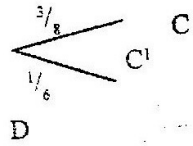
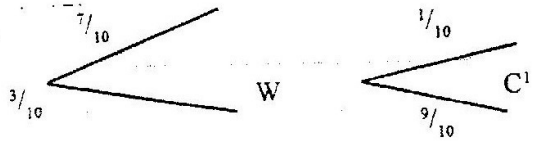
K.C.S.E 2002 MATHEMATICS PAPER 121/1 MARKING SCHEME

SOLUTION	MARKS	ALTERNATIVE METHOD
1. $\frac{+4 \times 4 - (20)}{-6 - (+6 + 3) + (6)} = \frac{4 \times 4 + 20}{-6 \times 2 - 6} = \frac{36}{-18}$	3 marks	
2. Either $(x^2 + 4xy + 4y^2) - (x^2 - 4xy + 4y^2)$ $4xy + 4xy$ $8xy$ or $\{(x + 2y) - (x-2y)\}\ \{(x+2y) + (x-2y)\}$ $(4y)(2x)$ $8xy$	3 marks	
3. $Px - Py = xy$ $Px = xy + Py$ $Px = y(x+P)$ $y = \frac{Px}{x + P}$	2 marks	
4. $XY = OY - OX$ $= \begin{vmatrix} 3 \\ 2 \\ -2 \end{vmatrix} - \begin{vmatrix} 2 \\ 1 \\ -3 \end{vmatrix} = \begin{vmatrix} 1 \\ 1 \\ 1 \end{vmatrix}$ $= i + j + k$	2 marks	$xy = 1$ 1 1
5. $1 = 0.04072$ 24.56 $4.346^2 = 18.89$ $0.04072 + 18.89 = 18.93071$ $= 18.93$	3 marks	
6. $H = 12 \text{ Sin } 60$ $= 10.39$ $AD = (12 \text{ Cos } 60) \times 2 + 4$ $= 16$ Area $= \{ 1/2 \times (4 + 16)\ 10.39$ $= 103.9 \times 2$ $= 207.8 \text{ cm}^2$	M1 A1 4 marks	
7. (a) Swiss francs $52/1.28 = 40.63$ (b) Kshs '40.63' x 45.21 = 1837	B1 A1	
8. $X > 1$ $X \leq 4$ 	B1 B1 3 marks	B1
9. $P(1-0.09)^3 = 150\ 700$ $P = 150\ 700$ 0.91	M1 M1	

	SOLUTION	MARKS	ALTERNATIVE METHOD
	No: 150 700, 0.913, 2.0×10^5 Log: 5.1781, $\bar{1}.9590 \times 3$, $\bar{1}.8770$, 5.3011	M1 A1 4 marks	
10.	(a) Making 3 equal length from B along BA and joining the last point Z to C Construction of angle at x equal to angle Z and identify D (b) Area of DABD = $\frac{1}{2} \times 2.7 \times 8$ $= 7.83 cm^2$	B1 B1 M1 A1 4 marks	
11.	x-section area = $\frac{22}{7}(4^2 - 3^2)$ cm Volume = $\frac{22}{7} \times 7 \times 0.2$ cm^3 = cm^2	M1 A1	
12.	MY = 14 - 8 = 6 CM Therefore 4 (MQ) = 8 x 6 MQ = 12	M1 A1 2 marks	
13.	a) $x^2 = (\sqrt{5})^2 - 1^2 = 4$ x = 2 Therefore Cos x = $\frac{2}{\sqrt{5}}$ $= \frac{2\sqrt{5}}{5}$ b) Tan (90 - x) = 2	B1 B1 B1 3 marks	
14.	$P = \frac{k + c}{q}$ $10 = \frac{k + c}{1.5}$ k + 1.5c = 15 $20 = \frac{k + c}{1.25}$ K + 1.25 = 25 $P = \frac{75}{0.5} - 40$ c = -40 K = 75	M1 M1 A1 4 marks	
15.	(5 x 220) + (3 x 120) + (4 x 180) + (12 x 150) 6 + 3 + 4 + 2 $= \frac{2700}{15}$ = 180	M1 M1 M1 4 marks	
16.	(i) $\frac{dy}{dx} = 6 \times 2 + x + -4$ When x = 1 $\frac{dy}{dx} = 6 + 1$ = 3 (ii) $y + \frac{1}{2} = (3x - 1)$ $y = 3x - 3 - \frac{1}{2}$ $= 3x - 3\frac{1}{2}$	M1 A1 4 marks	...ent 2y = 6x - 7)

