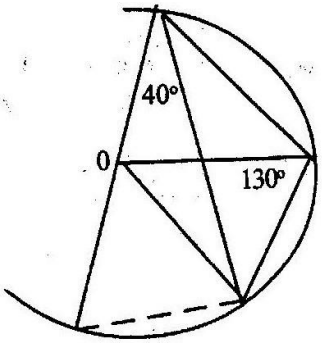
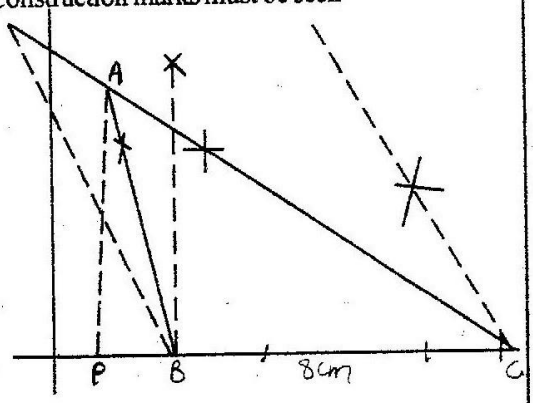
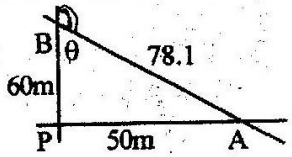
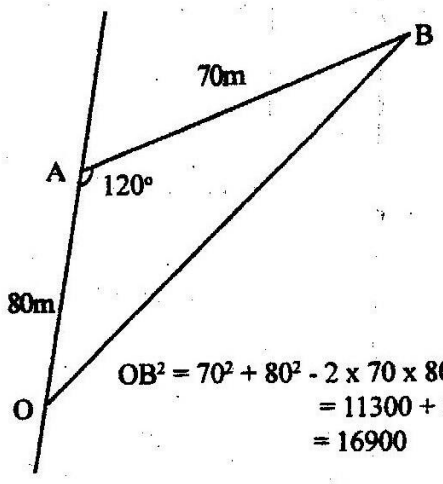
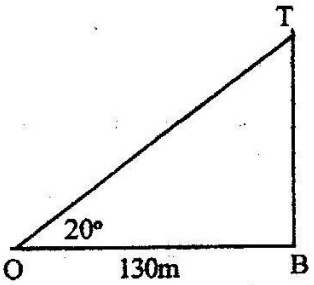
K.C.S.E 2003 MATHEMATICS PAPER 121/1 MARKING SCHEME

SOLUTION	MARKS	ALTERNATIVE METHOD
1. $\frac{1}{2} \times \frac{4}{9} = \frac{2}{9}$ $\frac{2}{5} \times \frac{9}{2} = \frac{9}{5}$ $\frac{9}{5} - \frac{11}{10}$ or $\frac{18-11}{10} = \frac{7}{10}$ $\frac{1}{6} \times \frac{3}{8} = \frac{1}{16}$ $\frac{7}{10} : \frac{1}{16} = \frac{7}{10} \times 16$ $= 11\frac{1}{5}$	M1 M1 A1 3 marks	Simplification of numerator towards $\frac{7}{10}$ Simplification of demonimator toward $\frac{1}{16}$ or $\frac{3}{48}$ Accept 11.2
2. $\left\{\left(a+\frac{1}{b}\right)-\left(a-\frac{1}{b}\right)\right\}\left\{\left(a+\frac{1}{b}\right)+\left(a-\frac{1}{b}\right)\right\}$ $\left(a^2+\frac{2a}{b}+\frac{1}{b^2}\right)-\left(a^2-\frac{2a}{b}+\frac{1}{b^2}\right)=\left(\frac{2}{b}\right)(2a)$ $= \frac{4a}{b}$	M1 M1 A1 3 marks	Factorisation or expansion Simplified product or sum $\frac{4a}{b}$, $\frac{4a}{b}$, $4\frac{1}{b}a$
3. $T^2 = x^2(c^2+d^2)$ or $\frac{T^2}{x^2} = c^2+d^2$ $c^2 = \frac{T^2}{x^2} - d^2$ $c = \pm\sqrt{\frac{T^2}{x^2} - d^2}$	M1 M1 A1 3 marks	Removal of the root sign Making c2 the subject Award A1 if no
4. Value at end of 2nd year $\left\{21600 \times \frac{75}{100} \times \frac{80}{100}\right\}$ Value at end of 4th year $21600 \times \frac{75}{100} \times \frac{80}{100} \times \left(\frac{85}{100}\right)^2$ $= 9369.60$	M1 M1 A1 3 marks	Logs used sh. 9365 partial tables partial logs 9363, 9364, 9360 Alternative End of 1st year $21600 \times \frac{75}{100} = 16200$ 2nd year $16200 \times \frac{80}{100} = 12920$ 3rd year $12960 \times \frac{85}{100} = 11016$ 4th year $11016 \times \frac{85}{100} = 9363.60$

