mathematics
paper 1 scheme

121/1 MS
MATHEMATICS (Alt. A)
Paper 1
Nov 2019
MARKING SCHEME

THE KENYA NATIONAL EXAMINATIONS COUNCIL

Kenya Certificate of Secondary Education

MATHEMATICS (Alt. A)

PAPER 1

MARKING SCHEME
(CONFIDENTIAL)

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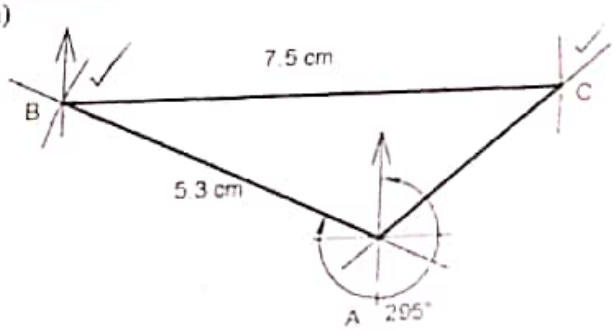
This marking scheme consists of 15 printed pages

MATHEMATICS ALT. A 121/1 PAPER 1 MARKING SCHEME

No.	Marking Scheme	Marks	Comments
1.	$\frac{5.4}{0.025\times3.6} = \frac{5.4\times10^4}{0.025\times3.6\times10^4}$ $= \frac{54\times1000}{25\times36}$ →	M1	Removal of decimals or equivalent
	$\frac{6000}{100}$ →	M1	Simplification
	$= 60$ →	A1	
		3	
2.	$1728 = 2^6\times3^3$ or $2\times2\times2\times2\times2\times2\times3\times3\times3$ $2025 = 3^4\times5^2$ or $3\times3\times3\times3\times5\times5$	B1 B1	
	$\frac{\sqrt[3]{1728}}{\sqrt{2025}} = \frac{\sqrt[3]{2^6\times3^3}}{\sqrt{3^4\times5^2}} = \frac{2^2\times3}{3^2\times5}$ —	M1	✓ removal of cube root and square root
	$= \frac{4}{15}$ or $0.2\dot{6}$ Accept 0.2667	A1	
		4	
3.	Time taken = $\left.\begin{matrix}10.15\\8.30\end{matrix}\right\}$ — 1.45	M_1	Correct subtraction of time.
	= 1 hr 45 mins = 1.75hrs = $1\frac{3}{4}$		~~Correct conversion of time taken to hours~~
	Speed = $\frac{140}{1.75}$ —	M1	or $\frac{140}{1\frac{3}{4}}$
	= 80 km/h —	A1	
		3	
4.	$4(q+6)+7(q-3) = 4q+24+7q-21$ —	M1	
	$= 11q+3$ —	A1	
		2	