SOLUTION	MARKS	ALTERNATIVE METHOD
17. (a) (i) $750{,}000 \times \frac{90}{100}$	M1	
$= 675{,}000$	A1	
(ii) $675{,}000\,(1.1)^3 = 898.425$	M1	
$898{,}425 + 75{,}000 = 973\ 425$	A1	
(b) $675{,}000\,(1-1)^n = 816{,}750$	M1	
$(1.1)^n = 1.21$	A1	
$n = \frac{0.0828}{0.0414}$		
$n = 2$ years	8 marks	
18. (a) $AC = \sqrt{(82 + 62)} = \sqrt{100} = 10$	B1	
$EC = \sqrt{(102 + 202)} = \sqrt{5} \times 100 = 10\sqrt{5}$	M1, A1	
(b) (i) $\sin Q = \frac{8}{(\sqrt{5})}$	M1	
$= 20.96°$	A1	
(ii) $\tan x = \frac{8}{20}$	M1	
$x = 21.8°$	A1	
19. (a) HHH HHT HTH HTT	B1	
TTT TTH THT THH	B1	
(i) P (at least two heads) $= \frac{4}{8}$ or $\frac{1}{2}$	B1	
(ii) P (only one tail) $= \frac{3}{8}$	B1	
b) 	B1	
	M1 A1	
(i) $\left(7 \times \frac{5}{10}\right) + \left(\frac{3}{10} \times \frac{1}{6}\right)$	B1	
$\frac{35}{60} + \frac{3}{100} = \frac{46}{75}$	8 marks	

(ii) $\frac{3}{10} \times \frac{9}{10} = \frac{27}{100}$

	SOLUTION	MARKS	ALTERNATIVE METHOD
20.	a) Gradient = -1 $y = x + 7$ (b) $7 - x = (x-1)^2 + 4$ $x^2 - x - 2 = 0$ $(x - 2)(x + 1) = 0$ $x = 2, y = 5$ $x = -1, y = 8$ Co-ordinates of P,Q are P (-1, 8), Q(2,5)	B1 B1 M1 M1 A1 5 marks	
	$\frac{1}{2}(8+5)\ 3\text{-}2\ (x^2 - 2x + 5)\ dx$ $= \frac{39}{2} - \{\frac{x^3}{3} - x^2 + 5x\}^2$ $= 19.5 - \frac{82}{3} + 6\frac{1}{3}$ $= 19.5 - 15$ $= 4.5$ or $4\frac{1}{2}$	M1 M1 A1 3 marks	
21.	(a) Construction of 30o Completion of DPQR (b) ⊥bisector of PR (must be seen) Location of S_1 QS = 8cm and drawing DPRS (c) Consturction of semicircle with diameter SQ construction of parallel line to QS through R location of T_1 and T_2 $T_1 T_2 = 4.7 \pm 0.1$ cm	B1 B1 B1 B1 B1 B1 B1 B1 8 marks	
22.	(a) (i) $\begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} 2 & 5 \\ 3 & 3 \end{pmatrix} = \begin{pmatrix} -4 & -1 \\ 3 & 3 \end{pmatrix}$ $2a + 3b = -4 \quad 2c + 3d = 3$ $5a + 3b = -1 \quad 5c + 3d = 3$ $a = 1, b = -2 \quad c = 0, d = 1$ Therefore $M = \begin{pmatrix} 1 & -2 \\ 0 & 1 \end{pmatrix}$ (ii) 1 -2 4 x 2 0 1 1 y =1 C1 = (2, 1) b) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 1 & -2 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ 1 & -2 \end{pmatrix}$	M1 M1 M1 A1 M1 A1 M1A1 8 marks	
23.	(a) (i) $135 \times \frac{\pi}{180} = \frac{3\pi}{4}$ $\quad \frac{135\pi}{180}$ Area of sector $= \frac{3}{8} \times \frac{22}{7} \times 28^2$ $= 924$ cm^2 (ii) Length of mirror $\frac{3}{8} \times \frac{22}{7} \times 28 \times 2 = 66$ cm	B1 M1 A1	

