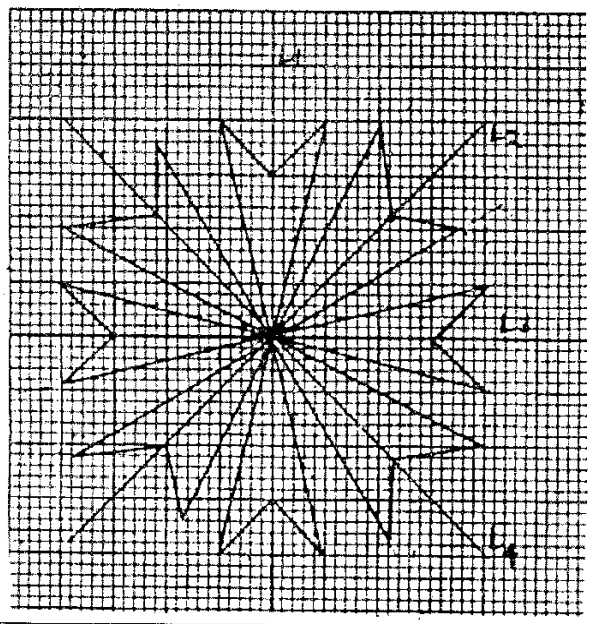
MATHEMATICS

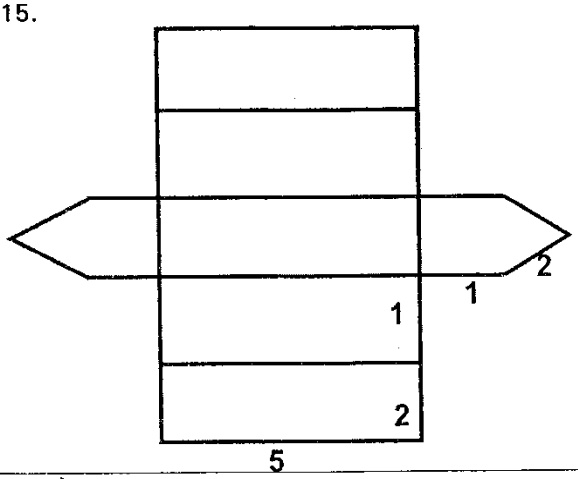
K.C.S.E PAPER 121/ 2 2005

MARKING SCHEME

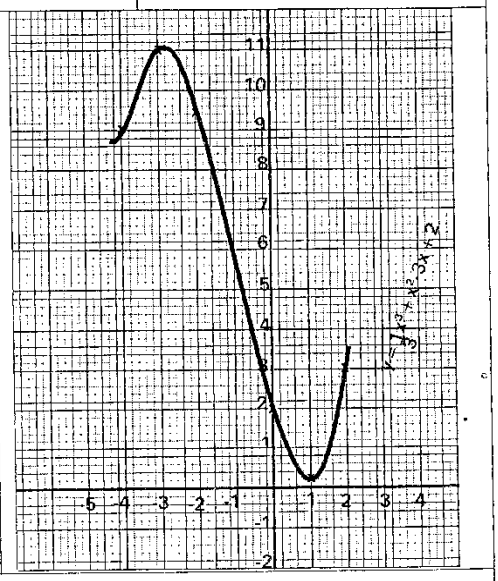
SOLUTION	MARKS	ALTERNATIVE METHOD
1. $\frac{243 \times 3^{2y}}{729 \times 3^{3y} \div 3^{(2y-1)}}$ $= \frac{3^5 \times 3^{2y}}{3^6 \times 3y \div 3^{2y-1}} = 3^5$ $= \frac{3^{5+2y}}{3^{6+y-(2y-1)}}$ $3^{5+2y} = 3^5$ $= 3^{-2+3y} = 3^5$ Hence $3y - 2 = 5$ $3y = 7$ $y = {}^3/_7 = 2{}^1/_3$	M1 M1 A1	
2. $\frac{\sqrt{63}+\sqrt{72}}{\sqrt{32}+\sqrt{28}} \times \frac{(\sqrt{32}-\sqrt{28})}{(\sqrt{32}-\sqrt{28})}$ Deno $\Rightarrow 32 - \sqrt{32}\sqrt{28} + \sqrt{28}\sqrt{32} - 28$ $\Rightarrow 4$ Num $\Rightarrow \sqrt{63}\sqrt{32} - \sqrt{63}\sqrt{28} + \sqrt{(72\times32)} - \sqrt{(72\times28)}$ $\Rightarrow \sqrt{9\times7\times16\times2} - \sqrt{9\times7\times7\times4} + \sqrt{9\times4\times2\times16\times2} - \sqrt{9\times4\times2\times7\times4}$ $\Rightarrow \sqrt[12]{14} - 42 + 48 - \sqrt[12]{14} = 16$ ${}^6/_4 = 1{}^1/_2$	M1 ½ A1 ½	
3. Men: ${}^7/_9 \times 45 = 35$ Wom: ${}^2/_9 \times 45 = 10$ Let the No. be x Men: ${}^5/_9(45 + x) = 35$ $25 + {}^5/_9x = 35$ ${}^5/_9x = 10$ $x = 18$	M1 M1 A1	Alternatively: ${}^4/_9(45 + x) = (10 + x)$ $4(45 + x) = 9(10 + x)$ $180 + 4x = 90 + 9x$ $5x = 90$ $x = 18$

SOLUTION	MARKS	ALTERNATIVE METHOD
4. 		
5. $\frac{x}{3} = \frac{16}{3x}$ $3x^2 = 48$ $x^2 = 16$ $x = 4$	B1 A1 2 marks	$\frac{16}{3x} = \frac{x}{3}$ $xX\frac{16}{x} = xXx$ $x = \sqrt{16}$ $= 4$
6. In 1hr: $\frac{1}{3} + \frac{1}{6}$ of water = ½ of tank is filled $\frac{1}{2} - \frac{1}{8} = 4 - \frac{1}{8} = \frac{3}{8}$ $\frac{3}{8}$ is filled in 1hr. All pipes open $\frac{1}{2}$ of the tank = $\frac{1}{2} \times 1 \div \frac{3}{8}$ $= \frac{1}{2} \times \frac{8}{3} = \frac{4}{3}$ = 1hr and 20 minutes Total time taken = 2hrs and 20 min	M1 M1 B1 A1 4 marks	In 1hr $\frac{1}{3} + \frac{1}{6} - \frac{1}{8} = 8 + 4 - \frac{3}{24}$ Filled in 1hr = $\frac{9}{24} = \frac{3}{8}$ $\frac{1}{2} \times \frac{8}{3} = \frac{4}{3} = 1\frac{1}{3}$ hrs Total time = $1 + 1\frac{1}{3}$ = $2\frac{1}{3}$ hrs
7. $\log_2(x^2 - 9) = 3\log_2 + 1$ $\log_2(x^2 - 9) = \log_2(8) + \log_2 2$ $\log_2(x^3 - 9) = \log_2(8 \times 2)$ $x^2 - 9 = 16$ $x^2 = 25$ $x = \pm 5$	M1 M1 M1 A1 4 marks	$\log_2(x^2 - 9) = 3\log_2 2 + \log_2 2$ $\log_2(x^2 - 9) = \log_2 16$ $x_2 - 9 = 16$ $x = \pm 5$
8. Volume scale factor = $\frac{4752}{1408}$ = 2 3.376 v.s.f = $(1.s.f)^3$ 1.s.f = $3\sqrt{3.375}$ = 1.5 Area scale factor = $(1.2.f)^2$ = 1.52 = 2.25 Area of larger cylinder = 352 x 2.25 = 792cm^2	M1 M1 M1 A1 4 marks	1.s.f = (v.s.f) $\frac{1}{3}$ = A.s.f) $\frac{1}{2}$ $(1.s.f)^2 = (A.s.f)$ $(L.s.f)^3 = (v.s.f)$ = 3.776 1.s.f = $(3.376)\frac{1}{3} = 1.5$ A.s.f = $(1.5)^2 = 2.25$ Area of larger cylinder = Area of smaller x A.s.f = 352 x 2.25 = 792cm^2

SOLUTION	MARKS	ALTERNATIVE METHOD
9. Cos 2x° = 0.870 2x° = 36.2, 143.8, 216:2, 328:, 396:2, 503.8, 576.2, 683.8 Hence x° = 18:1, 71:9, 108:1, 161:9, 198:1, 251:9, 288:1, 341:9	B1 M1 M1 A1 4 marks	
10. 120,000 + 15,000 = 105,000 Commission = $105{,}000 \times {}^{5}/_{100}$ = 5,250 Discount = $120{,}000 \times {}^{5}/_{200}$ = 3,000 Total earnings = 9000 + 2250 = 11,250/=	M1 M1 A1 3 marks	
11. $\frac{9 + 8.2 + 6.7 + 5.4 + 4.7}{5} = A$ $\frac{8.2 + 6.7 + 5.4 + 4.7 + k}{5} = B$ A − B = 0.6 $6.8 - \frac{(25 - k)}{5} = 0.6$ 34 − (25 + k) = 3.0 9 − k = 3.0 k = 6	B1 M1 A1 3 marks	
12. Gradient of $L_1 = \frac{6 - 0}{0 - 4} = \frac{3}{2}$ y − 6 = 3 x − 0 = 2 2y − 12 = 3x $y = {}^{3}/_{2}x + 6$ Atp; $L_1 = L_2$ $^{1}/_{2}x + 6 = 2x - 2$ 1.5x = 2x − 8 = 16 Substitute y = 30	M1 M1 A1 3 marks	Gradient of $L_1 = \frac{0 - 6}{-4 - 0}$ $= {}^{3}/_{2}$ y intercept = 6 Therefore y = mx + c general eq. $y = {}^{1}/_{2}x + 6$ At p; L1 = L2 $^{3}/_{2}x + 6 = 2x - 2$ x = 16 sub. Y = 30
13. $(3x - y)^4 \Rightarrow (3x)^4y^0, (3x)^3y^1, (3x)^2y^2, (3x)^1y^3, (3x)^0y^4$ $\Rightarrow 81x^4 = 27x^3y, 9x^2y^2$ $3xy^3, y^4$ With coeff. $(3x - y)^4 = 81x^4 - 4 \times 27x^3y + 6 \times 9 \times -4 \times 9xy^3 + y^4$ $= 81x^4 - 108x^3y + 54x^2y^2 - 36xy^3 + y4$ x = 2 and y = 0.2 $(6 - 0.2)^4 = 81 \times 2 - 108 \times 2 \times 0.2 + 54 \times 2^2 \times 0.2^2$ = 162 − 43.2 + 86.4 = 205.2	B1 M1 M1 A1 4 marks	$(3x-y)^4 = 81x^4 - 108x^3y + 54x^2y^2 - 36xy^3 + y^4$ $(6 - 0.2)^4 = (3 \times 2 - 0.2)$ $\Rightarrow$ x = 2 and y = 0.2 $(6 - 0.2)^4 = 162 - 43.2 + 86.4$ = 205.2
14. $d\alpha {}^{km}/_{13}$ $D = \frac{500}{5^3}$ 2 = 4k $2 = {}^{5}/_{9}$ $k = {}^{1}/_{2}$ $d = \frac{m}{2r^3}$ $10 = \frac{540}{2r^3}$ $r^3 = 27$ r = 3	 M1 A1	$d\alpha \frac{m}{r^3}$ $d = \frac{km}{r^3}$; k = constant $2 = \frac{500k}{5^3}$ $k = {}^{1}/_{2}$ $d = \frac{m}{2r^3}$ $r^3 = \frac{m}{2d}$ subst $r^3 = \frac{540}{20}$ 3 = r