P2

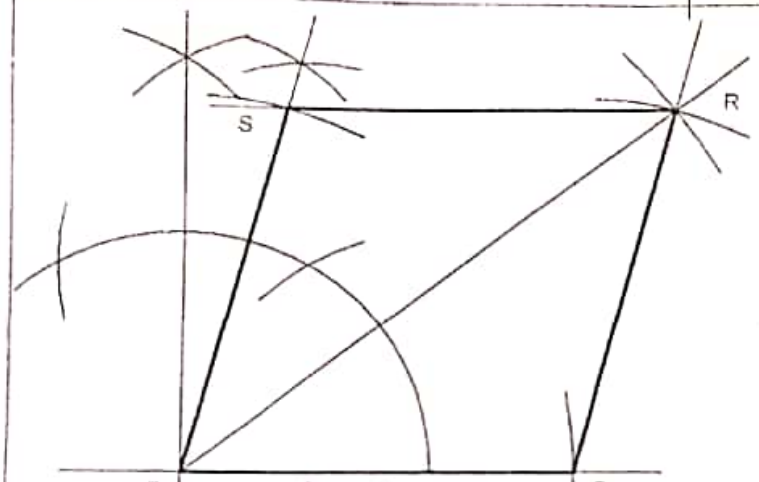
No.	Marking Scheme	Marks	Comments
5.	Area of trapezium $= \frac{1}{2}(8 + 6)h = 28$	M1	
	$7h = 28$		
	$h = 4cm$	A1	unit not a must
		2	
6.	$\sqrt[3]{9^4}\ \ 3^n$		ALT.
	$(3^2)^{\frac{4}{3}} = 3^n$	M1	Base 3 (both sides) $\frac{4}{3}\log 9 = n\log 3$
	$3^{\frac{8}{3}} = 3^n$	M1	$= \frac{4\log 9}{3\log 3} = n$
	$n = \frac{8}{3} = 2\frac{2}{3}$	A1	$2.666 = n$ or 2.667
		4	
7.	(a) 	B1	Location of B
		B1	Location of C
	(b)	B1	for AC = 3.5cm ± 0.1
		B1	for AC = 35km
		4	
8.	$40 = 2\times2\times2\times5$ $250 = 2\times5\times5\times5$ $350 = 2\times5\times5\times7$	M1	Process of cal the LCM
	LCM $= 2\times2\times2\times5\times5\times5\times7$	M1	~~process of cal the LCM~~
	$= 7000g$	A1	
		3	

P3

No.	Marking Scheme	Marks	Comments
9.	$\sin 2x = \cos(3x - 10)$		
	$2x + (3x - 10) = 90$	M1	Or equivalent
	$5x = 100$		
	$x = 20°$	A1	
	$\tan 20° = 0.3640$	B1	
		3	
10.	\$5820 = Ksh (5820×102.10) = Ksh 594222	M1	multiplication
	Balance in \$		
	$= \frac{594222 - 450000}{103.0} = \frac{144222}{103}$	M1	for conversion to ₹
	= 1400 US Dollars	A1	
		3	
11.	$\underline{a} = 3\begin{pmatrix}3\\2\end{pmatrix} - 2\begin{pmatrix}2\\4\end{pmatrix}$	M1	for substituting
	$\begin{pmatrix}9\\6\end{pmatrix} - \begin{pmatrix}4\\8\end{pmatrix}$		
	$= \begin{pmatrix}5\\-2\end{pmatrix}$	A1	
	$\lvert\underline{a}\rvert = \sqrt{5^2 + (-2)^2}$	M1	
	= 5.39	A1	
		4	

if a candidate writes $\sqrt{5^2 + -2^2}$ we write until we see $\sqrt{25 + 4}$ m1

* If the candidate fails to label the rhombus but writes and confirms his/her measurement of PR = 9.5cm then we award all the marks there.

No.	Marking Scheme	Marks	Comments
12.			If 75° is measured then; B0 B1 B1 B1 (3 mks)
		B1	Construction of 75°
		B1	✓ Locating point R
		B1	Complete Rhombus
	PR = 9.5 cm	B1	
		4	
13.	$2x - 1 \leq 3x + 4$		
	$-5 \leq x$	B1	
	$3x + 4 < 7 - x$		
	$4x < 3$		
	$x < \frac{3}{4}$ $x < 0.75$	B1	
	$-5 \leq x < \frac{3}{4}$	B1	
	{reject solution on a number line}	3	

90° must be constructed for a candidate to earn B1 for 75° at P.