	SOLUTION	MARKS	ALTERNATIVE METHOD
	(b (i) ΠrI = area of curved surface $r\Pi = \frac{924 \times 7}{22 \times 28}$ = 10.5 cm $h = \sqrt{(28^2 - 10.5^2)}$ =25.96	M1 A1 8 marks	
24.	(b) Log P = n log r + log k		

P	1.2	1.5	2.0	2.5	3.5	4.5
Log P	0.08	0.18	0.30	0.40	0.54	0.65

B1

R	1.58	2.25	3.39	4.74	7.86	11.5
log r	0.20	0.35	0.53	0.68	0.90	1.06

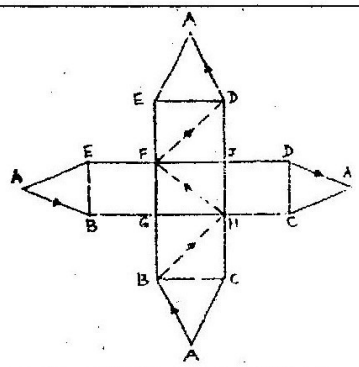
B2

Scale S1
Plotting P1
Line L1

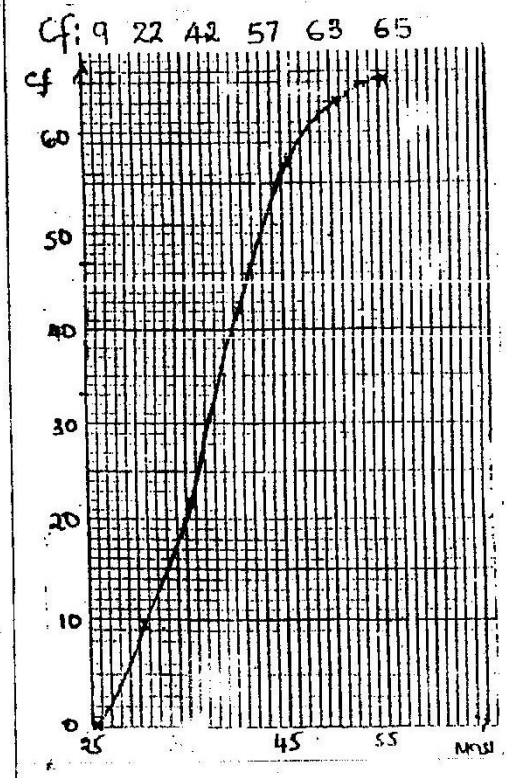
Log k = 0.05 = T.95 B1
K = 0.8913 89 B1
$N = \frac{2}{3} = 0.6667$
0.6667 ± 0.0200

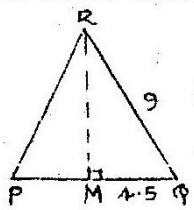
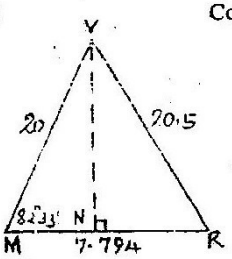
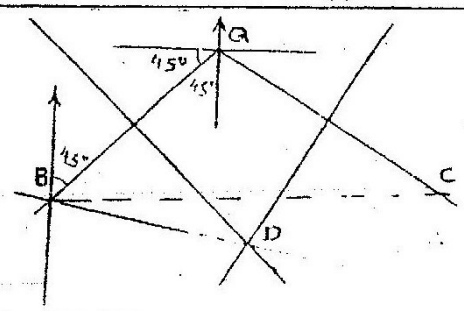
8 marks

