K.C.S.E 1996 MATHEMATICS PAPER 121/1 MARKING SCHEME

SOLUTION	MARKS	ALTERNATIVE METHOD
1. No. | Log 36.15 | 1.5581 0.02573 | $\bar{2}.4104$ | $\bar{1}.9685$ 1.938 | 0.2874 | $\bar{1}.6811 \div 3$ | $(\bar{3} + 2.6811) \div 3$ $7{,}829 \times 10^{1}$ 1.8937 = 0.7829 or 0.7828	m1 m1 A1 3 marks	✓ ✓ 3 log (All logs) Additional, subtraction & division by 3 for -ve characteristic division by 3 Accept 0.78.28 or standard form
2. $3x^2 - 3xy + xy - x^2$ $3x(x-y) + y(x-y)$ $(x-y)(3x+y)$	m1 A1	Award marks for working by inspection be $(x-y)\,3x=y)$ m1 A1
3. $5s + 3b = 1750$ .....(i) $3s + b = 850$ .....(ii) $5s + 3b = 1750$ ..... (iii) $9s + 3b = 2550$ ..... (iv) $4s = 800$ $S = 200$ $b = 250$	B1 m1 A1 3 marks	For forming simultaneous equations Elimination of equivalent T/E evidence Scores B1 M1 A1
4. $\tan 45° = \frac{h}{60}$ or $h = 60$ m $\tan\theta = \frac{60}{240} = 0.25$ $= 14.04°$ ($14° 2'$)	m1 m1 A1 3 marks	Scale drawing 90°, 45 ± 1 m1 h θ 45° ↓80° m com⊥ m1 θ = 14° ± 1° A1
5. $67° = \angle ADB = 180° - (45 + 68)$ $31° = \angle ABD = 180° - 67 + 82$ $68° - 31 \angle DBC$ $= 37°$	m1 A1 m1 A1 4 marks	98 ∠DCB m1 37O ∠DBC A1 68° - 37° ABD m1 = 31°
6. $a = 6000$ $n = 5$ $s_5 = 32400$ $32400 = \frac{5}{2}(12000 + 20d)$ $64800 = 60000 + 20d$ $20d = 4800$ $d = 240$	 B1 m1 * A1 3 marks	1st year = 6000 2nd year = 6000 + d 3rd year = 6000 + 2d 4th year = 40000 + 3d 5th year = 6000 + 4d 30000 + 10d = 32400

SOLUTION	MARKS	ALTERNATIVE METHOD
7. (a) $21000 \times 48 - 560000$ $1008000 - 560000$ $= 448000$ (b0 $448000 = \frac{560000 \times R \times 4}{100}$ $r = \frac{44800 \times 100}{560000 \times 4}$ $= 20\%$	m1 A1 m1 A1 4 marks	
8. Cap of the tank $= 2.4 \times 2.8 \times 3 \times 1000$ $= 20160$ litres Amount needed $= 20160 - 3600$ $= 16560$ litres Time $= \frac{16560}{0.5 \times 60 \times 60}$ $= 9h$ 12 minutes	m1 m1 m1 m1 A1 4 marks	When converting to litres For the subtraction $2.4 \times 2.8 \times y \times 100 = 3600$ $y = 0.5357$
9. $17500 \times \frac{95}{5}$ $=$ Sh 332500	m1 A1 2 marks	
10. 25, 289, 4, 484, 4 806 $o = \sqrt{\frac{806}{5}}$ $= \sqrt{161.2}$ $= 12.7$	B1 m1 A1 4 marks	B0 if item missing For $\frac{806}{5}$ For sqrt. method of S.D. manipulation if B0
11. $A^2 = \begin{pmatrix}1 & 2\\4 & 3\end{pmatrix}\begin{pmatrix}1 & 2\\4 & 3\end{pmatrix} = \begin{pmatrix}9 & 8\\16 & 17\end{pmatrix}$ $B = \begin{pmatrix}9 & 8\\6 & 17\end{pmatrix} = \begin{pmatrix}1 & 2\\4 & 3\end{pmatrix} = \begin{pmatrix}8 & 6\\12 & 14\end{pmatrix}$	m1 A1 m1 A1 A1 4 marks	 If A1 above lost But first must be second
12. $\frac{5}{2}\theta$ - $210°, 330$ $\theta = \frac{420°, 660°}{5}$ $= 84°, 132°$	B1 B1 2 marks	