Ps

No.	Marking Scheme	Marks	Comments
14	$\begin{pmatrix} 2 & 3 \\ 4 & 4 \end{pmatrix}\begin{pmatrix} x & 1 \\ 2 & 3 \end{pmatrix} = \begin{pmatrix} 2x+6 & 11 \\ 4x+8 & 16 \end{pmatrix}$	M1	process of multiplication
	$\begin{vmatrix} 2x+6 & 11 \\ 4x+8 & 16 \end{vmatrix} = 0$		
	$16(2x+6) - 11(4x+8) = 0$	M1	
	$32x + 96 - 44x - 88 = 0$		
	$32x - 44x = 88 - 96$		
	$-12x = -8$		
	$x = \frac{2}{3} = 0.\dot{6}$	A1	
		3	
15.	$A + B = 50$ $60A + 56B = 2872$	M1	the two eqn's
	$60A + 56(50-A) = 2872$	M1	substituting for B
	$4A = 2872-2800$		
	$4A = 72$		
	$A = 18$	A1	
		3	
16.	Time taken = 5 hours 40 min + 3 hours 15 min + 40 min = 9 hours 35min	M1	Or equivalent
	Arrival time = 08.15 + 9 hrs 35 min	M1	
	= 1750 hours	A1	Accept 1750 17.50 A0
		3	

ALT.

b(i) Total vol = 2.4 + 2 + 1.5 = 7.2 m³ = 7200l

Amount of water in the tank = 2.4 × 2 × 0.45 × 1000 + 10 × 3 × 60 − 48

= 3480l

Amount remaining to be filled 7200 − 3480 (m1) = 3720l

Time = $\frac{3720}{360}$ = 10½ hrs ∴ Total time = 10⅓ hrs + 2hrs (m1) = 13⅓ A1

No.	Marking Scheme	Marks	Comments
17.	(a) Volume of water required		
	= 2.4 × 2 × (1.5 − 0.45) m³	M1	Or equivalent 2·4+2+1·05
	= 2.4 × 2 × 1.05 m³		
	Amount of water in litres		
	= 2.4 × 2 × 1.05 × 1000 litres	M1	Conversion to litres
	= 5040 litres	A1	
	(b) (i)		
	Amount of water let in by 3h is		
	= 10 × 3 × 60 = 1800 litres		
	Amount of water drawn from the tank in 2h is		
	= 4 × 120 = 480 litres		
	Total amount of water in tank after 3h		
	= 2160 + 1800 − 480	M1	
	= 3480 litres	A1	
	Height of water in tank is		
	= $\frac{3480}{1000 \times 2 \times 2.4}$	M1	
	= 0.725 m	A1	
	b(ii) Height of water to be filled		
	= 1.5 − 0.725 = 0.775 m		
	Time in hours taken to fill the tank is		
	= $3h + \left(\frac{2.4 \times 2 \times 0.775 \times 1000}{6 \times 60}\right)h$	M1	
	= $3h + 10\frac{1}{3}h$	M1	
	= $13\frac{1}{3}h$ (or 13h 20min)	A1	
	800min or 48,000sec.	10	

{F.T.Φ}

ALT. b(ii) Time remaining to be filled after 3hrs

5040 − 1320 = 3720 m1

Time = $\frac{3720}{360}$ = 10hrs 20min

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Time taken to fill 10hrs + 2hrs (m1) + 3h

= 13hrs 20min A1

ALT.