SOLUTION	MARKS	ALTERNATIVE METHOD
5. 		0ABC Kite <BOC = 50° - B1 <OBC = 65° ∴ <ABC = 25° - B1 See 100o - B1 See 50o - B1 See 25o - B1
< AOC = 100o, radii, base <s, < sum of a triangle	B1	
Reflex <AOC = 260o <ABC = 130o ∴ <BAC = $\frac{180o - 130o}{2}$ = 25°	B1	Using ABCD - <O - 50o -B1 <ABC = 130o - B1 <DAC - 25o - B1 < at centre, < at O (accept other methods and even angles marked in the diagram)
6. $p = 3\begin{bmatrix} 2 & -3 & -5 \\ 1 & 4 & 3 \\ -2 & -1 & 2 \end{bmatrix}$ $= \begin{bmatrix} 6 \\ 3 \\ -6 \end{bmatrix} + \begin{bmatrix} 3 \\ -4 \\ 1 \end{bmatrix} + \begin{bmatrix} -10 \\ 6 \\ 4 \end{bmatrix}$	M1	After simplification for substitution and removal of scalar
$p = \begin{bmatrix} -1 \\ 5 \\ -1 \end{bmatrix}$ or $\underset{\sim}{p} = -\underset{\sim}{i} + 5\underset{\sim}{j} - \underset{\sim}{k}$	A1	
$\lvert p \rvert = \sqrt{(-1)2 + (5)2 + (-1)2}$ $= \sqrt{27}$ = 5.196	M1	
to 3 sf = 5.20	4 marks	

	SOLUTION	MARKS	ALTERNATIVE METHOD
7.	$3 \tan 2x - 4 \tan x - 4 = 0$ Let $\tan x = y$ $3y2 - 4y - 4 = 0$ $(3y + 2)(y - 2) = 0$ $y = -\frac{2}{3}$ or $y = 2$ $\tan x = -\frac{2}{3}$ $x = 146.30°, 146.31°, 146.32°$ $\tan x = 2$ $x = 63.43°$	 B1 B1 4 marks	if $(3 \tan x + 2)(\tan x - 2) = 0$ - M1 $= \tan x \; 4 \pm \frac{16 + 48}{6}$ M1 $= \frac{4 \pm 8}{6}$ $= 2$ OR $-\frac{2}{3}$ - A1 146° 18' or 146°, 19' 63° 26'
8.	Construction marks must be seen  	 B1 B1 B1 4 marks	BC = 8 cm and <BCA = 30 thro construction <ABC = 105° through construction and triangle completed AP constructed (AP = 5.5 + 0.1 cm) Area = $\frac{1}{2} \times 8 \times 5.5$ $= 22 \text{ cm}^2$ (21.6 22.4) $A = 22 + 0.4$ $21.6 \leq A \leq 22.4$
9.	Ratio 4:2:1 a) P (A wins) = $\frac{4}{7}$ b) P(either B or C wins) $= \frac{2}{7} + \frac{1}{7}$ $= \frac{3}{7}$	B1 B1 B1 3 marks	P(B) = x P(A) = 2x P(C) = 1/2x P(C) = x P(B) = 2x P(A) = 4x $3\frac{1}{2}x = 1 \quad x = \frac{2}{7}$ $P(A) = \frac{4}{7}$ P (B or C) = $x + \frac{1}{2}x$ $= \frac{2}{7} + \frac{1}{7}$ $= \frac{3}{7}$