13. B.P $= \frac{144}{6} \times 100$ S.P $= \frac{165}{100} \times \frac{144}{6} \times 100$ $= 3960$ Let pineapple sole at Sh.72 for every 3 be x and at Sh.60 for every 2 be $144 - x$ $\frac{144-x}{2} \times 60 + \frac{x}{3} \times 72 = 3960$ $4320 - 30x + 24x = 3960$ $60x = 360$ $x = 60$	m1 m1 A1 3 marks	ALT $BP = \frac{144}{6} \times 100$ $SP = \frac{x}{3} \times 72 + \frac{144x}{2} \times 60$ $24x + (144-x)\,30$ $24x + (144 - x)30 - 2400$ $= 24.00$ m1 $= 55$ m1
14. $\frac{2T}{m} = U^2 - V^2$ $V^2 = U^2 - \frac{2T}{m}$ $V = \sqrt{U^2 - \frac{2T}{m}}$	m1 m1 A1 3 marks	$Mu^2 - Mv^2 = 2T$ m1 $MV^2 = Mu^2 - 2T$ $V^2 = Mv^2 - 2T$ m1 $V_2 = \frac{Mu - 2T}{M}$ $V = \sqrt{\frac{Mu^2 - 2T}{M}}$ A1
15. R = 8.5 r = 5.5 $V = \pi R^2 h - \pi r^2 h$ $= \frac{22}{7} \times 14\,(8.5 - 5.5)(8.5 + 5.5)$ $= 44\ (3)\ (14)$ $= 1848$	B1 m1 A1 3 marks	Award m1 for (8.5 - 6.5) (8.5 + 6.5) only CAO
16. Let speed of B be x km/h and " " A be (x + 5) km/h Time for A $= \frac{3120}{x+5}$ Time for B $= \frac{3120}{x}$ $= \frac{3120}{x} - 4 = \frac{3120}{x+5}$ $3120\,(x + 5) - 4x(x+5) = 3120x$ $3120x + 15600 - 4x^2 - 20x = 3120x$ $4x^2 + 20x - 15600 = 0$ $x2 + 5x - 3900 = 0$ $(x - 60)\,(x + 65) = 0$ $x = 60$km/h	B1 m1 m1 A1 5 marks	Speed A is x B is x - 5 $A = \frac{3120}{x}$ $B = \frac{3120}{x-5}$ } B1 $\frac{3120}{x} + 4 = \frac{3120}{x-5}$ m1 $3120(x - 5) + 4x\,(x-5) = 3120x$ m1 $x^2 - 5x - 39600 = 0$ m1 $(x - 65)\,(x + 60)$ $x = 60$km/h A1