SOLUTION	MARKS	ALTERNATIVE METHOD
15. 	B1 M1 A1	
16. $\frac{ds}{dt} = 0$ at maximum $= 29.4 - 9.8t$ $9.8t = 29.4$ $t = 3$ hence $S = 29.4 \times 3 - 4.9 \times 3^2$ $= 44.1m$	B1 M1 A1	
17. $\frac{dx}{dx} = x^2 + 2x - 3$ at turning points; $\frac{dx}{dx} = 0$ $x^2 + 2x - 3 = 0$ $x^2 - x + 3x - 3 = 0$ $x(x - 1) + 3(x - 1) = 0$ $(x - 1)(x + 3) = 0$ $X = 1$ or -3 Subst $y = \frac{1}{3}$ or 11 The turning points are $(1, \frac{1}{3})$ and $(-3, 11)$		

x	1	3	0	2	-4	-2
y	$\frac{1}{3}$	$1\frac{1}{3}$	2	$2\frac{2}{3}$	$8\frac{2}{3}$	$9\frac{1}{3}$



18. (a) $\begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} 2 & 2 & 4 \\ 0 & 4 & 4 \end{bmatrix} = \begin{bmatrix} 2a & 2a+4b & 4a+4d \\ 2c & 2c+4d & 4c+4d \end{bmatrix}$

$\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix} \begin{bmatrix} 2a & 2a+4b & 4a+4d \\ 2c & 2c+4d & 4c+4d \end{bmatrix} = \begin{bmatrix} -2c & -2c-4d-4c-4d \\ -2a & -2a-4b-4a-4d \end{bmatrix}$

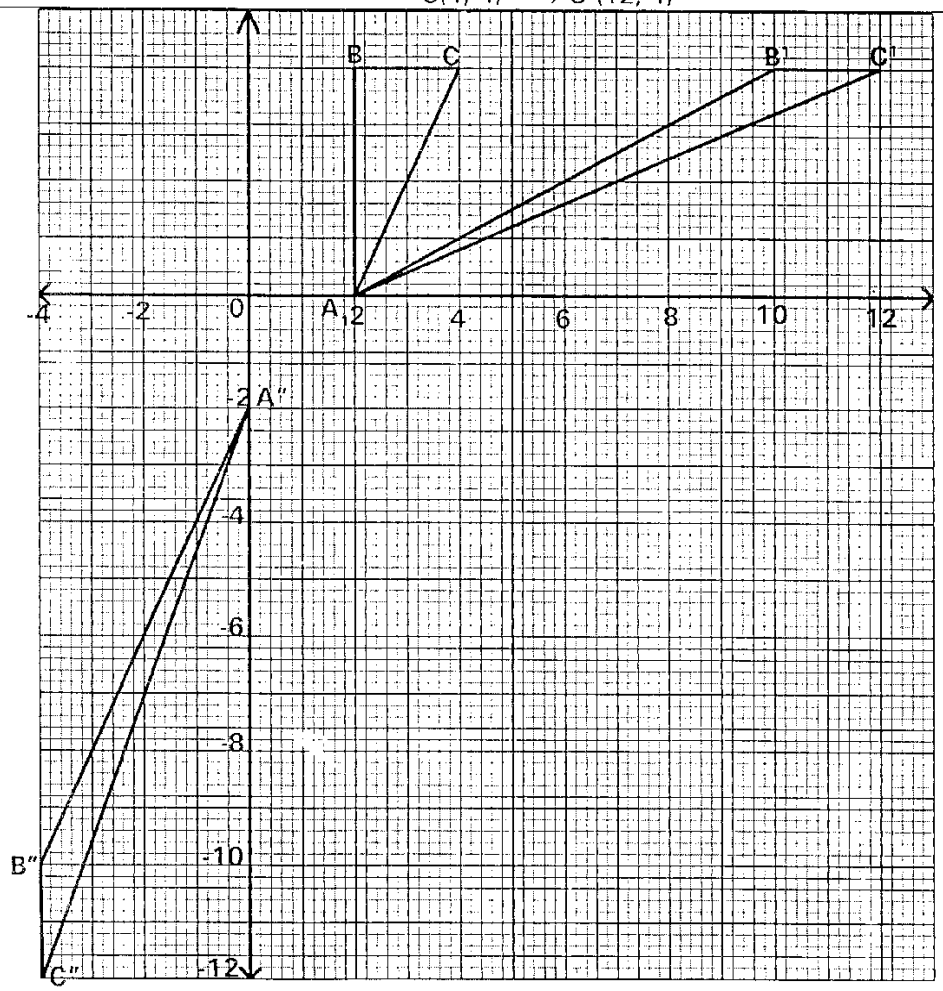
$\begin{bmatrix} 0 & -4 & -4 \\ -2 & -10 & -12 \end{bmatrix} = \begin{bmatrix} -2c-2c-4d & -4c-4d \\ -2a-2a-4d & -4a-4d \end{bmatrix}$

$-2c = 0 \Rightarrow c = 0 \quad -4d = -4 \quad -2a - 4b = -10$
$-2a = 2 \Rightarrow a = 1 \quad d = 1 \quad -2 - 4b = 10$
$b = 2$

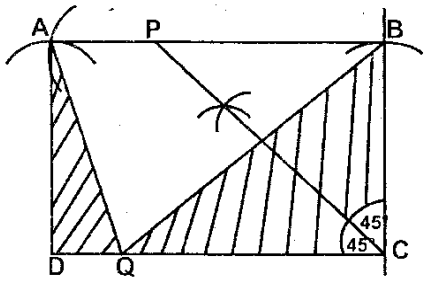
Hence $R = \begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$

(b) $\begin{bmatrix}1 & 2\\0 & 1\end{bmatrix}\begin{bmatrix}2 & 2 & 4\\0 & 4 & 4\end{bmatrix} = \begin{bmatrix}2+0 & 2+8 & 4+8\\0+0 & 0+4 & 0+4\end{bmatrix} = \begin{matrix}A^1 & B^1 & C^1\end{matrix}\begin{bmatrix}2 & 10 & 12\\0 & 4 & 4\end{bmatrix}$

(c) Shear x – axis invariant and B(2, 4) ⟶ B^1(10, 4) or
C(4, 4) ⟶ C^1(12, 4)

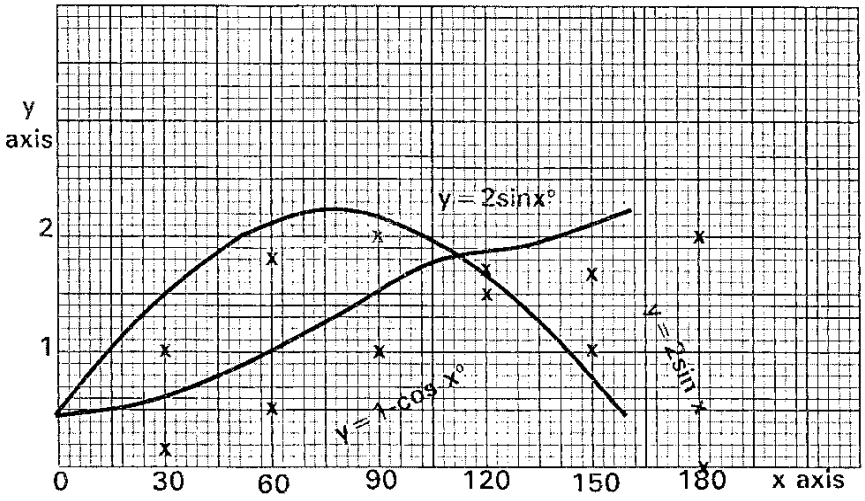


19. (a) c.d = 64800 – 60000 = 69600 = 64800 = 4800 a = 60000 n^{th} term = a + (-1)d =60000 + (n – 1) 4800	M1 B1	
(b) Common ratio $=\frac{64800}{60000} = \frac{69984}{64800} = 1.08$ n^{th} term = ar^{n-1} where a = 60000 r = 1.08 = $60000(1.08)^{n-1}$	M1 A1	
7^{th} term: Abdi = 60000 + (7 – 1) 48000 = 88800	M1	
Amoit = arn-1 = $60000(1.08)^6$ = 95213	M1	
Difference = 95213 – 88800 = sh 6413	B1 8 marks	