SOLUTION	MARKS	ALTERNATIVE METHOD
10. Area Δ face $= {}^1/_2 \times 6 \times 6 \times \sin 60^\circ$ $= 18 \times 0.866$ $= 15.59$ Total surface area $= (2 \times 15.59) + (3 \times 6 \times 10)$ $= 31.18 + 180$ $= 211.18\ cm^2$	M1 M1 A1 3 marks	
11. $4x + 2\left(\frac{3}{2}x\right) = 21$ $7x = 21$ $x = 3$ width is 3 cm	M1 A1 2 marks	
12.  Required angle is the supplement of <PBA or angle marked on diagram $\tan\theta = \frac{50}{60} = 0.8333$ $= 39.8^\circ\ (39^\circ\ 48^1)$ $180 - 39.8^\circ$ Obtuse $= 140.2^\circ\ (140^\circ\ 12^1)$ $\tan\theta = \frac{-50}{60} = 0.8333$ $-180 - 39.2^\circ = 140.2^\circ$	 M1 M1 3 marks	 or equivalent identification $\sin\theta = \frac{50}{78.1}$ $\cos\theta = \frac{60}{78.1}$
13. Ext. $d = 11$ cm or $r_1 = 5.5$. cm Int. $d = 9$ cm or $r_2 = 4.5$ cm Volume $= \pi (r_1^2 - r_2^2) \times 600$ cm $= 3.142(5.5^2 - 4.5^2) \times 600$ cm $= 18852$	M1 M1 A1 3 marks	Follow through logs $18860\ cm^3$
14. a) $10x + y$ b) $3(x + y) + 8 = 10x + y$ $10y + x = 10x + y + 9$ $2y - 7x = -8$ ..... (i) $y = x + 1$ ..... (ii) $2(x + 1) - 7x = -8$ $x = 2$, $y = 3$ The number	B1 M1 A1 A1	Forming both equations of one unknown correctly

SOLUTION	MARKS	ALTERNATIVE METHOD
15.  $OB^2 = 70^2 + 80^2 - 2 \times 70 \times 80 \cos 1200$ $= 11300 + 5600$ $= 16900$	M1	
$OB = \sqrt{16900} = 130m$	A1	
b)  $\tan 20° = \frac{BT}{130}$ $BT = 130 \tan 20o$ $= 130 \times 0.3640$ $= 47.32$	M1 A1 4 marks	
16. $V = 3t^2 - t + 4$ $S = \int (3t^2 - t + 4)\, dt$ $= \left[t^3 - \frac{t^2}{2} + 4t\right]_1^5$	M1	
$= \left(25 - \frac{25}{2} + 20\right) - \left(\frac{1}{2} - 1 + 4\right)$	M1	
$= \frac{256}{2} - \frac{9}{2}$ $= \frac{256}{2}$ $S = 128m$	A1 3 marks	