SOLUTION	MARKS	ALTERNATIVE METHOD
21. a) $\begin{array}{c\|ccccc} x & -5.5 & -5 & -4.25 & -3.75 \\ \hline y & 16.25 & 12 & 6.56 & 3.56 \end{array}$ $y = x^2 + 2x - 3$ b) $A = 0.5\,(18.56 + 14.06 + 10.06 + 6.56 + 3.56 + 106)$ $0.5 \times$ '53 $\times$ '53.86' $= 26.93$s1 units c) (i) $= \frac{x^3}{3} + x^2 - 3x \Big\|_{-6}^{3}$ $= 9 + 18$ $= 27$ sq units (ii) $\frac{27 - 26.93 \times 100}{27}$ $= \frac{0.07}{27} \times 100$ $= (0.2592\%, 0.2593\%)$	B1 m1 A1 m1 A1 m1 A1 8 marks	
22. a) (1) $AC = OA + OC$ $= -a + b$ b) $BN = BA + AN$ $= -b - \frac{2}{3}a$ c) (i) $AX = hAC$, $BX = kBN$ $OX = OA + AX = a + h(b - a)$ ..... (1) $OX = OA + AB + BX$ $a + b + K(-b - \frac{2}{3}a)$ ..... (2) $a - ha + hb = a - \frac{2}{3}ka + b - kb$ $(1 - h)a + hb = (1 - \frac{2}{3}k)a + (1 - k)b$ $(1 - h)a + hb = (1 - \frac{2}{3}k)a + (1 - k)b$ $1 - h$ $1 - \frac{2}{3}k$ ..... (3) $h = 1 - k$ ..... (4) $h\,\frac{2}{5}$ $k = \frac{3}{5}$ b) (ii) $OX = a + \frac{2}{5}(b - a)$ $= \frac{3}{5}a + \frac{2}{5}b$	B1 m1 A1 m1 m1 A1 B1 8 marks	

SOLUTION	MARKS	ALTERNATIVE METHOD
23 a Bisecting < BAD	B1	
b) Construction of 1 at B and at A	B1	
" " 45° or 135° at B	B1	
Bisecting 45° or 135° to get $67^{1}/_{2}°$ at B	B1	A construction of $67^{1}/_{2}$ at A
Construction of 1 bisector of AB	B1	
Identification of AB	B1	
Identification of the centre O	B1	If complete circle drawn B0
identification of the locus P	B1	unless otherwise illustrate
(c) Size of the <ABC = 131° ± 1°	8 marks	
24. (a) (i) P (B) = $^{8}/_{15}$	B1	
(ii) P (G or R) = $^{7}/_{15}$	B1	
	B1	For tree diagram branches required
		For both b(i) and (ii) follow through a multiple of ratio 8:2:5
(b) (i) P (first two pens picked are both green)		
$\frac{2}{15} \times \frac{1}{14} = \frac{1}{105}$ or 2 any other multiples $\frac{}{210}$	m 1	
	A1	
(ii) $\frac{8}{15} \times \frac{5}{14} + \frac{2}{15} \times \frac{5}{14} + \frac{5}{15} \times \frac{8}{14} + \frac{1}{15} \times \frac{2}{14}$		ml All produces
$\frac{40 + 10 + 40 + 10}{15 \times 14}$	ml	For summary products
$= \frac{10}{21}$	Ap	It tree diagram missing Ow -1

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SOLUTION	MARKS	ALTERNATIVE METHOD
1 $\sqrt{\frac{62.5 \times 25.6}{25 \times 8 \times 5}}$ $= \sqrt{16}$ $= 4$ $\sqrt{\frac{605 \times 25.6}{25 \times 80 \times 5}}$	m1 m1 A1 4 marks	Removal of dp in denominator Mt - 2 Use of log
2. $R = \frac{k}{d^4} - 2 = \frac{k}{3^2}$ $k = 18$ When $d = 4$ $R = \frac{18}{4^2} = \frac{18}{16}$ $= 1.125$ or $1\frac{1}{8}$	m1 m1 A1 3 marks	See constant K- m1 But first m0 Use 'his' k but A0 or $\frac{9}{8}$ C AO
3) Let Ali have a goats $= a + a + 2 + 3(a + 2) + a + 2 + 3(a + 2) - 10$ $= 9a + 6$ $9a + 6 - 17 \times 3$ $9a = 45$ $a = 5$ Odupoy sold 28 - 10 = 18 goats	B1 m1 A1 4 marks	or the total must be for all or equivalent 9m - 12, 3k - 12 m-7, k=12 Allow if B1 and m1 are earned
4. Ksh. bought = 98 x 84 = 77112 £ bought = $\left\{\frac{918 \times 84}{85}\right\}$ = £907.2 £ lost = £ 918 - £907.2 = £10 Use of log 10.6	m1 m1 A1	$\frac{77112}{85}$ m1 $\frac{918}{85}$ 918 $\frac{92,81}{85}$ = 10.8 $\frac{918}{85}(155 - 84) = \frac{918}{85} = 10.8$ Constructing segment centre B Identifying second centre D Constructing segment with new centre D Note : apply Ow - 1 circles are complete and lock not identified
6. P (both winning) = $\frac{3}{8} \times \frac{4}{7} = \frac{12}{56}$ $= \frac{3}{14}$ P (at least one winning) $= 1 - \frac{5}{8} \times \frac{3}{7} = 1 - \frac{15}{56}$ $\frac{11}{56}$	m1 A1 m1 4 marks	$\frac{3}{8}$ V $\frac{4}{7}$ L $\frac{8}{7}$ $\frac{3}{7}$ or $\frac{3}{8} \times \frac{3}{7} + \frac{5}{8} \times \frac{3}{7} = \frac{3}{8} + \frac{4}{7}$