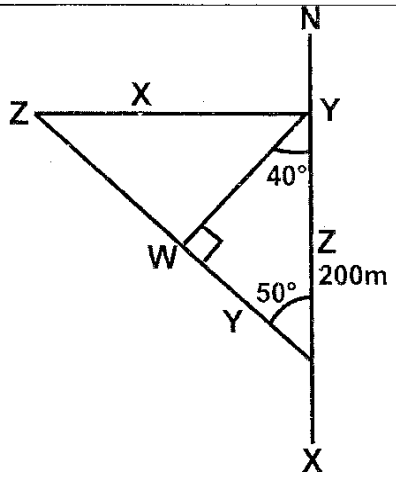
SOLUTION	MARKS	ALTERNATIVE METHOD
20.(a) P lies on any point along cp AQB $\leq 60° \leq 90°$  (b) Q lies on the unshaded region.	Rect 3 mks Drawing M2 A1	

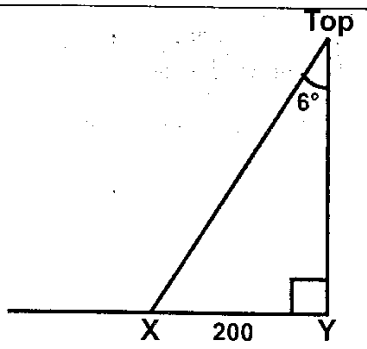
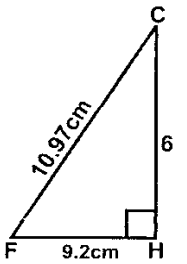
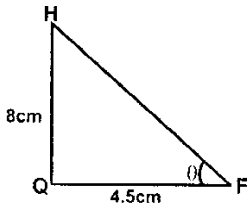
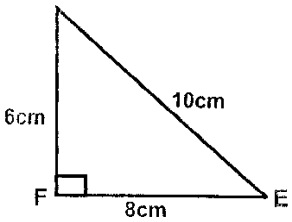
21.(a)

x°	0	30	60	90	120	150	180
2 sinx°	0	1	1.732	2	1.732	1	0
1 - cos x°	0	0.134	0.5	1	1.5	1.866	2

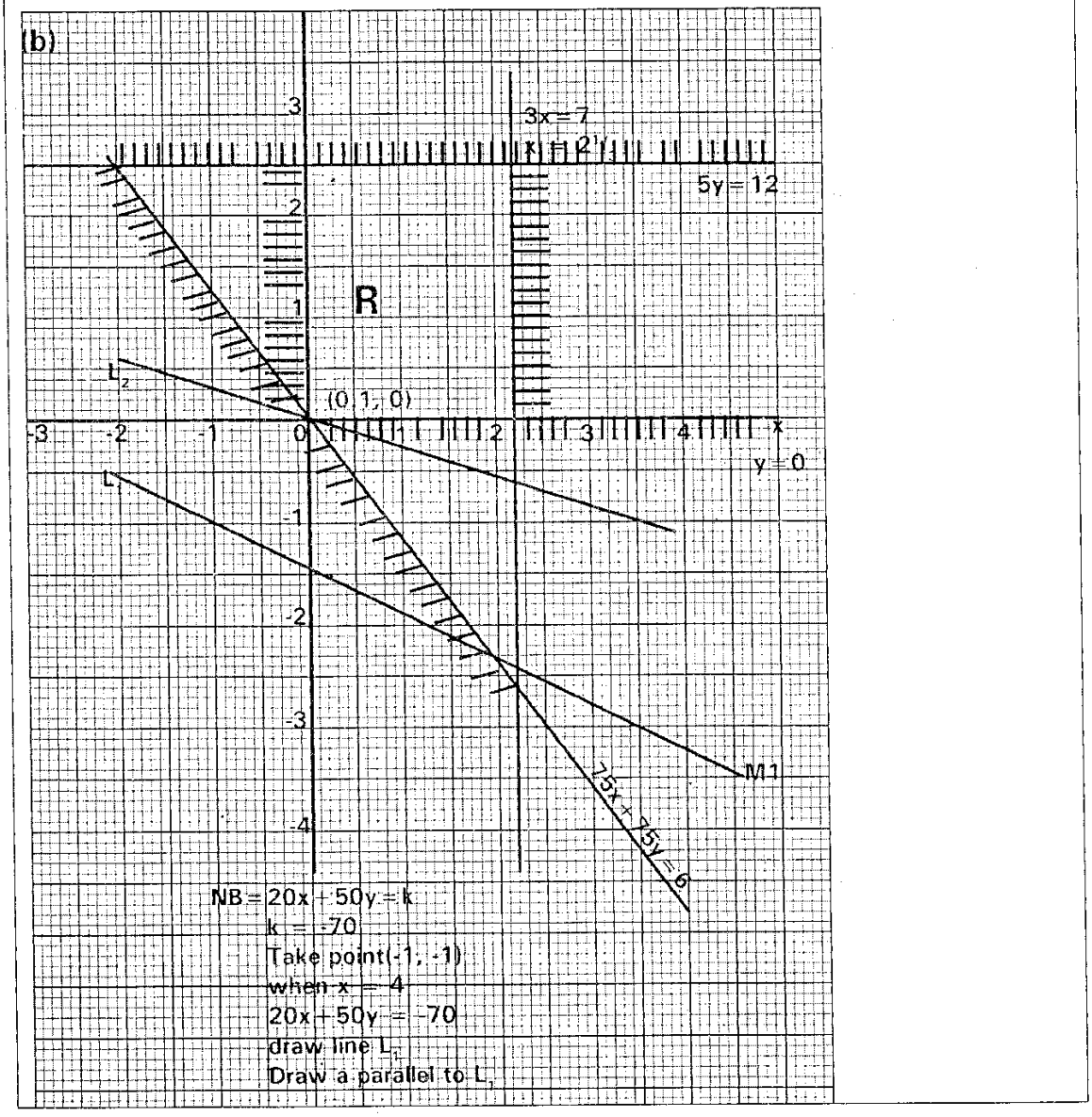


(c) (i) 129°
(ii) $0 < x < 129°$

22.(a) $x^2 = y^2 + z^2 - 2xy \cos x$ $= 40000 + 40000 - 2 \times 40000 \cos 50$ $= 80000 - 51424$ $x^2 = 28576$ $x = 169.04$ Sin rule $\frac{y}{\text{Sin } y} = \frac{x}{\sin x}$ $200 - 169$ Sin y = sin 50 Sin y = $\frac{200 \sin 50}{169}$ Sin y = 0.90656 y = 65° bearing z from y = (180 + 65°) = 245°	M1 A1	

(b) wy = 200 sin 50 sin 90 wy = $\frac{\sin 50 \times 200}{\sin 90}$ =0.90656 x 200 wy = 181m (c) TYX = ∟ (right angled triangle) XTY = 6°(given) Therefore XYT = (90 – 6) = 84° Angle of elevation of the top = 84°	M1 A1 B1 M1 A1 8 marks	
23.(a) $PH^2 = \sqrt{4.5^2 + 8^2}$ $= \sqrt{20.25 + 64}$ = 9.2 fe = $\sqrt{9.2^2 + hc^2}$ = $\sqrt{9.2^2 + 6^2}$ = 10.97cm (b) (i) tan θ = $^6/_{9.2}$ tan θ = 0.6522 θ = 33° (ii) tan θ = $^8/_{4.5}$ A1 tan θ 1.7750 θ = 60.60° (c) Cosine rule $6^2 = 10^2 + 8^2 - 2 \times 8 \times 10 \cos \theta$ $36 = 100 + 64 - 160 \cos \theta$ $36 = 164 - 160 \cos \theta$ Cos θ = $^{128}/_{16}$ θ = 0.8 = 36°.9'	A1 A1 A1 B1 A1 M1 A1 8 marks	   tan e = $^6/_8$ = 0.75 =36°.9'
24.(a) (i) = 75x + 75y>6 = 25x + 25y>2 (ii) 75x≤175 3x≤7 (iii) 75≤180 5y≤12 (iv) y≥0 (v) x≥0	M1 M1 M1	

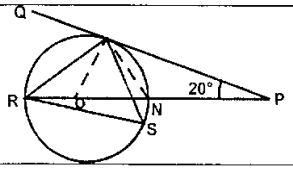
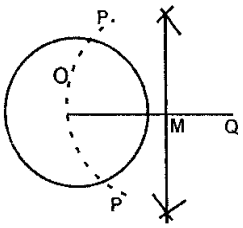
(b) See diagram next page	4 mks	
(c) (i) Lowest cost = 20x + 50y At(0.1, 0) c = 20 x 0.1 + 50 x 0 c = 2/=	A1	
(ii) Max cost = 20 x 2.3 + 50 x 2.4 c = 46 + 120 c = 166/=	8 marks	

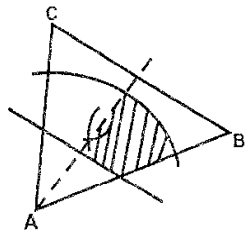
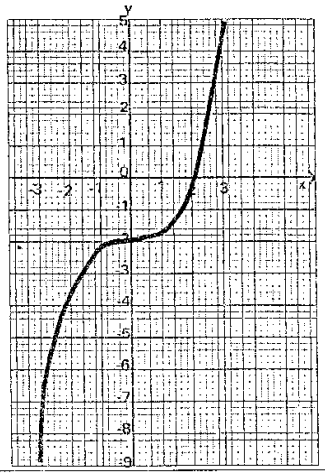