b(i) Water added after 3hrs

600 + 720 (m1) = 1320 A1

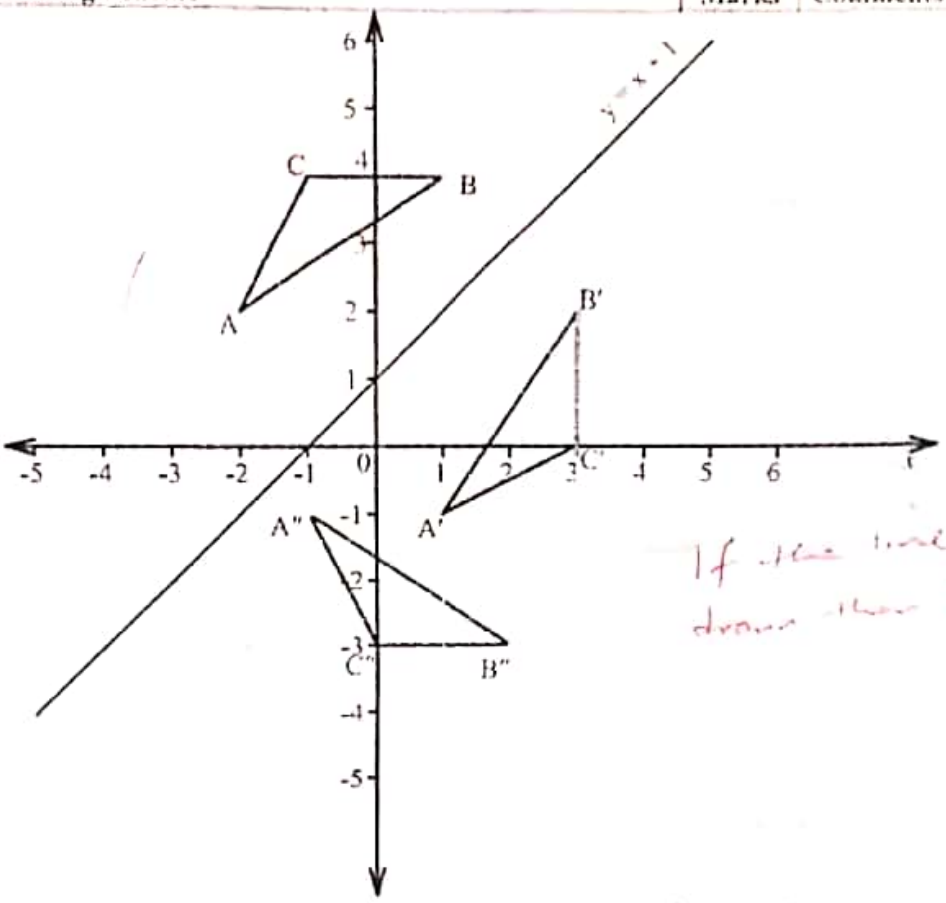
Height added

$\frac{1320}{1000 \times 2.4 \times 2}$ = 0.275 m1

New height = 0.45 + 0.275

0.725 A1

No.	Marking Scheme	Marks	Comments
18.	(a) Gradient		
	$\frac{7-3}{5-3}$ or $\frac{3-7}{3-5}$	M1	
	$= 2$ $= 2$		
	Equation of L_1		
	$\frac{y-3}{x-3} = 2$	M1	Or equivalent
	$y = 2x - 3$	A1	
	(b) (i) Gradient of L_2		
	$= -\frac{1}{2}$	B1	
	Equation of L_2		
	$\frac{y-3}{x+2} = -\frac{1}{2}$ or $\frac{y-3}{x--2} = -\frac{1}{2}$	M1	Or equivalent
	$y - 3 = -\frac{1}{2}x - 1$		
	$y = -\frac{1}{2}x + 2$	A1	
	(b)(ii) When $y=0$		
	$\frac{1}{2}x + 2 = 0$		
	$x = -4$		
	The x intercept of L_2 is -4	B1	
	(c) At point of intersection of L_1 and L_2		
	$2x - 3 = -\frac{1}{2}x + 2$	M1	
	$2\frac{1}{2}x = 5$		
	$x = 2$		
	When $x = 2$, $y = 2(2) - 3 = 1$	M1	
	Point of intersection is (2,1)	A1	
		10	

No.	Marking Scheme	Marks	Comments
19.			
	(a) (i) ΔABC correctly drawn	B1	
	(ii) Line $y = x + 1$	P1 L1	Plotting ✓Line drawn
	(iii) Triangle A'B'C'		
	Identifying coordinates of vertices of $\Delta A'B'C'$	B1	
	$\Delta A''B''C''$ correctly drawn	B1	
	(b) Correct rotation of -90°	B1	
	Correct vertices of $\Delta A''B''C''$	B1	
	$\Delta A''B''C''$ correctly drawn	B1	
	(c) (i) Oppositely Congruent	B1	
	(ii) Directly Congruent	B1	
		10	

