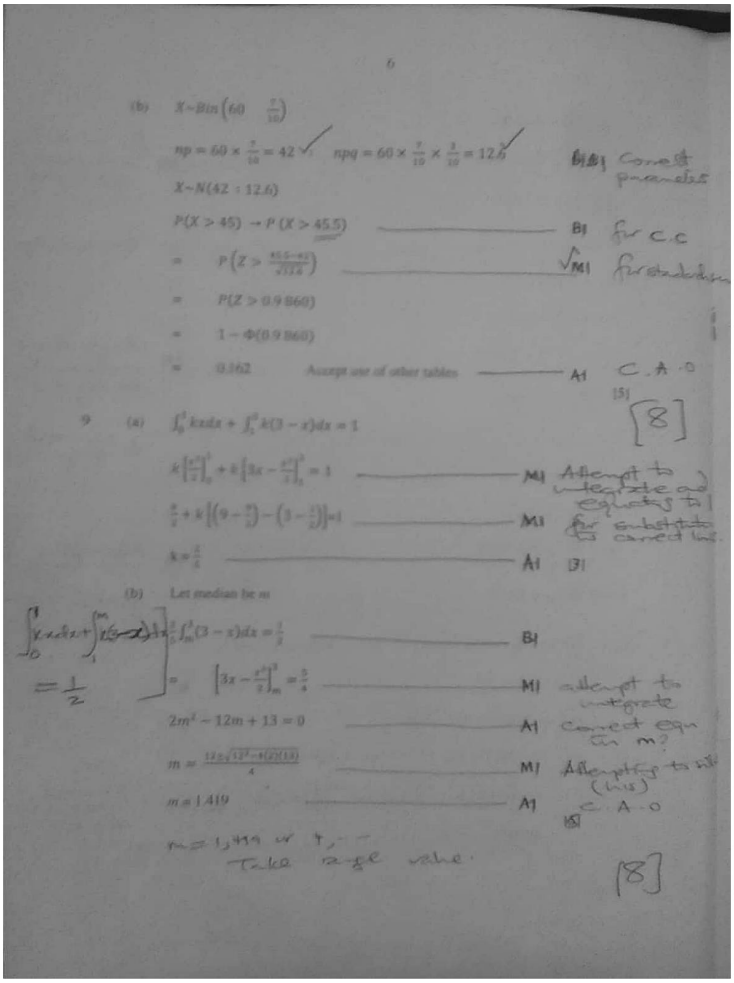
[5] [8]

9 (a) $\int_0^2 kx\,dx + \int_2^3 k(3-x)\,dx = 1$

$k\left[\frac{x^2}{2}\right]_0^2 + k\left[3x - \frac{x^2}{2}\right]_2^3 = 1$ ——— M1 Attempt to integrate and equate to 1

$\frac{k}{2} + k\left[\left(9 - \frac{9}{2}\right) - \left(3 - \frac{4}{2}\right)\right] = 1$ ——— M1 for substitution of correct limits

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(b) $X \sim Bin\left(60, \frac{7}{10}\right)$

$np = 60 \times \frac{7}{10} = 42$ ✓ $npq = 60 \times \frac{7}{10} \times \frac{3}{10} = 12.6$ ✓ B1B1 Correct parameters

$X \sim N(42, 12.6)$

$P(X > 45) \rightarrow P(X > 45.5)$ B1 for c.c

$= P\left(Z > \frac{45.5-42}{\sqrt{12.6}}\right)$ √M1 for standardising

$= P(Z > 0.9860)$

$= 1 - \Phi(0.9860)$

$= 0.162$ Accept use of other tables A1 C.A.O

[5]

[8]

9 (a) $\int_0^1 kx\,dx + \int_1^2 k(3-x)\,dx = 1$

$k\left[\frac{x^2}{2}\right]_0^1 + k\left[3x - \frac{x^2}{2}\right]_1^2 = 1$ M1 Attempt to integrate and equating to 1

$\frac{k}{2} + k\left[\left(6 - \frac{4}{2}\right) - \left(3 - \frac{1}{2}\right)\right] = 1$ M1 for substitute to correct limit

$k = \frac{2}{3}$ A1 [3]

(b) Let median be m

$\int_0^1 x\,dx + \int_1^m (3-x)\,dx = \frac{1}{2}$ B1

$= \left[3x - \frac{x^2}{2}\right]_m^2 = \frac{5}{6}$ M1 attempt to integrate

$2m^2 - 12m + 13 = 0$ A1 correct eqn in m?