SOLUTION	MARKS	ALTERNATIVE METHOD
17. a) Volume of milk $\frac{3}{4}(1.7m \times 1.4m \times 2.2m)$ $= 3.927\ m^3$	M1 A1	Logs used 3.926
b) i) Volume of each $\frac{1}{3} \times \frac{1}{2} \times 16 \times 16 \sin 60^o \times 13.6$ $= \frac{1}{3} \times \frac{1}{2} \times 256 \times 0.866 \times 13.6$ $= 502.5\ cm^2$ in 2 sf $= 500\ cm^3$	M1 M1 A1 B1	Or equivalent for base area Accept 502.4, 502.7 log used 50.75 Heroes formula used
ii) Number of full packets $\frac{3.927 \times 10^6}{502.5} \times 25 = 7814 \times 25$ $=$ Sh. 195 350	M1 A1	Long multiplication and division using 3.926 give Sh. 195 300
1. $7814 \times 25 = 195350 - \frac{3.927 \times 10^6}{502.5}$ 2. 195350 = 7814 x 25 -3.926 log used 3. 195272 = 7811 x 15 - altitude correctly or heroes formula (13.86) 4. 195400 = 7816 x25 - when 502.4 is used 5. 195225 - Using 13.86 or heroes formula 3.926 (7809 x 25) 6. 195300 = $\frac{3.926 \times 10^6}{502.5}$ = 7812 x 25	8 marks	Logs used sung 3.926 gives Sh. 195 350 Accept sh. 195, 400, 195, 275 Heroes formula used
18. a) x 1.0 2.0 3.0 4.0 5.0 6.0 1.9 2.9 3.9 4.9 5.9 6.9 f 6 14 10 7 2 1 cf 6 20 30 37 39 40	B1	fit can be implied
Lower quartile $= 1.95 + 1 \times \frac{4}{14}$ $2.236 = (2.24)$	M1	
Upper quartile $= 3.95 + 1 \times \frac{10}{10}$ $= 3.95$	M1	
Interquartile $3.95 - 2.246 = 1.714$ $= 1.714$	A1	

SOLUTION	MARKS	ALTERNATIVE METHOD
b)		

x	f	dx-a	fd	fd^2
1.45	6	-2	-12	24
2.45	14	-1	-14	14
3.45	10	0	0	0
4.45	7	1	7	7
5.45	2	2	4	8
6.45	1	3	3	9
			-12	62

M1 ∑fd - column andsum

M1 ∑fd^2 column and sum

$sd = \sqrt{\frac{62}{40} - \left(\frac{-12}{40}\right)^2}$

$= \sqrt{1.55 - 0.09}$

$= 1.55 - 0.09$

$= \sqrt{1.46}$

$= 1.208$

M1

A1

8 marks

19. a) Area $= \frac{120}{360} \times 7 \times 7 \times \frac{22}{7} = 51\frac{1}{3}$ cm2