No.	Marking Scheme	Marks	Comments
20.	(a) $\frac{AB}{8} = \frac{10}{20}$	M1	
	$AB = \frac{1}{2}\times 8$		
	$= 4\ cm$	A1	
	(b) (i) $AC = \sqrt{16+16}$ cm	M1	
	$= \sqrt{32}$ cm		
	$= 5.66$ cm	A1	
	(ii) $\frac{1}{2}$ height of pyramid		
	$\sqrt{10^2 - \left(\frac{1}{2}\times 5.66\right)^2} = \sqrt{(10^2 - 2.83^2)}$	M1	
	$= 9.59\ cm$	A1	
	(c) Volume of VABCD		
	$= \frac{1}{3}\times 4\times 4\times 9.59$	M1	
	$= 51.15\ cm^3$		
	Volume of VEFGH		
	$= \frac{1}{3}\times 8\times 8\times (2\times 9.59)$	M1	$2\times 9.59 = 19.18$
	$= 409.17$		
	Volume of frustum ABCDEFGH		
	$= 409.17 - 51.15$	M1	
	$= 358.02 cm^3$	A1	
		10	

ALT. (C)

L.S.F = 1:2

V.S.F = 1:8

V of frustum = $V_{Big} - V_{small}$ = 7

V of pyramid = 7x bl of small

$7 \times \frac{1}{3}\times 4\times 4\times 9.59$ M1M1

358.05 A_1

10

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ALT. (a)(i) Candidate who uses his/her own assumed mean; Column fd M1

median = A + $\frac{\sum fd}{\sum f}$ M1

179 A1

No.	Marking Scheme	Marks	Comments
21	(a) $2 + 8 + 10 + 6 + 2 + x = 40$ $x = 12$	B1	
	(b) Modal class = 180 – 189	B1	
	(c) (i) Mean		

(M1) (M1)

Height	Mid pt	Freq	fx
150 - 159	154.5	2	309
160 - 169	164.5	8	1316
170 - 179	174.5	10	1745
180 - 189	184.5	12	2214
190 - 199	194.5	6	1167
200 - 209	204.5	2	409
		40	**7160**

M1 for midpoint x {All correct}

M1 for fx {All correct}

Mean height = $\frac{7160}{40}$ M1

= 179 A1 C.A.O

(ii) Median

U.C.B	159.5	169.5	179.5	189.5	199.5	209.5
C.F	2	10	20	32	38	40

B1 B1 From table or implied

Median Height = height of 20th athlete

= 179.5 M1 A1 C.A.O

	10

* ALT.

Median = $169.5 + \left(\frac{20-10}{10}\right) \times 10$ M1

B_1

= 179.5 A1

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H/B ⇒ If a candidate does the average for 20th & 21st then; B0 B0 M0 A0. {B_1 – is for c.f}

No.	Marking Scheme	Marks	Comments
22.	(a) Let $\angle BDC = \theta$		
	$\frac{\sin\theta}{5} = \frac{\sin 30^\circ}{4}$	M1	Follow thro Question
	$\sin\theta = \frac{5\times\sin 30}{4}$ 0.625	A1	
	Acute $\theta = 38.68^\circ$		
	Obtuse $\theta = 141.32^\circ$	B1	
	(b) Length AD		
	Angle ABD $= 180 - 38.68\times 2$	M1	process of getting 102.64
	$= 102.64$		
	$AD^2 = 4^2+4^2 - 2\times4\times4\cos 102.64$	M1	use of cosine rule/Sine rule
	$= 39$		
	$AD = 6.25m$	A1	
	(c) Length of DC		
	$\angle DBC = 180 - (30+141.32)$		
	$= 8.68^\circ$		
	Using sine rule		
	$\frac{\sin 8.68}{D} = \frac{\sin 30}{4}$	M1	
	$\Rightarrow$		
	$D = 8\sin 8.68$		
	$1.21m$	A1	
	(d) Area of ABC		ALT. Heron's formula
	$= \frac{1}{2}\times 4\times 5\sin(8.68+102.64)$	M1	$S = 8.23$, $A = 9.31m^2$; $8.68^\circ + 102.64^\circ = 111.32^\circ$
	$= 9.32m^2$	A1	
		10	