$m = \frac{12 \pm \sqrt{12^2 - 4(2)(13)}}{4}$ M1 Attempting to use (this)

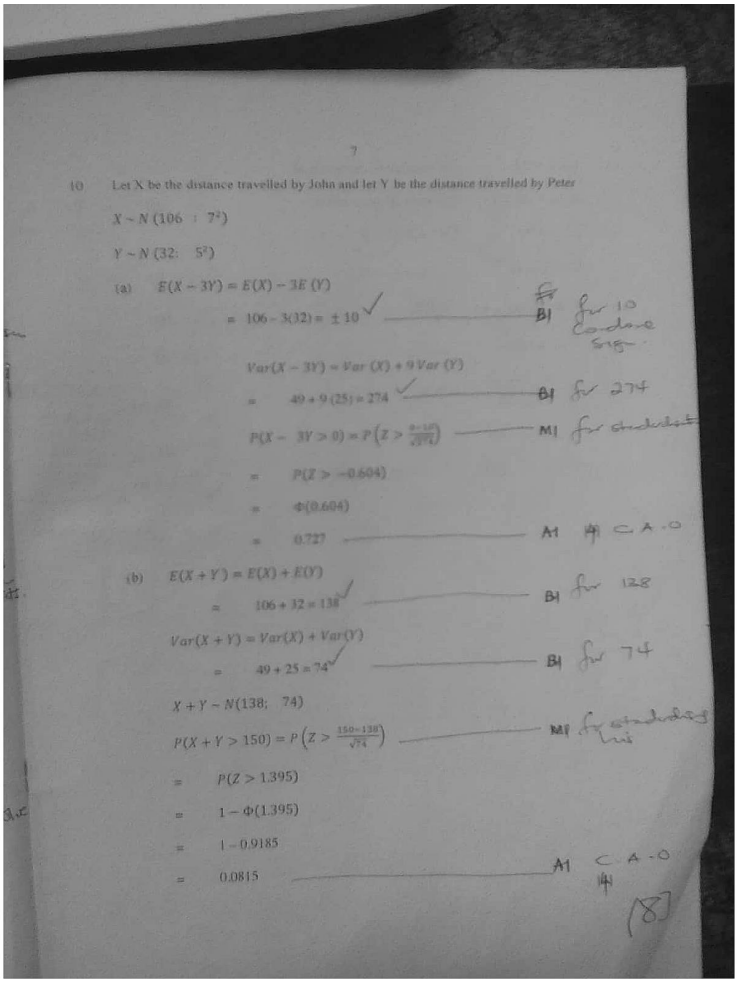
$m = 1.419$ A1 C.A.O

[5]

$m = 1.379$ or 9.62 Take real value.

[8]

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7

10 Let X be the distance travelled by John and let Y be the distance travelled by Peter

$X \sim N(106;\ 7^2)$

$Y \sim N(32;\ 5^2)$

(a) $E(X - 3Y) = E(X) - 3E(Y)$

$= 106 - 3(32) = \pm 10$ ✓ —— B1 for 10 Condone sign

$Var(X - 3Y) = Var(X) + 9Var(Y)$

$= 49 + 9(25) = 274$ ✓ —— B1 for 274

$P(X - 3Y > 0) = P\left(Z > \frac{0-10}{\sqrt{274}}\right)$ —— M1 for standardising

$= P(Z > -0.604)$

$= \Phi(0.604)$

$= 0.727$ —— A1 CAO

(b) $E(X + Y) = E(X) + E(Y)$

$= 106 + 32 = 138$ ✓ —— B1 for 138

$Var(X + Y) = Var(X) + Var(Y)$

$= 49 + 25 = 74$ ✓ —— B1 for 74

$X + Y \sim N(138;\ 74)$

$P(X + Y > 150) = P\left(Z > \frac{150-138}{\sqrt{74}}\right)$ —— M1 for standardising

$= P(Z > 1.395)$

$= 1 - \Phi(1.395)$

$= 1 - 0.9185$

$= 0.0815$ —— A1 CAO

[8]

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(c) (i) $r = \frac{10(27\,260)-(398)(664)}{\sqrt{16\,836}\ \sqrt{5904}}$ — M1 correct substitution

$= 0.8433$ — A1 C.A.O [2]

(ii) Strong positive linear correlation — B1 B1 for the 2 words [2]

13 1. $\frac{6}{252}$ M_1 $= \frac{6}{252} = \frac{1}{42} = 0,0238$ A_1 [11]

O	E	$\frac{(O-E)^2}{E}$	
67	61.43	0.50504	0,51
128	133.57	0.23227	0,23
26	28.04	0.14842	0,15
63	60.96	0.06827	0,066
16	19.53	0.63804	0,6
46	42.47	0.29340	0,28

M1 A1 A1 for E — correct method, any one correct, for all

M1 — correct method

A1 A1 for $\frac{(O-E)^2}{E}$ — for all correct, any one correct

H_0: there is no relationship between the size of the commuter omnibus and the number of fatal accidents. — B1 for H0

$X^2 = \frac{\Sigma(O-E)^2}{E} = 1.885$ — M1 A1 for summation — C.A.O (1,485 – 2,2482)

$X^2_{5\%}(2) = 9.21$ — B1 9,21

Since $1.885 < 9.21$. Do not reject H_0 and conclude that there is no relationship. — √M1 comparison, A1 conclusion [12] [12]

14 (a) $\bar{X} = \frac{\Sigma xf}{\Sigma f} = 2.5$ √ — B1

Let X be the number of buses passing a road block

$X \sim Po(2.5)$

H_0: X can follow a Poisson distribution — B1 for correct H0

H_1: X is not distributed in this way

Expected frequencies

$P(X = 0) = e^{-2.5}\frac{(2.5)^0}{0!} = 0.082084998624 \times 100$

$= 8.2085$

12 12 28 26 50 0 778 = 87 878

Rest ① 370 → 1560

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$P(X = 1) = e^{-2.5}(2.5) = 0.20521249656 \times 100$