K.C.S.E 2002 MATHEMATICS 121/2 MARKING SCHEME

	SOLUTION	MARKS	COMMENTS
1.	No log $0.0056 \xrightarrow{\frac{1}{2}} \bar{3}.7482 + 2 = \bar{2}.8741$ $1.38 \longrightarrow 0.1399$ $27.42 \longrightarrow 1.4381$ $+ = 1.5780$ $0.001977 \xleftarrow{(8)} \bar{3}.2961$	M1 M1 A1 3 marks	✓ logs (all) ✓ operations including ✓ attempt to divide by 2 accept std. form or 0.001978
2.	Fraction of work done in 1 hour by: Kipketer $\frac{1}{7}$ Wanjiku $\frac{1}{5}$ Both $\frac{1}{7}+\frac{1}{5}=\frac{12}{35}$ Time taken $= \frac{35}{12}$ $= 2\frac{11}{12}$ hours	B1 B1 B1 3 marks	Allow both ✓ $\frac{\text{product}}{\text{sum}} = \frac{7\times5}{5+7} = \frac{35}{12}$ Or 2.917 hr of 2hours 55 minutes (if 2 : 55 – B0)
3.	$\frac{1}{2}\times 14 \times 8 \sin\theta = 28$ $\sin\theta = \frac{28}{56} = \frac{1}{2}$ $\theta = 30^0$ or 150^0	M1 A1 2 marks	Both values must be given
4.	Det T = (-1) (1) = (2) (1) = -3 $T^{-1} = -\frac{1}{3}\begin{pmatrix}-1 & -2\\ -1 & 1\end{pmatrix} = \begin{pmatrix}\frac{1}{3} & \frac{2}{3}\\ \frac{1}{3} & -\frac{1}{3}\end{pmatrix}$ $\begin{pmatrix}x\\ y\end{pmatrix} = \begin{pmatrix}\frac{1}{3} & \frac{2}{3}\\ \frac{1}{3} & -\frac{1}{3}\end{pmatrix}\begin{pmatrix}7\\ 1\end{pmatrix} = \begin{pmatrix}3\\ 2\end{pmatrix}$ Coordinates (3, 2)	M1, A1 M1, A1 4 marks	If a different M0 A0 Method used M0 A0 may be implied Accept X by $-\frac{1}{3}\begin{pmatrix}-1 & -2\\ -1 & 1\end{pmatrix}$ C.A.O
5.	Cost of beans in mixture $= \frac{3}{5}\times 2100$ Cost of maize in mixture $= \frac{2}{5}\times 1200$ Cost of mixture per bag $= \frac{3}{5}\times 2100 + \frac{2}{5}\times 1200$ = Sh. 1740	M1 M1 A1 3 marks	Alternative $3\times 2100 = 6300$, $2\times 1200 = 2400$ M1 $\frac{6300+2400}{5}$ M1 Or equivalent = 1740 A1
6.		B1 B1 2 marks	✓ Sketch of the net of the solid (not free hand) base must be square, other lengths must be within ✓ labeling of all verticals with the path ✓ ly shown AB and DA may be shown once Accept any other possible ne
7.	$\frac{(3^4)^{2x} \times (3^3)^x}{(3^2)^x} = 3^6$ $8x + 3x - \ldots = 6$ $9x = 6$ $x = \frac{2}{3}$	M1 A1 3 marks	Expression written ✓ [illegible] Or equivalent (equating powers) When logs used ✓ logs – M1 ✓ simplification – M1 x – A1