M1, A1

Accept = 3.142

Accept 51.33 cm2, 51.34 cm^2 if log used

b) $\frac{1}{2}$ AD $= 7 \sin 60°$

$= \frac{7\sqrt{3}}{2} = 6.062$

M1

$AB = 14 - 2 \times 7 \cos 60°$

$= 14 - 2 \times 7 \times 0.5$

$= 7$

M1

Area of trapezium XABY $= \frac{1}{2}(7+14) \times 6.062$

$= 63.65 cm^2$

M1

A1

Accpt 63.66, 63.63 tangent of 60°

c) Area of shaded region

$= 2\left(63.65 - 51\frac{1}{3}\right)$

$= 127.30 - 102.67$

$= 24.63 cm^2$

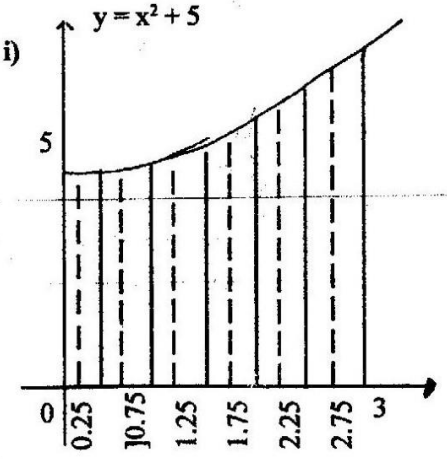
M1

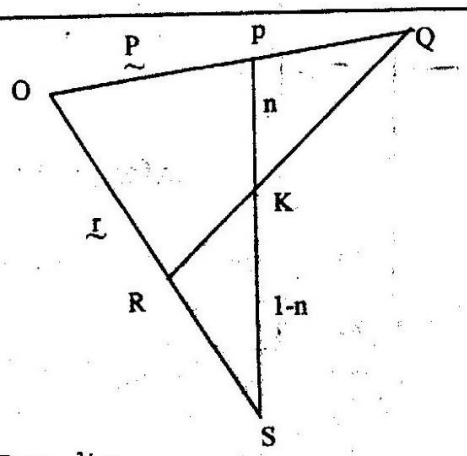
A1

8 marks

20.

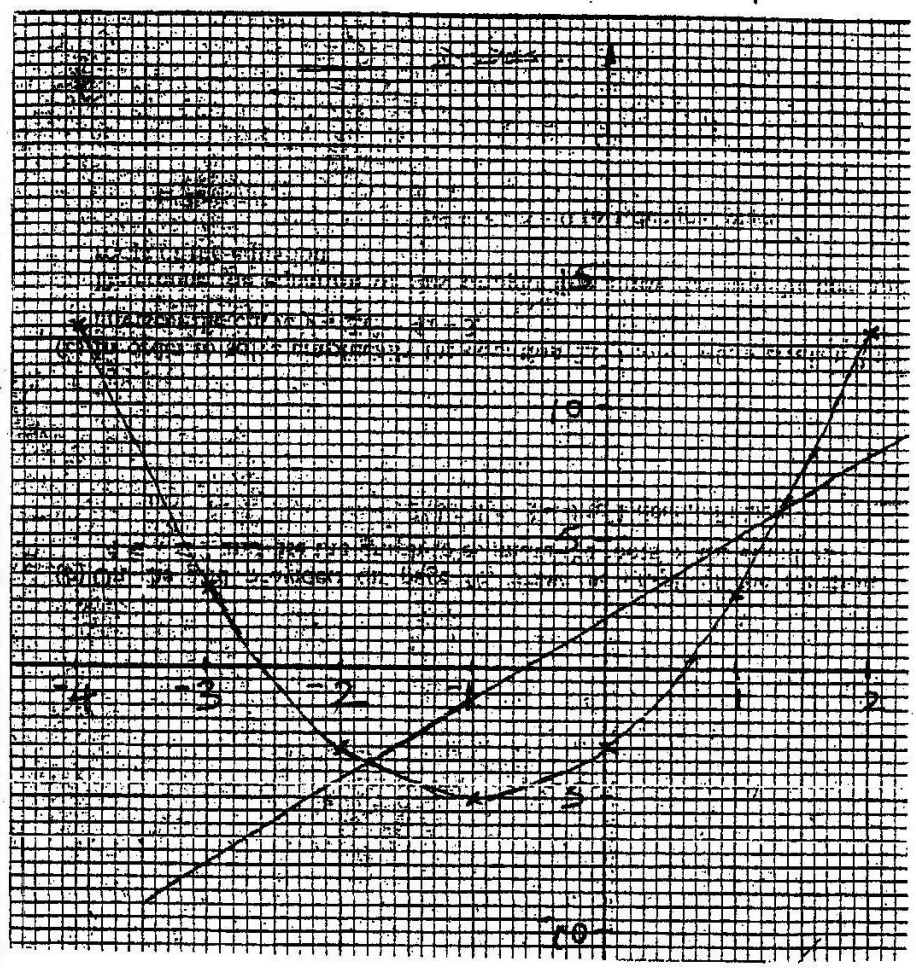
a) i)