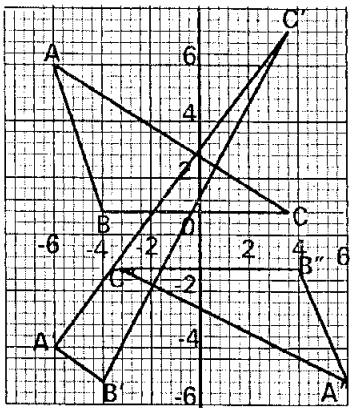
MATHEMATICS

K.C.S.E PAPER 121/ 2 2006

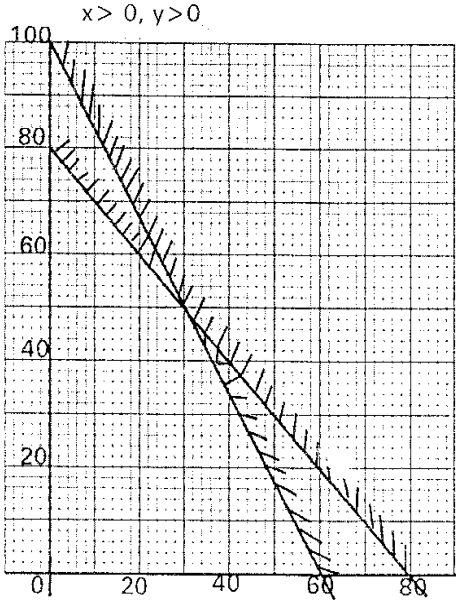
MARKING SCHEME

SOLUTION	MARKS	ALTERNATIVE METHOD
1. No: $(0.46)^2$; 36.72; 185.4; $10^{-1} \times 3.473$ Log: $\bar{1}.6628 \times 2$; 2.3256 +; 1.5649; 0.8905; $- 2.2682$; $\bar{2}.6223 \times 1/3$; $(3 + 1.6223) 1/3$; 1.5408; $= 0.3473$	M1 M1 M1 A1 4 marks	All 3 logs Operations (x3, +, -) Correct attempt Accept standard form
2. $p = r^2(1 - as^2)$ $s^2 = 1/a(1 - p/r^2)$ $s = \pm\sqrt{1/a(1 - p/r^2)}$	M1 M1 A1 3 marks	For squaring both sides or equivalent for s^2 subject CAO $\pm\sqrt{\frac{r^2 - p}{ar^2}}$
3. $\angle PTO = 90°$ or $\angle RTN = 90°$ $\angle TOR = 110°$ or $\angle TOP = 70°$ $\angle RST = 55°$	B1 B1 A1 3 marks	
4. $800 \times 0.006 = 4.8$ $\%error = \frac{4.8 - (788 \times 0.006)}{788 \times 0.006} \times 100\%$ $= \frac{0.072}{4.728} \times 100\%$ $= 1.523\%$	B1 M1 A1 3 marks	Accept 52284264% Rounded off to at least 3 d.p
5. $\bar{x} = \frac{9 + 11 + 12 + 13 + 11 + 10}{6}$ $(x - \bar{x})^2 = 4, 0, 1, 4, 0, 1 = 11$ $s^2 = \frac{4 + 0 + 1 + 4 + 0 + 1}{6}$ $1.6 = x = 10 \div 6 = 2^2/_3$	M1 M1 A1 3 marks	
6. $\frac{(3\sqrt{2} - \sqrt{3})(2\sqrt{3} + \sqrt{2})}{(2\sqrt{3} - \sqrt{2})(2\sqrt{3} + \sqrt{2})}$ $= \frac{6\sqrt{6} + 6 - 6 - \sqrt{6}}{12 - 2}$ $= 1/2\sqrt{6}$	M1 M1 A1 3 marks	
7. 	B1 B1 2 marks	Mid point OQ determined by construction Arc centre M radius OM cutting circle at P
8. Tax on 1st 9680 $= \frac{10}{100} \times 9680 = 968$ Monthly income (shs) $\frac{(1916 - 968)100 + 9680}{15}$ $= 6320 + 9680 = 16000$	M1 M1 A1 3 marks	

SOLUTION	MARKS	ALTERNATIVE METHOD
9. $\sqrt{q^2 + (1/3)^2 + (2/3)^2} = 1$ $\sqrt{q^2 + 1/9 + 4/9} = 1$ $\sqrt{q^2 + 5/9} = 1$ $q = 2/3$ or $-2/3$	B1 M1 M1 A1 4 marks	
10. (a) Coordinates of A: $\left(\frac{5+3}{2}, \frac{5/2+-1}{2}\right) = A(1, 2)$ (b) $r^2 = (5-2)^2 + (5-1)^2$ $r = 5$ Equ. $(x-1)^2 + (y-2)^2 = 5^2$ $x^2 - 2x + 1 + y^2 - 4y + 4 = 25$ $x^2 + y2 - 2x - 4y - 20 = 0$	B1 M1 M1 A1 4 marks	
11. $(2+\frac{1}{2})^5 + 2^5 + 5(2^4)\left(\frac{1}{2}\right) + 10(2^3)(\frac{1}{2})^2 +$ $10(2^2)(\frac{1}{\sqrt{2}})^3 + 5(2)(\frac{1}{\sqrt{2}})^4 + (\frac{1}{2})^5$ $(2-\frac{1}{\sqrt{2}})^5 = 2^5 - 5(2^4)\left(\frac{1}{\sqrt{2}}\right) + 10(2^3)(\frac{1}{\sqrt{2}})^2$ $- 10(2^2)(\frac{1}{\sqrt{2}})^3 + 5(2)(\frac{1}{2})^4 - (\frac{1}{2})^5$ $= 2\left[2^5 + 10(2^3)(\frac{1}{\sqrt{2}})^2 + 5(2)(\frac{1}{\sqrt{2}})^4\right]$ $= 64 + 80 + 5$ $= 149$	M1 M1 M1 A1 4 marks	
12. $t = k^x/\sqrt{y} = t_1 = k^{0.96x}/\sqrt{1.44y} = 0.8t$ Decrease $= t - 0.8t = 0.2t$ % decrease $= \frac{0.2t}{t} \times 100\% = 20\%$	M1 M1 M1 A1 4 marks	
13.  	B1 B1 B1 B1 4 marks	⊥Arc centre A radius 6cm drawn bisector of BC drawn & dotted parallel 4cm from BC drawn region shaded. Apply if to BC is a full line NB: All boundaries must enclose the required region
14.  	P1 C1 B1	Plotting of all points Smooth curve For $x = 2.5 \pm 0.1$ at $y = 2$

SOLUTION	MARKS	ALTERNATIVE METHOD
15. $V = \int adt = 10t - {}^{2}/_{2}t^2 + c$ at $t = 0, v = 9 \Rightarrow c = 9$ $\therefore = 10t - t^2 + 9$ at $t = 3, v = 10(3) - 3^2 + 9$ $= 30m/s$	B1 M1 A1 4 marks	
16. $\angle POG = 180 - (36 \times 2)$ $= 108°$ Dist. PQ $= 108 \times 60$ $= 6480mm$	B1 M1 A1 3 marks	
17. (a) (i) Principal $= 358400 - (12800 \times 3)$ $= 320000$ (ii) $r = \frac{12800}{320000} \times 100\% = 4\%$ (b) (i) Deposit $= \frac{25}{100} \times 56000 = 14000$ Instalments $= \frac{56000-14000}{2625} = 16$ (ii) Cash price $\frac{100-12.5}{100} \times 4000 = 35000$ %difference $= \frac{56000-35000}{35000} \times 100\%$ $= 60\%$	M1 A1 M1 A1 M1 A1 M1 A1 M1 A1 10 marks	
18. Let width of the path be x Area $= (10 + 2x)(8 + 2x) = 168$ $\Leftrightarrow 80 + 20x + 16x + 4x^2 = 168$ $4x^2 + 36x - 88 = 0$ $\Leftrightarrow x^2 + 9x - 22 = 0$ $(x - 2)(x + 11) = 0$ $(x - 2)(x + 11) = 0$ $x = 2$ or -11 width of path $= 2m$ (b) Area covered by small slabs $= 14 \times 12 - (10 \times 8 + 4(2 \times 2)$ $= 72m^2$ No of slabs $= \frac{72}{0.5 \times 0.5} = 288$ Cost of slabs Large $= 600 \times 4 = 2400$ Small $= 50 \times 288 = 14400$ Total cost $= 2400 + 14400 = 16800$	M1 M1 M1 A1 M1 M1 A1 M1 M1 A1 10 marks	Or equivalent Or equivalent
19.(a) (i)  Shear maps(1, 0) - 1(1, 1½)	B1 B1 B1	B' (-4, -5) plotted C' (3, 6½) plotted A'B'C' drawn

(ii) shear maps 1(1,) 1(1, 1½) Matrix = $\begin{pmatrix} 1 & 0 \\ 1\frac{1}{2} & 1 \end{pmatrix}$ A′ B′ C′ A″ B″ C″ (b) (i) $\begin{pmatrix} -1 & 0 \\ 1\frac{1}{2} & -1 \end{pmatrix}\begin{pmatrix} -6 & -4 & 3 \\ -4 & -1 & -2 \end{pmatrix} = \begin{pmatrix} 6 & 4 & -3 \\ -5 & -1 & -2 \end{pmatrix}$ (ii) Half turn, about (0, 0)	M1 A1 M1 A1 B1 B1 B1 10 marks	OR $\begin{pmatrix} 1 & 0 \\ k & 1 \end{pmatrix}\begin{pmatrix} -6 \\ 5 \end{pmatrix} = \begin{pmatrix} -6 \\ -4 \end{pmatrix}$ Accept general form after formation of 4 possible equation A″B″C″ drawn & labelled
20.(a) x/y: 1 2 3 4 5 6 7 8 1: * •* * * o* o* o* 2: * * •* * * o* o* 3: • * * •* * * o* 4: • * * •* * * 5: • * * •* •* * 6: o • * * •* * 7: o o • * * 8: o o o •		Dots listing table missing
(i) p(1x – y1 = 2) favourable outcomes = 12 p(1x –y1 = 2) = $\frac{12}{64} = \frac{3}{16}$ (ii) p(1x –y/5) favourable outcomes p(1x –y5) = $\frac{12}{64} = \frac{3}{16}$ (iii) p(x>y) favourable outcomes p(x>y) = $\frac{28}{64} = \frac{3}{16}$	B1 B1 B1 B1 B1 B1	On the table or listed O on the table or listed *on the table or listed
(b) (i) k + 2k+3k+4k+5k+6k = 1 21k = 1 k = $^1/_{21}$ (ii) p(11) = $^5/_{21} \times {}^6/_{21} + {}^6/_{21} \times {}^5/_{21}$ = $^{60}/_{441}$ = $^{20}/_{147}$	M1 A1 M1 A1 10 marks	
21.(a) Alcoholic vol. in the mixture = $\frac{60}{100} \times 80 = 48$ litres New proportion of alcohol = $\frac{48}{80+x}$ $\therefore \frac{40}{80+x} = \frac{40}{100}$ x = 40 (b) % of alcohol in the new solution is $\frac{48}{120+30} \times 100 = \frac{48}{150} \times 100 = 32$ (c) Alcohol volume in the mixture in litres = $5 \times \frac{32}{100} + 2 \times \frac{60}{100}$ = 1.6 + 12 = 2.8 The ratio = 7 – 2.8) : 2.8 = 4.2 : 2.8 = 3 : 2	B1 B1 M1 A1 M1 A1 M1 A1 M1 A1 10 marks	The volume of the water $\frac{40}{100} \times 80 = 32$ litres New proportion of water = 32 + x $\frac{32+x}{80+x} = \frac{60}{100}$ x = 40 water volume in this mixture = $5 \times \frac{68}{100} + 2 \times \frac{40}{100}$ 3.4 + 0.8 = 4.2 The ratio = 4.2 : (7 – 4.2) = 4.2 : 2.8 = 3 : 2