8.	Absolute error $= 0.5 + 0.5 + 0.5 = 1.5$ % error $= \frac{1.5}{33} \times 100\%$ $= 4.55\%$ (to 2d.p) $= 4.54\%$ (if logs used)	M1 M1 A1 3 marks	
9.	$(a-b)^6 = a^6 - 6a^5b + 15a^4b^2 - 20a^3b^3 + 15a^2b^4 - 6ab^5 + b^6$ $1.98 = 2 - 0.02$ $1.98^6 \simeq 2^6 - 6(2)^5(0.02) + 15(2)^4(0.02)^2$ $= 64 - 3.84 + 0.096$ $= 60.256$	B1 B1 M1 A1 4 marks	With all terms given ✓ ly May be implied
10.	$QP = \begin{pmatrix} -8 \\ -2 \end{pmatrix}$ $\frac{1}{2}QR = \frac{1}{2}\begin{pmatrix} -3 \\ -4 \end{pmatrix} = \begin{pmatrix} -1\frac{1}{2} \\ -2 \end{pmatrix}$ $OT = \begin{pmatrix} -8 \\ -2 \end{pmatrix} + \begin{pmatrix} -1\frac{1}{2} \\ -2 \end{pmatrix} - \begin{pmatrix} -9\frac{1}{2} \\ -4 \end{pmatrix}$ Coordinates of T $(-9\frac{1}{2}, -4)$	B1 B1 B1 3 marks	
11.	$4x^2 - y^2 = (2x+y)(2x-y)$ $2x^2 - 7xy + 3y^2 = (x-3y)(2x-y)$ $\therefore \frac{(2x+y)(2x-y)}{(x-3y)(2x-y)} = \frac{2x+y}{x-3y}$	M1 M1 A1 3 marks	Numerator ✓ ly factorise Denominator ✓ ly factorise Allow $\frac{(2x+y)(2x-y)}{(x-3y)(2x-y)}$
12.	Dividends $\frac{5}{15} \times 81000 = 27000$ Atieno's: $\frac{5}{9} \times 27000$ $=$ Sh 15000	M1 M1 A1 3 marks	
13.	a) $\angle ECA = 28^0$ $\angle AEG = 28^0$ b) $\angle CAE = 60^0$ or $\angle CEG = 120^0$ or $\angle EAG = 120^0$ $\angle ABC = 88^0$	B1 B1 B1 B1 4 marks	All angels may be marked on the diagram
14.	a) $T_{40} = 500 + (40-1)\,50$ $= 500 + 1950$ $= 2450$ b) $S_{40} = \frac{40}{2}[500 \times 2 + (40-1)50]$ $= 20\,(1000 + 1950)$ $= 59000$	M1 A1 M1 A1 4 marks	
15.	a) $\angle AEB = \angle DEC$, vertically opp. $\angle$s $\angle ABE = \angle EDC$, alternate $\angle$s $\angle EAB = \angle ECD$, alternate $\angle$s Δ ABE is similar to Δ CDE (AAA) b) BE = 3ED DB: EB = 4:3	 B1 B1 B1 B1 4 marks	 Accept any two Apply 0W – 1 if reasons are not given Allow $\angle AEB = \angle DEC$ $\angle ABD = \angle BDC$ $\angle CAB = \angle ACD$

16.	$x^2 + 4x + y^2 - 5 = 0$ $x^2 + 4x + 4 + y^2 = 5 + 4$ $(x + 2)^2 + (y + 0)^2 = 9$ Radius $= \sqrt{9} = 3$	B1 B1 B1 B1 4 marks	LHS ✓ ly factorised Allow $(x + 2)^2 + y$ RHS ✓ ly simplified Must be in correct form Alternative $(x - a)^2 + (y - b)^2 = r^2$ $x^2 - 2ax + y^2 - 2by + a^2 + b^2 - r^2 = 0$ $2ax = 4x$ & $-2by = 0 \longrightarrow$ B1 $a = 2, b = 0$ Centre $= (-2,0) \longrightarrow$ B1 $a^2 + b^2 - r^2 = -5$ $r^2 = 5 + 4 + 0 = 9 \longrightarrow$ B1 radius $= \sqrt{9} = 3 \longrightarrow$ B1 4 marks
17.	a) $\frac{d}{50} - \frac{d}{80} = 3$ $\frac{8d - 5d}{400} = 3$ 3d = 1200 d= 400km b) (i) $400 \times 0.35 + 400 \times 0.3 = 260$lit. (ii) Total time $\frac{400}{50} + \frac{400}{80} = 13$hr Average consumption $\frac{260}{13}$ = 20lit/hr	M1 M1 A1 M1 M1 M1, A1 8 marks	**17.** Alternative $\frac{d}{t} = 80$ & $\frac{d}{t+13} = 50$ $80t = 50(t + 13)$ $t = 5$ $d = 5 \times 80 = 400$
18.	a) $\frac{16510 \times 12}{20}$ = 9906 b) Taxation: $4512 \times 2 = 9024$ $4512 \times 3 = 13536$ $(9906 - 9024) = 882 \times 4 = 3528$ $\frac{9024 + 13536 + 3528}{12} = 26088 \div 12$ $= 2174$ c) Tax due: $2174 - 960 = 1214$	M1 A1 M1 M1 A1 M1, A1 8 marks	1st slab ✓ ly taxed all other slabs ✓ ly taxed $(9024 + 13536 + 3528) - 960 \times 12$ $= 26088 - 11520$ $= 14568$ $14568 \div 12 = 1214$ (allow MR if housing is involved)
19.		B1 P1 C1 B1 B1 B1 M1 A1	May be implied Plotting of against upper class limits ✓ 0 give ✓ median = 38kg ± at 32.5th (33rd) Q1 = 33kg – at 16.25th (16.5th) OR Q3 = 43kg – at 48.75th (49.5th) Range: $Q_3 - Q_1$ ✓ = 43-33 = 10kg Q_1, Q_3 read from ✓ positions $\frac{65-47}{65}\% = \frac{18}{65} \times 100\%$ $= 27.69\%$ Allow $\frac{19}{65} \times 100 = 29.23\%$