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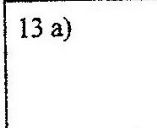
SOLUTION	MARKS	ALTERNATIVE METHOD
7) $1 + x^2 = (2x - 1)^2 - 1$ ✓ $3x^2 - 4x - 1 = 0$ ✓ $x = \frac{4 \pm \sqrt{28}}{6}$ ✓ $= 1.549$ ✓	M1 M1 M1 A1	Use Pythagras therorem $1 + x^2$ and $(2x - 1)^2 = 4x^2 - 4x$ simplification and equating to zero or equivalent for choosing positive root only
8) Area $= \int_2^4 (2x^3 - 5)\,dx$ ✓ $= \left[\frac{x^4}{2} - 5x\right]_2^4$ ✓ $= 108 + 2$ $= 110$ Sq. units ✓	M1 M1 A1 3marks	Integration By numerical substitution all coordinates m1 m1 A1 4 strips area = 111.4915 8 strips area = 110.38 (110.3708)
9. $= 2^{3\,(4x3)}$ $\Rightarrow 4x^2 = 12x - 9$ $4x^2 - 12x + 9 = 0$ $= (2x - 3)(2x - 3) = 0$ $x = 1\frac{1}{2}$	m1 m1 A1 3 marks	$4x^2 = 3(4x - 3)$
10. Vol. of Container $= 36 \times 24 \times 18 = 15{,}558 cm^3$ V.S.F $= (L.S.F)^3 = 1:216$ $\Rightarrow 216 \equiv 15{,}558 = \frac{15558}{216} =$ $1 \equiv ?$ $= 72 cm^3$	m1 A1 2 marks	or 6 x 4 x 3
11. Missing values of y: 26, 138 Area $= \frac{1}{2} \times 2\,(10 + 230) + 2\,(6 + 26 + 70 + 138)$ $= 240 + 480$ $= 720$	B1 m1 m1 A1 4 marks	Integration used MR - 2 Simplification into formula Simplification of inner bracket
12. $(1 + a)5 = 1 + 5a + 10a^2 + 10a^3 + 5a^4 + a^5$ $(1 - 0.2)^5 = 1 + 5\,(-0:2) + 10\,(-0.2)^2 +$ $10\,(-0.2)^3 + 5(-0.2) + (-0.2)^5$ $1 - 1 + 4 - 0.08 + 0.008 - 0.00032$ $= 0.40800 - 0.8032 = 0.32768$ $= 0.3277$	B1 m1 A1 3 marks	Subtraction of a = -0.2