ALT.

b) $4\cos 38.68^\circ = \frac{1}{2}AD$ M1

$AD = 4\cos 38.68$

$6.25m$ A1

b) $\frac{AD}{\sin 102.64} = \frac{4}{\sin 18.68}$ M1A1

$AD = \frac{4\sin 102.64}{\sin 18.68} = 6.25m$ A1

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No.	Marking Scheme	Marks	Comments
23.	(a)		

x	0	200	400	600	800	1000	1200	
Ordinates along AB	200	240	280	300	280	240	200	B1
Ordinates along CD	400	500	580	600	580*	580	640	B1
AC − AB	200	260	300	300	300	340	440	

For ordinates along CD
At $x = 800$, accept
$580 \leq 580^{*} \leq 590$

(b) Area of piece of land ABCD using trapezium rule

Area under curve AB

$= \frac{1}{2} \times 200\{(200 + 200) + 2(240 + 280 + 300 + 280 + 240)\}$ — M1

$= 100(400 + 2680)$

$= 308\,000\ m^2$

Area under curve CD

$= \frac{1}{2} \times 200\{(400 + 640) + 2(500 + 580 + 600 + 580 + 580)\}$ — M1

$= 100(1040 + 5680)$

$= 672000$

Area of land ABCD

$= 672000 - 308000$

$= 364000\ m^2$ — A1

$= \frac{364000}{10000}$ ha

$= 36.4$ ha — B1

(c) (c) Area using mid ordinate Rule:

$= 400\{(500 + 600 + 580) - (240 + 300 + 240)\}$ — B1 — Mid ordinates

$= 400 \times 900$ — M1 — Subtraction

$= 360000\ m^2$ — A1

$= \frac{360000}{10000}$

$= 36$ ha — B1

10

P13

No.	Marking Scheme	Marks	Comments
24.	(a)(i)		
	$y = x^3 + x^2 - x - 1$		
	$\frac{dy}{dx} = 3x^2 + 2x - 1$	M1	
	$3x^2 + 2x - 1 = 0$ at stationary point.		
	$(x + 1)(3x - 1) = 0$	M1	
	$x = -1$ or $\frac{1}{3}$		
	$(-1, 0)$ and $\left(\frac{1}{3}, -1\frac{5}{27}\right)$ or $(0.3, -1.185)$	A1	reject $\left(\frac{1}{3}, -\frac{32}{27}\right)$ A0
	(b)(ii) Nature of stationary points		
	$\frac{d^2y}{dx^2} = 6x + 2$		
	At $x = -1$		
	$\frac{d^2y}{dx^2} = -6 + 2$		
	$= -4$ (Negative)		
	$x = -1$ is a maximum point.	B1	for testing and stating
	At $x = \frac{1}{3}$,		
	$\frac{d^2y}{dx^2} = \frac{6}{3} + 2$		
	$= 4$		
	At $x = \frac{1}{3}$ is a minimum point	B1	for testing and stating

If a student gets a(i) A0 but uses -1 & $\frac{1}{3}$ correctly for testing & stating then the student is given B1 M1 in a(ii)

B1 ✓

No.	Marking Scheme	Marks	Comments
	(b) (i) at $x = 1$ $y = 0$ At $x = 1$ $\frac{dy}{dx}$ $3(1) + 2(1)$ $1 = 4$ Equation of tangent $\frac{y-0}{x-1} = 4$ $y = 4x - 4$ (b) (ii) Let gradient of normal = m_2 $m_2 \times 4 = -1$ $m_2 = -\frac{1}{4}$ $\frac{y-0}{x-1} = -\frac{1}{4}$ $y = -\frac{1}{4}x + \frac{1}{4}$	B1 M1 A1 M1 A1 10	

P15