22. (a) a x ar x ar^2 = 64 a^3r^3 = 64 r = $3\sqrt{\frac{64}{a^3}}$ = $\frac{4}{a}$ (b) (i) $a + a \times 3 + \frac{4}{a}\left(\frac{4}{a}\right)^2 = 14$ $a2 - 10a + 16 = 0$ a = 8 or 2 ∴ r = ½ or 2 8, 4, 2, 1 (ii) The product = $8(½)^{50-1} \times 2 \times 2^{50-1} = 16$	M1 M1 A1 M1 A1 B1 B1 B1 M1 A1 10 marks	
23. (a) 300x + 180 < 18000 5x + 3y < 300 x + y < 80 x > 0, y > 0  x = 30, y = 50 Max profit = 50 x 4000 + 30 x 6000 = 380000	B1 B1 B1 S1 B1 B1 B1 B1 B1 M1 A1 10 marks	
24. (a) 3x = 4 – x2 (x + 4) (x – 1) = 0 x = -4 or x = 1 ∴ The coordinator of P(1, -3) The coordinator of Q(-4, -12) (b) $\int_{-4}^{-2}(14 - x^2)dx = \left[4x - \frac{1}{3}x^3\right]_{-4}^{-3}$ = $(4 \times 2 - \frac{1}{3}x(-2)^3 - (4x - 4 - \frac{1}{3}(-4)^3$ = $10^2/_3$ The shaded area = ½ x 4 x 12 - $10^2/_3$ below x axis = $13^1/_3$ shaded area = $13\frac{1}{13} + [4x - \frac{1}{3}x^3]^0$ = $13\frac{1}{3} + 0 = \left[4x\,2 - \frac{1}{3}\right](8)$ = $13\frac{1}{3} + 5\frac{1}{3}$ = $18\frac{2}{3}$	M1 A1 M1 B1 M1 A1 M1 A1 M1 A1 10 marks	

MATHEMATICS

K.C.S.E PAPER 121/ 2 2007

MARKING SCHEME

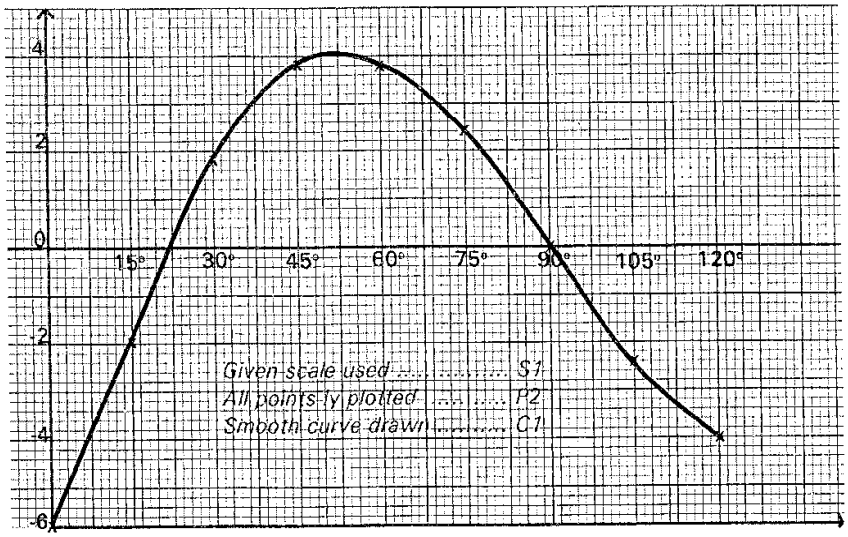
SOLUTION	MARKS	ALTERNATIVE METHOD
1. No | Log 0.32 | $\bar{2}.5051$ 14.26 | 1.1541 + $\bar{1}.6592$ 0.006 | 3.7782 - 1.8810 (4) | $1.8810 \times {}^{2}/_{3}$ 17.95 ← | $1.2540 = 17.95$	M1 M1 A1 3 marks	All 3 logs Division 3 By 2
2. $yx + 3yz = 2x - 2$ $yx - 2x = 03z - 2$ $x(y - 2) = -3yz - z$ $x = \frac{-3yz - 2}{y - 2}$	M1 M1 A1 3 marks	Or equivalent
3. $3 \cos x = 2(1 - \cos^2 x)$ $3 \cos x = 2 - 2 \cos^2 x$ $2y^2 + 3yz - 2 = 0$ $(2y - 1)(y + 2) = 0$ $y = ½$ or $y = -2$ $\cos x = 0.5$ $x = 60°, 300°$	M1 M1 A1 B1 4 marks	Or equivalent
4. (a) $1.1^5\left[\frac{1}{2}x\right]^{\circ} + 5.1^4\left[\frac{1}{2}x\right]^{1} + 10.1^3\left[\frac{1}{2}x\right]^{2} + 10.1^2\left[\frac{1}{2}x\right]^{3} + 1.1^{\circ}\left(\frac{1}{2}x\right)^{5}$ (b) $\left[1\frac{1}{20}\right]^5 = 1 + \frac{5}{2}\times\frac{1}{10} + \frac{5}{2}\times\frac{1}{100}$ $= 1\frac{11}{40}$ or 1.275	M1 A1 M1 A1 4 marks	Or 1 + 0.25 + 0.25 M1 = 1.275 AL
5. $S = \int(2 - t)dt$ $S = 2t - {}^{t^2}/_{2} + c$ When $s = 5, t = 2$ $5 = 2 \times 2 - {}^{2^2}/_{2} + c = 3$ $S = 2t - {}^{-1}/_{2t^2} + 3$	M1 M1 A1 3 marks	
6. Interest $= (13\,800 - 2280) \times \frac{20}{100} \times 2$ $= 11520 \times 0.2 \times 1 = 4608$ Each monthly instalments $= \frac{11520 + 4608}{24}$ = Ksh 672	M1 M1 A1 3 marks	
7. $\left[\frac{6+2}{2}, \frac{1+3}{2}\right] = (4, 2)$ $M_1M_2 = \frac{1-3}{6-2} \times m2 = -1$ $\frac{y-2}{x-4} = 2$ $\therefore 2x - y = 6$	B1 M1 M1 A1 4 marks	Or equivalent

SOLUTION	MARKS	ALTERNATIVE METHOD
8. Greatest possible error $=\frac{64(3.15-3.05)}{2}$ $=\frac{201.6-195.2}{2}$ $=3.2\ cm^3$	M1 A1 2 marks	
9. 2.5 litres $= 2500cm^3$ $^4/_5 \times 2500 = 2000cm^2$ (water) $^1/_5 \times 2500 = 500cm^3$ (milk) $200 \times 1 + 500 \times 1.2$ $= 2600gm$	M1 M1 A1 3 marks	$\frac{4\times1+1\times1.2}{5} = 1.04$ $1.04 \times 2500 = 2600g$
10. $\frac{67-32}{14} = \frac{37}{14}$ $= 2.5$ $67 - 6 \times 2.5$ $= 52cm$	M1 M1 A1 3 marks	
11. (a) NR $= \sqrt{4^2 + 7.5^2}$ $= 8.5$ (b) QR $= (14 + 8.5) = 7.52$ QR $= 4 \times AN = 14x\ (8.5 - 2.5)$ AN $= \frac{14 \times 6}{4} = 12cm$	B1 M1 M1 A1 4 marks	
12. $\|P\| = \sqrt{3^2 + (-1)^2 + (1\,^1/_2)^2}$ $Q = 2p$ or $-2p$ $Q = 6i - 2j + 3k$ or $6i + 2j - 3k$	B1 B1 2 marks	
13. Longitude difference $= 360° - (133° + 118°) = 109$ $\therefore 109 \times 60 \cos x = 5422$ $\cos x = 0.8291$ $x = 22.99°$ $\therefore$ Longitude of A or B $= 34°N$	M1 M1 A1 3 marks	
14. When $x = 0, y = 2$ $\therefore 2 = k \times 1 \times 2$ $2 = -2k$ $\therefore k = -1$	M1 A1 2 marks	
15. $\frac{3}{\sqrt{5}-2} + \frac{1}{\sqrt{5}} = \frac{3(\sqrt{5}+2)}{5-4} + \frac{1}{5}\sqrt{5}$ $= 3\sqrt{5} + 6 + \frac{1}{5}\sqrt{5}$ $= 6 + \frac{16}{5}\sqrt{5}$	M1 M1 A1 3 marks	
16. $x^2 + y^2 - {}^3/_2 x + y = {}^1/_4$ $x^2 - {}^3/_2 x + {}^9/_{16} + y^2 + y + {}^1/_4$ $= {}^{-1}/_4 + {}^9/_{16} + {}^1/_4 = {}^9/_{16}$ $\left(x + \frac{3}{4}\right)^2 + \left(y + \frac{1}{2}\right)^2 = {}^9/_{16}$ Centre $= ({}^3/_4, {}^{-1}/_2)$ Radius $= {}^3/_4$	B1 B1 B1 B1 4 marks	
17. (a) (i) Fraction filled in 1hr (P & Q) $\frac{2}{9} + \frac{1}{3} = \frac{5}{9}$ Time taken $= 1\,^4/_5$ hr	M1 A1	