SOLUTION	MARKS	ALTERNATIVE METHOD
13 a) 	B1	
b) $AC^3 - 2(a)^2 + (2a)^2 - 8a^2$ $AC = 2a\sqrt{2} \quad = {}^1/_2 AC = a\sqrt{2}$	m1	$\text{Cos} = \frac{AC^2 + VC^2 \; VA^2}{2\,AC\,VC}$
$\text{Cos}\,\theta = a\sqrt{2} \quad = 1.414 = 0.4713$	A1	$\frac{2}{3\sqrt{2}}$
$\theta = 61^{\circ}\,53'$ (61.88°)	4 marks	$= 0.476$
14. $x^3 = 57 \times 3 - (55 + 56) = 60$ $x^4 = 59 \times 3 - (56 + 60) = 61$ $av3 = \frac{60 + 61}{3} : 62 = 61$ $av5 = \frac{62 + 60 + 70}{3} = 64$		
15. $\text{Sin}\,\theta = \frac{10}{20} = 0.5$ $\theta = 30°$ course = 030° or N30E	M1 A1 B1 3 marks	
16. $(1 + \sqrt{3})(1 - \sqrt{3}) = 1 - 3 = -2$ $\frac{1}{1+\sqrt{3}} = \frac{1}{1+\sqrt{3}} \times \frac{1-3}{1-\sqrt{3}} = \frac{1 - 1.7321}{-2}$ $\frac{-0.7321}{-2} = 0.366$	B1 B2 2 marks	Must make use of -2
17 a) (i) Total collection = Sh. 80 x 25 x 6 = Sh. 12,000	m1 A1	MRE - 34 trip used (i) 6000 (ii) 150
(ii) Net profit = 1200 - (1500 + 200 + 150 + 4000) = Sh. 12000 - 5850 = Sh. 6150	m1 A1	$\frac{80}{100} \times 600 = 4800$
b) The day's collections = $\frac{80}{100} \times 2000$ = Sh. 9,600	m1	$\frac{80 \times 25 - 80 \times 6}{100}$ 9,600
The net profit = Sh.9600 - 5850 = Sh 3750	m1	C.A.O. 4800 5850 $\frac{2}{3}(-10.50)$ m1
Shares $\frac{2}{5} \times 3700$ or $\frac{3}{5} \times 3750$	m1	$\frac{3}{5}(-10.50)$ m1
Sh 1500 and Sh 2250	A1 8 marks	for both CAO

SOLUTION	MARKS	ALTERNATIVE METHOD
18. a) (i) $\angle BAC$ or $\angle BCA = \frac{1}{2} \times 90^0 = 45^0$ $\angle CAD = 180 - (90 + 25)$ or $^1/_2 \times (180 - 2 \times 25)$ $= 65^0$ $\angle BAD = 45^0 + 65^0 = 110^0$ (ii) Obtuse $\angle BOD = 2(45 + 25)$ $= 140^0$ (iii) $\angle ACB = \angle BAC = 45^0$ base $\angle ABE = \angle ACB = 45^0$ <S in all segment $\angle CBF = \angle BAC = 45^0$ <S in all segment $\therefore \angle ABE = \angle CBF$	m1 m1 A1 B1 B1 B1 B1 B1	Can be indicated on diagram or BAD - 180 (25 + 45) 110° m1, m1 A1 140° m1, a1, 0w - 1 Allow B1 to ABE - 45O - CBF Adequate reason
19.		
Md x | f | fx | fx^2 9 | 4 | 36 | 324 12 | 7 | 84 | 1008 15 | 11 | 165 | 2475 18 | 15 | 270 | 4860 21 | 8 | 168 | 3528 24 | 5 | 120 | 2880 $\Sigma fx = 843$ | | | 15075		x | f | d | fd | fd2 9 | 4 | -6 | -24 | 144 12 | 7 | -3 | -21 | 63 15 | 11 | 0 | 0 | 0 18 | 15 | 3 | 45 | 135 21 | 8 | 6 | 48 | 388 24 | 5 | 9 | 45 | 405 fd = 93 | | | Σfd2 | 103
FX : 36. 84, 165, 270, 168, 120 a) Mean = $\frac{843}{50}$ = 16.86	M1 m1 A1	For at least 5 values $15 + \frac{93}{50} = 16.86$ 15 + 1.86 = 16.86
(b) (i) fx^2 : 324, 1008, 2475, 4860, 3528 2880 Variance = $\frac{15075 - 16.86^2}{50}$ = 301.5 - 284.2 = 17.3 (17.24) (ii) S.D. = $\sqrt{17.3}$ = 4.159 or (4.152)	m1 m1 m1 A1 8 marks	15 + 1.86 = 16.86
20. Location of T Location of K Location of G a) Distance TK = 80 ± km Bearing of t from K; 043° ± 1 b) Distance GT = 72 ± 2 km Bearing of G from T : 245° ± 2° c) Bearing of R from G: 130° ± 2°	B1 B1 B1 B1 B1 B1 B1 B1 8 marks	Measure length 8.4.÷1 cm 6.0 + 1 cm 30 + 0.1 cm Apply if either K of G is positively located If the diagram initially constructed