20. a) (i)	 $RM = \sqrt{9^2 - 4.5^2}$ $= \sqrt{60.75}$ (3) $= 7.794$ (5)	M1 A1	9×0.866
(ii)	 $\text{Cos } M = \frac{20^2 + 7.794^2 - 20.5^2}{2 \times 20 \times 7.794}$ $= 0.1299$ $\angle M = 82^0\ 33'$ $\angle R = 75^0\ 19'$ VN $= 20 \text{ Sin } 82^0\ 33'$ $= 20 \times 0.9915$ $= 19.83$ (4)	M1 A1	Or equivalent
(iii)	Volume $= \frac{1}{3} \times \frac{1}{2} \times 9 \times 7.794 \times 19.84$ $= 231.8$ <u>OR</u> 232 (9)	M1 A1	Or equivalent (allow if MN = NR assumed) or equivalent
b)	Mass (8) 231.8×2.7 $= 625.9g$ <u>OR</u> $= 626.1$ (2) (4) (5)	M1, A1	✓ or 0.6259 kg
		8 marks	
21. a)	$\frac{\pi}{12}$ used as constant width (or 0.26)	B1	
	$\frac{1}{2} \times \frac{\pi}{12}[(0 + 0.84) + 2(0.26 + 0.48 + 0.65 + 0.76 + 0.82)]$	M1	✓ substitution in trapezoidal rule
	$\frac{\pi}{24}[0.84 + 2(2.97)]$	M1	✓ simplification of inner brackets
	$\frac{3.142}{24} \times 6.78$ $= 0.8875$ (4) (6)	M1, A1	✓ simplifying to single term if $\pi = \frac{22}{7}$ or 3.14 apply PA – 1
b)	Absolute error: $0.8940 - 0.8875 = 0.0065$ (6) (6) (4) (4) (2)	M1	
	% error $= \frac{0.0065}{0.8940} \times 100\%$ $= 0.73\%$ (4)	M1 A1	C.A.O
		8 marks	
22. a)			
	✓ Scale used	S1	
	✓ Position of B	B1	Angles measured within 1^0 and
	✓ Position of C	B1	lengths within 0.1cm
	✓ Mediator of BQ or QC of BC	B1	D must be at the ✓ position
	2nd Mediator & D identified	B1	
b)	(i) Distance B to C = 73 ± 1 km	B1	May be implied if bearing is ✓
	(ii) North line ✓ at B ± 2^0	B1	If $\angle BQC = 105^0$ the diagram is
	Bearing = $102^0 \pm 1^0$ OR $S78^0E \pm 1^0$	B1	correct
		8 marks	