(ii) Fraction filled in 1hr (P, Q & R) $= \frac{5}{9} - \frac{1}{2} = \frac{1}{18}$ Time taken to fill tank = 18 hrs (b) (i) Fraction filled by 9.00 a.m P - $\frac{2}{9}$ x 1hr = $\frac{2}{9}$ Q - $\frac{1}{3} + \frac{1}{4}$h = $\frac{1}{12}$ P & Q - $\frac{2}{9} + \frac{1}{12} = \frac{11}{36}$ (ii) Fraction to be filled = $\frac{25}{36}$ Time taken $\frac{25}{36}$ x 18 = $12\frac{1}{2}$hr Time tank will fill up 0900 + 12.30 = 2130h(9.30 pm)	M1 A1 M1 M1 A1 M1 M1 A1 10 marks	
18.(a) (i) $y = \frac{K}{x^n}$ (ii) $k = 12 \times 2^n$ and $k = 3 \times 4^n$ $\Leftrightarrow 12 \times 2^n = 3 \times 4^n$ $4 \times 2^n = 4^n$ $2^{n+2} = 2^{2n}$ N = 2 or n = 2 K = 48 or n = 2 (b) $y = \frac{48}{(5\frac{1}{3})^2} = \frac{48 \times 9}{16^2}$ $= {}^{27}/_{16} = 1\,{}^{11}/_{16}$ or 1.6875	B1 B1 B1 M1 M1 M1 A1 B1 8 marks	$K = 12 \times (2^n)$ $K = 3 \times 4^n$ ${}^{k}/_{12} = 2^n$ and ${}^{k}/_{3} = (2^n)^2$ ${}^{k^2}/_{144} = (2^n)^2$ ${}^{k}/_{3} = {}^{k^2}/_{144}$ $48k = k^2$ $K^2 - 48k = 0$ $K(k - 48) = 0$ K = 0 or k = 48

19.(a)

x	0°	15°	30°	45°	60°	75°	90°	105°	120°
Y = 8 sin 2x – 6cos									

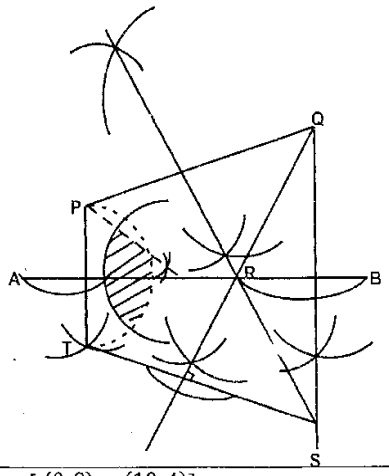
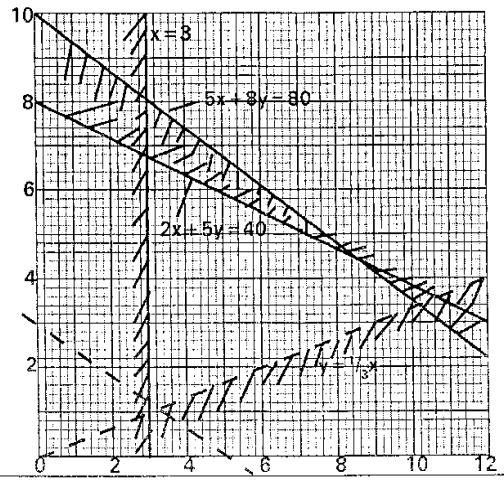


(c) (i) Maximum y = 4.1 ± 0.1

(ii) 8sin 2x – 6cos x = -2

X = 31.5 ± 0.75°

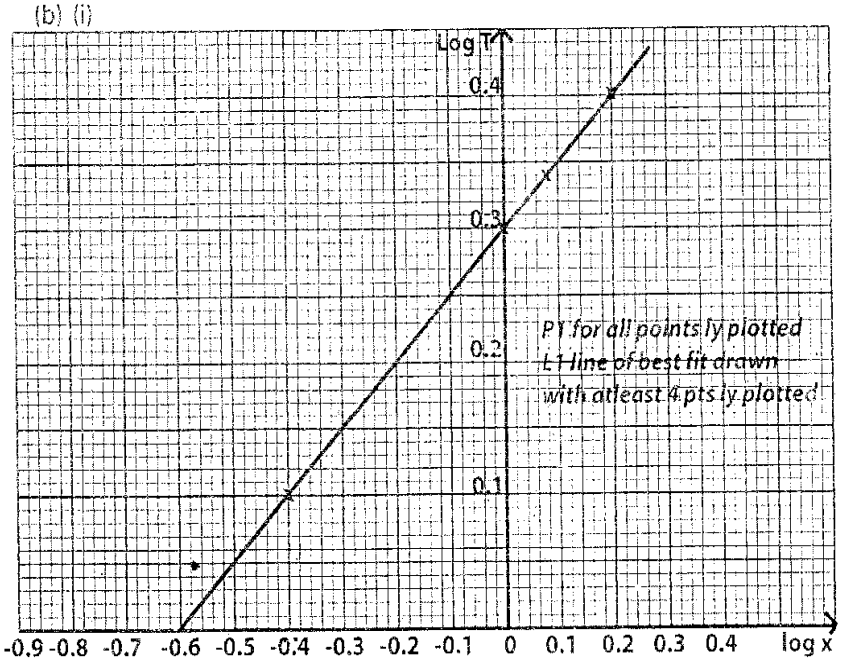
X = 78 ± 0.75°

20. (a) (i) $y = \frac{2x^2}{2} + x + c$ At $x = -4$, $y = 6$ $6 = (-4)^2 - 4 + c$ $C = -6$ $Y = x^2 + x - 6$ (ii) $x^2 + x - 6 = 0$ $(x - 2)(x + 3) = 0$ $X = 2$ or $x = -3$ (b) $\int_{-3}^{2}(x^2 + x - 6)dx$ $= [x^3/3 + x^2/2 - 6x]_{-3}^{2}$ $= [8/3 + 4/2 - 12] - [27/3 + 9/2 - 18]$ $= -7\frac{1}{3} - 13.5$ $= -20\frac{5}{6}$ square units	M1 M1 A1 M1 M1 A1 M1 M1 A1 B1 10 marks	
21.  	B1 B1 B1 B1 B1 B1 B1 B1 B1 10 marks	⊥bisector of PQ constructed and point R marked ⊥dropped from Q to AB or ∠PRB transferred to ∠BRS RS 1 form P to AB constructed PT = 2 length of 1 and polygon completed R from TS = 4.6 ± 0.1 Bisect of ∠QPT drawn dotted Arc centre R with radius 4.5cm drawn semicircle with PT as diameter drawn dotted correct region shaded.
22. (a) $\begin{bmatrix}(0,8) & (10,4)\\(0,10) & (8,5)\end{bmatrix}$ $2x + 5y < 40$ $5x + 8y < 80$ $x > 3$ $y > \frac{1}{3}x$ (b)  		

23. (a)

Log x	-0.4	0.00	0.08	0.15	0.20
Log T	0.10	0.30	0.34	0.37	0.40

(b) (i)



(ii) a = log-1 0.3 = 2.00

b = gradient = $\frac{0.4-0.1}{0.1-(-0.4)}$ or equivalent

= 0.5

(c) Lot T = b log x + log a

0 = 0.5 log x + 0.3

Log x = $\frac{-0.3}{0.5}$ = −0.6x

= 0.25

24. (a) P(RR) = $\frac{4}{6} \times \frac{2}{5} = \frac{8}{30} = \frac{4}{15}$ M1

P(YY) = $\frac{2}{6} \times \frac{3}{5} = \frac{6}{30} = 8\frac{1}{5}$ M1

P(same colour) = $\frac{8}{30} + \frac{6}{30} = \frac{14}{30} = \frac{7}{15}$ M1 A1

(b) (i) P($R_A R_A$) $\frac{4}{6} \times \frac{3}{5} = \frac{2}{5}$ M1

P($R_A R_A$) $\frac{2}{5} \times \frac{1}{1} = \frac{1}{10}$ M1

P(Both RED for A or B) M1

= $\frac{2}{5} + \frac{1}{10} = \frac{4+1}{10} = \frac{1}{2}$ A1

(ii) P (all RED) = $\frac{2}{5} \times \frac{1}{10} = \frac{1}{25}$ M1 A1

10 marks

MATHEMATICS

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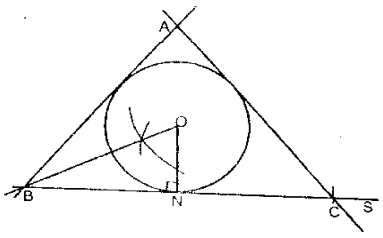
MARKING SCHEME

1. 1 cow feeds on $\frac{480}{2\times4}$kg in 1 day.
   $= 60$kg
   No of cows fo feed on 20160kg
   $$\frac{20160}{60X42}$$
   In 6 weeks $= \frac{20160}{60\times6\times7} = 8$

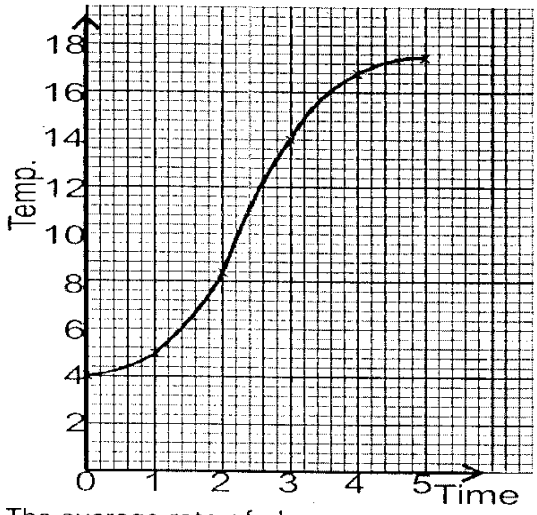
2. $x-(1.5+2\sqrt{2})(x-5-\sqrt{2})$
   $b = -3$ or $c = 0.25$
   $(x-1.5-\sqrt{2})(x-1.5+\sqrt{2}) = 0$
   $x^2 - 1.5x + x\sqrt{2} - 1.5x + 2.25 - 1.5\sqrt{2}$
   $-x\sqrt{2} + 1.5\sqrt{2} - 2 = 0$
   $x^2 - 3x + 0.25 = 0$
   $4x^2 - 12x + 1 = 0$

3. $m = c + kt^2$
   $40 = c + 4k$
   $65 = c + 9k$
   $25 = 5k$, $k = 5$
   $40 = c + 4x5$
   $C = 20$
   When $t = 4$, $m = 20 + 5x16$
   $= 100$g

4. Check 60° at 0
   120 at 0



5.