SOLUTION	MARKS	ALTERNATIVE METHOD
x 0.25 0.75 1.25 1.75 2.25 2.75 y 5.0625 5.5625 6.5625 8.0625 10.0625 12.5625 $5^{1}/_{16}$ $5^{9}/_{16}$ $69^{1}/_{16}$ $8^{1}/_{16}$ $10^{1}/_{16}$ $12^{9}/_{16}$	B2	Accept 4 significant figures
Area = $^{1}/_{2}$ (5.0625 + 5.5625 + 6.5625 + 8.0625 + 10.0625 + 12.5625) =1/2 (47.875) = 23.9375 = 23.94	M1 A1	 Accept $23\ ^{15}/_{16}$
a) ii) Exact area $\int_0^3 (x+5)\,dx = \frac{x^3}{3} + 5x \Big|_0^3$ = 9 + 15 = 24	M1 A1	
b) % error = $\frac{24 - 23.94}{24} \times 100$ $= \frac{0.06}{24} \times 100$ = 0.25%	M1 A1 8 marks	$\frac{24 - 23\ ^{15}/_{16}}{24} \times 100$ = 0.26%
21. 		
A) OR = r - $^{3}/_{2}$p PS = 2r - p	B1 B1	
b) OK = $^{3}/_{2}$p + m (r - 3/2p) OK = p + n (2r -p) $^{3}/_{2}$ + m(r-$^{3}/_{2}$p) = p + np + 2nr $^{3}/_{2}$p - $^{3}/_{2}$mp + mr = p - np + 2nr $^{3}/_{2}$ - $^{3}/_{2}$m)p + mr = (1 - n) p + 2nr ∴ 2n = m ... ... (1) $^{3}/_{2}$ - $^{3}/_{2}$m = 1 - ... .. (2) m = $^{1}/_{2}$ n = $^{1}/_{4}$	M1 M1 M1 M1	
c) PK : KS = 1:3	...KS	

SOLUTION	MARKS
22.	
a)	B2 For all entries
B1 for 7 entries	

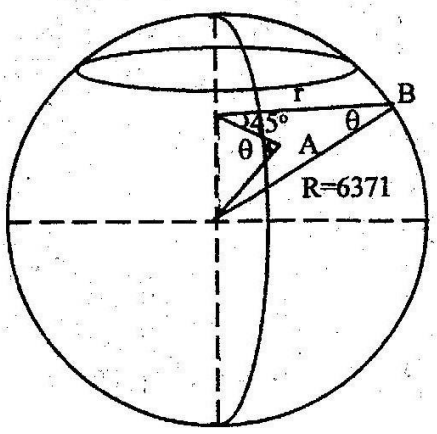
x	-4	-3	-2	-1	0	1	2
$2x^2$	32	18	8	2	0	2	8
4x - 3	19	15	-11	-7	-3	1	13
y	13	3	-3	-5	-3	3	13



b) P1 for linear scale and plotting C1
B1 for both roots correct

c) B1 equation y = 3x + 2
L1 line drawn
B1 roots

8 marks

SOLUTION	MARKS
23. a) Interest periods 3/2 x 4 = 6 $A = 450\,000\,(1 + \frac{6}{100})^6$ $= 450\,000 \times 1.06^6$ $= 450\,000 \times 1.419$ = Sh. 638 550 b) 1500 x 280 x 3 = Sh 1260 000 c) New value $450\,000\,(1 - \frac{16}{100})^3$ $= 450\,000\,(0.84)^3$ $= 450\,000\,(0.5927)$ = Sh 266 715 Total profit (1 260 000 + 266715) - 638 300 = Sh 888 415	M1 A1 M1 A1 M1 M1 A1 8 marks
24. a) Difference in time = 3h ∴ Longitude difference = 3 x 15° or 45° Longitude of B = 15° + 45° = 60°E  b) i) distance travelled = 850 x 31/2 km = 2975 km arc AB = 2975 ∴ $45 \times 3.142 \times 2r = 2975$ 360 $r = \frac{2975 \times 360}{45 \times 3.142 \times 2}$ = 3788, (7,9) (ii) 6371 Cos θ = 37[illegible] Cos [illegible] 3758 = 6371 = 0.594 53.51° ∴ Latitude [illegible] two towns is 53.51°N	B1 B1 M1 M1 M1 M1 A1