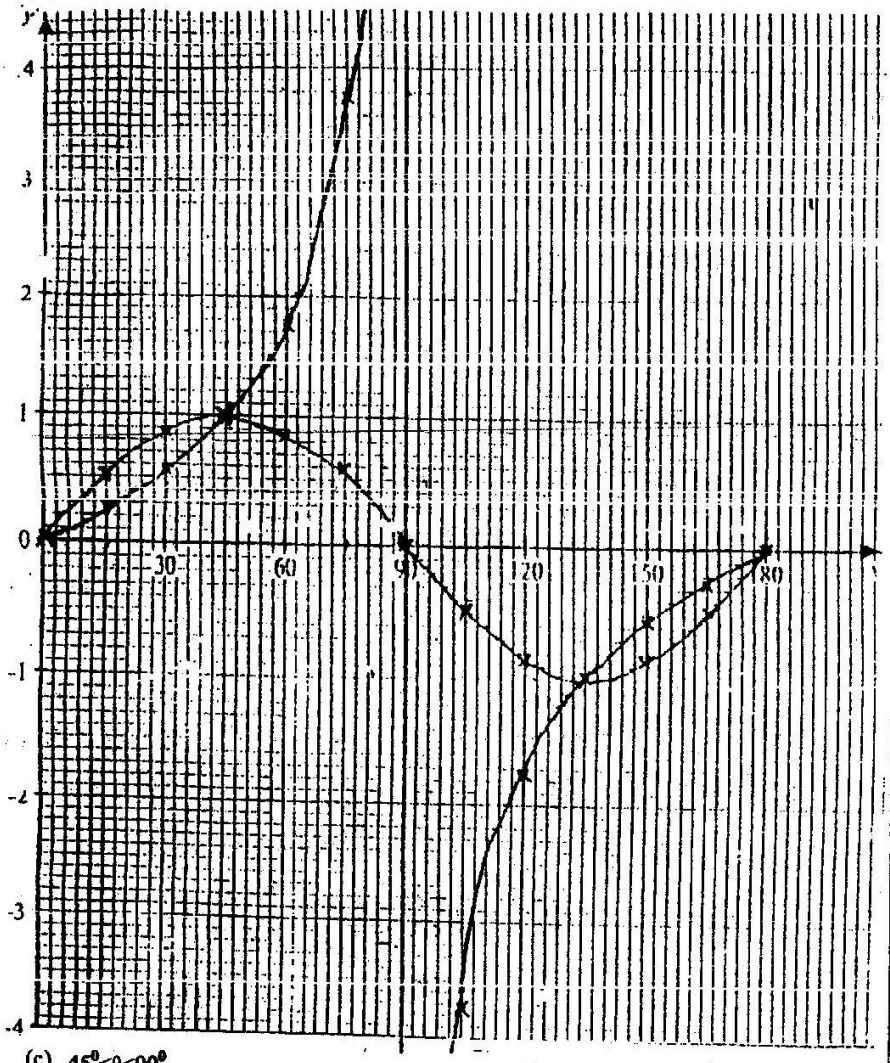
23.

(a)

θ		30^0		75^0		120^0		150^0
Tan θ				3.73				-0.58
Sin 2θ	0.87					-0.87		

B2 — Allow B1 for any 2✓

(b)



P1 — Tan curve: All points plots may be implied

C1 — Both parts of curve

B1 — Asymptote drawn or implied

B1 — Sine curve: All points plotted

C1 — Smooth sine curve

(Apply PA-1 Once on plotting If 1dp used)

(c) $45^0<\theta<90^0$ — B1

8 marks

24.

a) $\frac{ds}{dt} = 3+3t-6t^2$ $\quad \frac{d^2s}{dt_2} = 3-12t$ — M1

$a = 3 - 12(0)$ — M1

$= 3ms^{-2}$ — A1

b) i) $3 + 3t - 6t^2 = 0$ $\quad (t-1)(2t+1) = 0$ — M1

$t = 1$ or $-\frac{1}{2}$ $\quad t = 1$ sec — A1

ONLY t = 1 sec

ii) at t = 1 $\quad S = 3(1) + \frac{3}{2}(1)^2 - 2(1)^3$

$= 3 + \frac{3}{2} - 2$ $\quad = 2\frac{1}{2}m$ — B1

c) $3 - 12t = 0$ $\quad = \frac{1}{4}$

$V = 3 + 3(\frac{1}{4}) - 6(\frac{1}{4}$

$= 3 + \frac{3}{4} - \frac{6}{16}$

$= 3\frac{3}{8}m/s$ — Or 3.375

marks