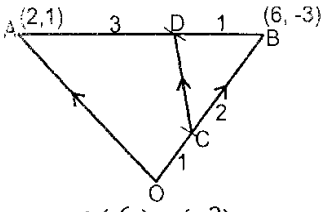


The average rate of change

$=\frac{15.5-7.6}{3.4-1.8}$

$=4.9375°c/min$

6.



$\underline{CO} = \frac{-1}{3}\begin{pmatrix}6\\-3\end{pmatrix} = \begin{pmatrix}-2\\1\end{pmatrix}$ or $\underline{OC} = \begin{pmatrix}2\\-1\end{pmatrix}$

$\underline{AD} = \frac{3}{4}\begin{pmatrix}4\\-4\end{pmatrix} = \begin{pmatrix}3\\-3\end{pmatrix}$

$\underline{CD} = \underline{CO} + \underline{OA} + \underline{AD}$

$= \begin{pmatrix}-2\\1\end{pmatrix} + \begin{pmatrix}2\\1\end{pmatrix} + \begin{pmatrix}3\\-3\end{pmatrix}$ addition of 3 vector

$= \begin{pmatrix}3\\-1\end{pmatrix}$

7. The LCM of 3 and 5 = 15

In 15 minutes, 8 customers will be served

$\therefore$ total time $= \frac{200}{8} \times 15$

$= 6¼$ hrs

8. $(2-x)^7 = 2^7 - 7.2^6.x + 21.2^5.x^2 - 35.2^4.x^3 +$

(a) $35.2^3.x^4 - 21.2^2x^5 + 7.2^1.x^6 - x^7$

$= 128 - 448x + 672x^2 - 560x^3 + 280x^4 - 84x^5 + 14x^6 - x^7$

(b) $(1.97)^7 = (2 - 0.03)^7$

$= 128 - 448x0.03 + 672x(0.03)^2 - 560x(0.03)^3$

$= 128 - 13.44 + 0.6048 - 0.01512$

$= 115.14968$

$= 115.1497$

9. Image area $= [(4X2) - (5X1]X21$

$= 63$ sq cm

10. $\frac{\sqrt{3}}{\sqrt{3}-\sqrt{2}} = \frac{\sqrt{3}(\sqrt{3}+\sqrt{2})}{(\sqrt{3}-\sqrt{2})(\sqrt{3}+\sqrt{2})}$

$= \frac{3 + \sqrt{3}.\sqrt{2}}{3 - 2}$

$= 3 + \sqrt{6}$

11. $(2 - 1)^2 + (5 - k)^2 = 10$

$k^2 - 10k + 16 = 0$

$(k - 2)(k - 8) = 0$

$k = 2$ or $k = 8$

Centre at (1, 2) (1, 8)

12. $\left(\frac{1}{7}X\frac{2}{5}\right) + \left(\frac{6}{7}X\frac{1}{6}\right)$

$= \frac{7}{35}$

13. Longitude difference $= 45° + 60° = 105°$

Distance in km

$= \frac{105}{360} \times 2 \times 3.142 \times 6370 \cos 40°$

$= 8943.7$km

$= 8946.12$km when $\frac{22}{7}$ is used for π

14. $4 - 4\cos^2 \propto = 4 \sin \propto - 1$

$4 - 4(1 - \sin^2 \propto) = 4 \sin \propto - 1$

$4 \sin^2 \propto - 4 \sin \propto + 1 = 0$

$(2 \sin \propto - 1)(2 \sin \propto - 1) = 0$

$\sin \propto = ½$

$\therefore \propto = 30°, 150°$

15. $AT^2 = 9 \times 4$

$= 36$

$\therefore AT = 6$cm

16. $\int (3t^2 - 6t - 9)dt = t^3 - 3t^2 - 9t + c$

$[t^3 - 3t^2 - qt]_1^3 = [3^3 - 3(3^2) - 9(3)] -$

$[1^3 - 3(1)^2 - (1)^2 - 9(1)] = -16$

$[t^3 - 3t^2 - 9t]_3^4$

$= [4^3 - 3(4)^2 - 9(4)] - [3^3 - 3(3^2) - 9(3)]$

$= 7$

Distance travelled = 16 + 7 = 23

17. (a) Total rate of flow in litres = 120 + 150 = 270 L/min

Time taken $= \frac{18900}{270}$

$= 70$ min (1 hr 10 min)

(b) (i) Part of tank filled after 25 min $= 270 \times 25$

$= 6750$

Time taken to fill remaining part

$= \frac{18900 - 6750}{270 - 20}$

$= 48.6$ min

Total time to fill tank $= 25 + 48.6 = 73.6$ min

(ii) Total inflow into tank $= 270 \times 73.6$

$= 19872$

Water wasted

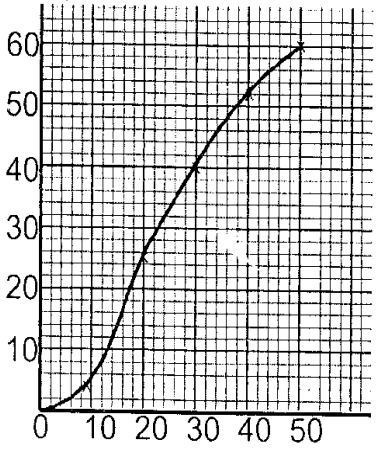
$= 19872 - (542 \times 25 + 6300) = 22$L

18. (a) value after 9 yrs $= 1240000(1+\frac{12}{100})^a$
$= 3438617.659$
$= 3438618$

(b) (i) $1240000(1.12)^n = 2741245$
$n \log 1.12 = \log\left(\frac{2741245}{1240000}\right)$
$n = \frac{\log 2.210681452}{\log 1.12}$
$n = 7$

(ii) $1240000(1+\frac{r}{100})^7 = 2917231$
$1+\frac{r}{100} = \sqrt[7]{\left(\frac{2917231}{1240000}\right)}$
$1+\frac{r}{100} = 1.130000011$
$r = 13\%$

19. (a) 2, 16, 40, 52, 60, 9.5, 19.5, 29.5, 39.5, 49.5



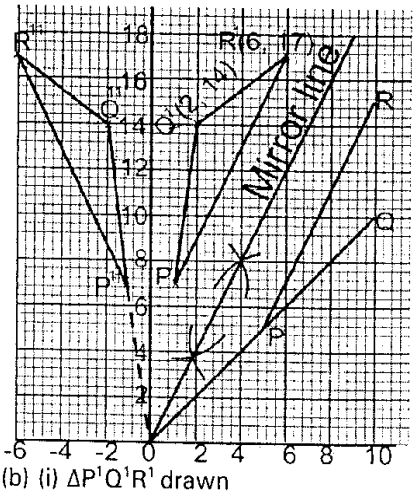
(b) (i) Median goals = 25.5

(ii) number of matches in which scores were between or -37 = 49

(iii) $Q1 = 19 \pm 0.5$
$Q3 = 33 \pm 0.5$
Inter quartile range 33 – 19 = 14

20. (a) $\begin{pmatrix} -0.6 & 0.8 \\ 0.8 & 0.6 \end{pmatrix}\begin{pmatrix} 5 & 10 & 10 \\ 5 & 10 & 15 \end{pmatrix} = \begin{pmatrix} 1 & 2 & 6 \\ 7 & 14 & 17 \end{pmatrix}$

$P^1(1, 7)$ $Q^1(2, 14)$, $R^1(6, 17)$



(b) (i) $\Delta P^1Q^1R^1$ drawn
Mirror line drawn through (3, 6), (7, 14)

(ii) mirror line equation = $y = 2x$

(c) (i) $\Delta P^{11}Q^{11}R^{11}$ √ly drawn

(ii) $\begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} P & Q & R \\ 5 & 10 & 10 \\ 5 & 10 & 15 \end{pmatrix} = \begin{pmatrix} P^{11} & Q^{11} & R^{11} \\ -1 & -2 & -6 \\ 7 & 14 & 17 \end{pmatrix}$
$\begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} 0.6 & -0.8 \\ 0.8 & 0.6 \end{pmatrix}$

(i) Rotation about (0, 0) through angle $53° \pm 1$

21. Tax on 1st $9680 = 9680 \times \frac{10}{100}$
Tax on ksh(1880-9680) $= 9120 \times \frac{5}{100}$
$= 1368$
Tax on ksh(24200 – 18800)
$= 5400 \times \frac{20}{100}$
Total tax = ksh(968 + 1368 + 1080)
= ksh3416