$= 20.5212$

$P(X = 2) = 0.2565156 \times 100$

$= 25.65156$

$P(X = 3) = 0.2137630 \times 100$

$= 21.3763$

$P(X = 4) = 0.133602 \times 100$

$= 13.3602$

$P(X = 5) = 0.0668009 \times 100$

$= 6.68009$

$P(X > 6) = 0.0420210$

$= 4.2021$

M1 A1 — Correct method anyone correct

A1 — for all correct

$P(x>6) = 1-(P(x\leq 6))$

O	E	$\frac{(O-E)^2}{E}$
5	8.21	1.2551
23	20.52	0.2997
23	25.65	0.2738
25	21.38	0.6129
14	13.36	0.03066
10	10.88	0.07118

M1 A1 — for correct E, for all correct

B1 — Pooling!

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Correct method
M1 A1 — any one correct

A1 — for all correct

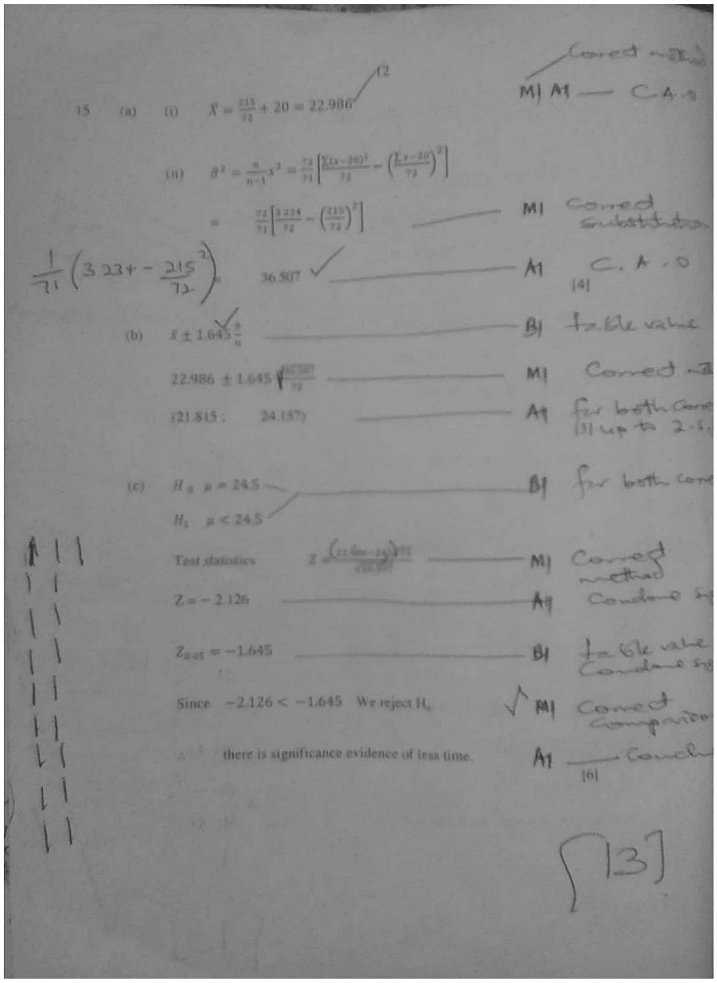
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for correct method E
M1 A1 — for all correct

B1 — Pooling!

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15 (a) (i) $\bar{X} = \frac{215}{72} + 20 = 22.986$ [2] — M1 A1 — C.A.O

(ii) $\hat{\sigma}^2 = \frac{n}{n-1}s^2 = \frac{72}{71}\left[\frac{\sum(x-20)^2}{72} - \left(\frac{\sum x-20}{72}\right)^2\right]$

$= \frac{72}{71}\left[\frac{3234}{72} - \left(\frac{215}{72}\right)^2\right]$ — M1 Correct substitution

$\frac{1}{71}\left(3234 - \frac{215^2}{72}\right)$ 36.507 ✓ — A1 C.A.O [4]

(b) $\bar{X} \pm 1.645\frac{\sigma}{\sqrt{n}}$ — B1 Table value

$22.986 \pm 1.645\sqrt{\frac{36.507}{72}}$ — M1 Correct method

(21.815 , 24.157) — A1 for both Correct [3] up to 2.d.p.

(c) H_0 $\mu = 24.5$

H_1 $\mu < 24.5$ — B1 for both correct

Test statistics $Z = \frac{(22.986 - 24.5)\sqrt{72}}{\sqrt{36.507}}$ — M1 Correct method

$Z = -2.126$ — A1 Conclusion

$Z_{0.05} = -1.645$ — B1 Table value Conclusion

Since $-2.126 < -1.645$ We reject H_0 — ✓ M1 Correct comparison

there is significance evidence of less time. — A1 Conclusion [6]

[13]

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