SOLUTION	MARKS	ALTERNATIVE METHOD
21 a) 2nd year saving = $2000 \times \frac{115}{100}$ = Sh. 2300	B1	Compound interest formula used will earn the candidate B1B1
b) 3rd year saving = $2300 \times \frac{115}{100}$ = Sh. 2645	B1	
c) Common ratio = $\frac{115}{100}$ or $\frac{23}{20}$	B1	or Equivalent $\frac{2300 - 15}{2000}$
d) $2000\ 9\ 1.15^{\circ} - 1) = 58000$ $1.15 - 1$ $2000 \times 1.15^{\circ} = 8700 + 2000$ $1.15^{\circ} = 8700 + 2000$ nlog 1.15 = log 5.35 0.0607n = 0.7284 $n = \frac{0.7284}{0.0607} = 11.99$ = 12	m1 m1 A1	m0 wrong use of formula $\frac{\log 29 = \log \text{arithms}}{\log 1.15 \quad \log}$ $n = \frac{\log \text{arthms}}{\log} = 1.4$
e) $S30 = \frac{2000 \times 1.1520 - 2000}{0.15}$ $= \frac{2000 \times 16.37 - 2000}{0.15} = \frac{30730}{1.15}$ = 204800 = 204933	m1 A1 8 marks	Numerical simplification of $\frac{2000 \times 1.1520 - 2000}{0.15}$
22. a) $x > 0$ and $y > 0$ $x + y = 7$ $64x + 48y \geq 384$ or $(4x + 3y \geq 24)$	B1	
b) $x + y - 7$ drawn $64x + 48y = 389$ Shading	L1 B1	
c) No. of buses for minimum cost 3 type of x and 4 type y or for $x = 3$ and $y = 4$	B1 B1	

SOLUTION	MARKS	ALTERNATIVE METHOD

23.

x	20	40	80	120	140	160	180
-3 Cos 28°	-2.30	-0.52	2.82	1.50	-0.52	-2.30	-3.00
2 Sin ($^1/_2$ + 30o)	1.73	2	1.00	-1.00	-1	-2.00	-1.73

All values B2
Allow B1 for all least 5 values
Use of the scale S1
Plotting - 3 Cos 2xo values P1
Plotting of 2 sin (3.2xo + 30o) P1
Cuves C1

Roots x = 62 ± 2° B1
x = 156 ± 2° B1
8 marks

24.

x	1.1	1.2	1.3	1.4	1.5	1.6
y	-0.3	0.5	1.4	2.5	3.8	5.2
x3	1.331	1.728	2.197	2.744	3.375	4.096

(a) All values of x^3 B2
Allow B1 for at least 4 or if all values are correct to 1 or 2d p
Linear scale used S1
(b) (i) Line of best fit drawn 4 of his points correctly plotted P1
Plotting points B1
a = 2 B1
b= -3 B1
(ii) $y = 2x^3 - 3$ B1