(b) Tax paid = 3416 – (1056 $+ 2400 \times \frac{15}{100}$
= ksh2000

(c) Increase in tax paid = ksh2000 $\times \frac{36.3}{100}$
= ksh726
∴ increase in earnings = ksh726 $\times \frac{100}{20}$
= ksh3630
% increase $= \frac{3630}{24200} \times 100\%$
$= 15\%$

22. (a) $AC = \sqrt{(15\sqrt{2})^2 + (15\sqrt{2})^2} = 30CN$

(b) Identification of Q (<CAG)

$\tan\theta = \frac{8}{30}$ or equivalent

$\theta = 14.93°$

(c) Pyramid height $= \sqrt{(17\sqrt{2})^2 - 15^2}$

$= 18.79cm$

$VO = 18.79 + 8$

$= 26.79cm$

(d) Identification of $\propto$

$\tan\propto = \frac{18.79}{7.5\sqrt{2}}$

$\propto = 60.55°$ or 60.56

23. (a) (i) $\frac{8}{2}\{2x2 + (8 - 1)d\} = 156$

$d = 5$

(ii) $\frac{n}{2}\{2x2 + (n-1)5\} = 1 + 16$

$5n^2 - n = 832$

$5n^2 - n - 832 = 0$

$(5n + 64)(n - 13) = 0$

$n = 13$

(b) (i) 1st three terms of the G.P, $a + 2d$, $a + 4d$, $a + 7d$

These terms are; $a + 6$, $a + 12$ and $a + 21$

$r = \frac{a+12}{a+6} = \frac{a+21}{a+12}$

$(a + 12)^2 = (a + 6)(a + 21)$

$a^2 + 24a + 144 = a^2 + 27a + 126$

$a = 6$

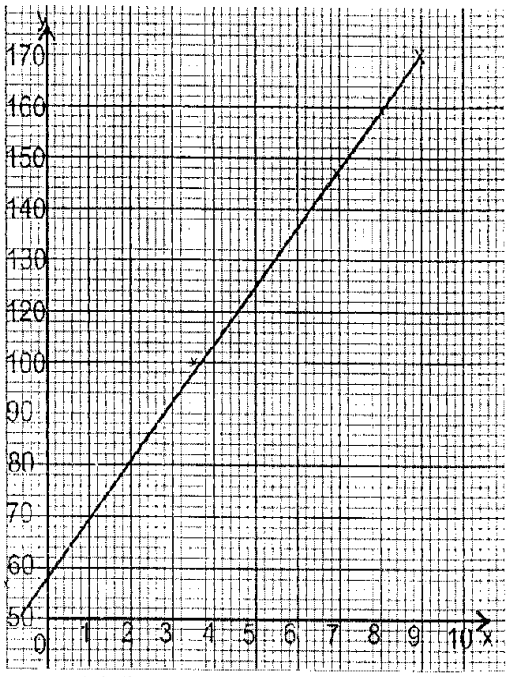
$\therefore$ 1st term of GP $= 6 + 6 = 12$

$r = \frac{6+12}{6+6} = \frac{3}{2}$

$Sq = 12\left(\frac{\frac{3}{2}^9 - 1}{\frac{3}{2} - 1}\right)$

$= 898.6$ (to 4 sf)

24.



(a) (i) scale

(ii) Plotting

(b) (i) average volume of ball bearing

$= \frac{133 - 108}{6 - 4}$

$= 12.5$

(ii) $\frac{y - 133}{x - 6} = 12.5$

$Y = 12.5x + 58$

(c) Volume of water in cylinder is the value of y when $x = 0$;

$Y = 12.5 \times 0 + 58$

$= 58$

MATHEMATICS
K.C.S.E PAPER 121/ 2 2010
MARKING SCHEME

1. $\sqrt{5134}$

$6 \times -18 \div + (5- {}^{-}3)$

$= \sqrt{2^6 \times 3^4}$

$6x - 18 \div 9 + 8$

$= \underline{2^3 \times 3^2}$

$6 \times -2 + 8$ M1 method y $\sqrt{5184}$ without use of calc

$= \underline{72}$ M1 Order of operations

-4

$= -18$ A1

03

2. $\dfrac{2^1/_4 + {}^3/_5 \div {}^5/_6 \text{ of } 2^2/_5}{1^7/_{10}}$

$= \dfrac{2^1/_4 + {}^3/_5 \times {}^6/_5 \times {}^5/_{12}}{1^7/_{10}}$

$= \dfrac{2^1/_4 + {}^3/_5 \times ½}{1^7/_{10}}$

$= (2^1/_4 + {}^3/_{10}) \div {}^{17}/_{10}$ M1 order for operations of numerators

$= 5^1/_{20} \times {}^{10}/_{17}$ M1 multiplying by $^{10}/_{17}$

$= {}^3/_2$ or $1^1/_2$ A1

03

3. $x = y = 2:3 \Rightarrow \underline{x} = \underline{2k}$ where k is a constant

$y \quad 3k$ B1

$x=2k \; ; \; y = 3k$

thus $(5x - 2y) : (x-y)$

$(5(2k) - 2x3k) : (2k + 3k)$ M1

$4k \; : \; 5k$

$\Rightarrow 4:5$

AH 1

$\underline{x} = {}^2/_3$ M1

y

$x = {}^2/_3 y$ or $y = {}^3/_2 x$

$(5({}^2/_3)y - 2y) : {}^2/_3 y + y)$

$4 : 5$ A1

A1

03

AH 2:

$x=2 \; y = 3$ M1

$\therefore 5(2) - 2(3) : 2 + 3$ M1

$4:5$ A1

4. Distance covered by bus
= 63 x (10.45 – 8.15)
= 63 x 2.5
= 157.5
Speed of car $\frac{157.5}{1.75}$
= 90km/h

Alt 1
M1 Extra distance
63 x ¾ = 47.25 M1
Relative speed
M1 x = -63
$\frac{47.25}{} = {}^{7}/_{4}$ M1
A1 x-63
X = 90
03 $\frac{63 \times 150}{150}$ = 90km/h

5. 54-1/2 x 27000 2/3
2-4 x 30 x 52
$= \frac{1}{\sqrt{64}} \times (x3\sqrt{27000})^2$
$= {}^{1}/_{16} \times 3^0 \times 25$
$= {}^{1}/_{8} \times 900 \times {}^{16}/_{25}$ M1
= 72

M1 removal of –ve indices
M1 Removal of rooty
simplification
A1
04

6. AC = $\sqrt{85^2} - \sqrt{75^2} = \sqrt{1600}$
= 40
Area of quad ABCD
= ½ x 40 x 75 + $\sqrt{75(75-60)(75-60)(75-40)}$ M1
= 500 + $\sqrt{984375}$
= 2492m^2
= 0.25ha

sum of both areas
A1
B1
04

7. Time between Monday 0545 and Friday 1945h
= 4 x 24 + 14
= 110h

M1 Expression leading to 110hrs

Time lost = 0.5 x 110 = 55min
Time shown in 12hour system
1945 – 55 = 1850h M1
= 6.50p.m.

A1
03

8. $\frac{12x^2 + 4x - 6a^2}{9x^2 - 4a^2}$

$\frac{(4x + 3a)(3x - 2a)}{(3x + 2a)(3x - 2a)}$ M1 factorising numerator

M1 ,, denominators √ly

$= \frac{4x + 3a}{3x + 2a}$ A1

03

9. $y = {}^{2}/_{5}x + 2$

Gradient $= {}^{-2}/_{5}$ B1

$\frac{k - 5}{3 - -2} = {}^{-2}/_{5}$ M1

$k - 5 = -2$

$\Rightarrow k = 3$ A1

03

$5y + 2x = 10$

$5(5) + 2(-2) = 21$

$5h + 6 = 21$

$(k,3)\ 5k = 15$

10. Let exterior ⟨ = ⟨at the centre) be x

$\therefore 6.5x + x = 180$

$7.5x = 180$

$x = 24$

$\therefore$ No. of sides $= \frac{360}{24}$

$= 15$ sides

Alt. 1

M1 let the no. of sides be n

$\frac{360}{n} \times 6.5 + \frac{360}{n} = 180$

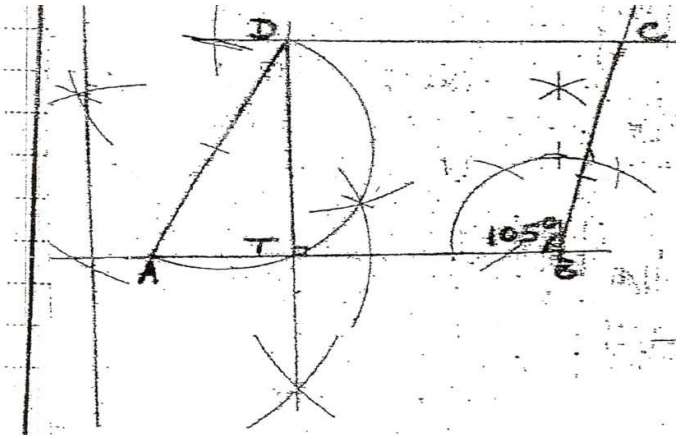
M1 $180n = 2700$

A1 $n = 15$ A1

03

11.

- construction of 105^0
- fixing point C and construct of line parallel to AB through C
- Completion of trapezion ABCD
- Location of point T from D only if any above B above 125



12. Let angle between ground and wire be θ°

$\therefore 0 + {}^{1}/_{3}\theta = 90$

$\Rightarrow \theta = 90 \times \frac{3}{4} = 67.5$ B1 or 22.5

Let the wire be x cm in length

$\therefore \text{Cos } 67.5 = {}^{6}/_{x}$

$x = \frac{6}{\text{Cos } 67.5} = \frac{6}{0.382683432}$ M1

= 15.68m or 1568cm A1

03

13. Sin (3x + 30) = sin 60° B1 for 60°

Sin (3x +30) = sin 120° B1 for 120°

3x + 30 = 60

3x + 30 = 120

X = 10° x=30° B1 for 10°

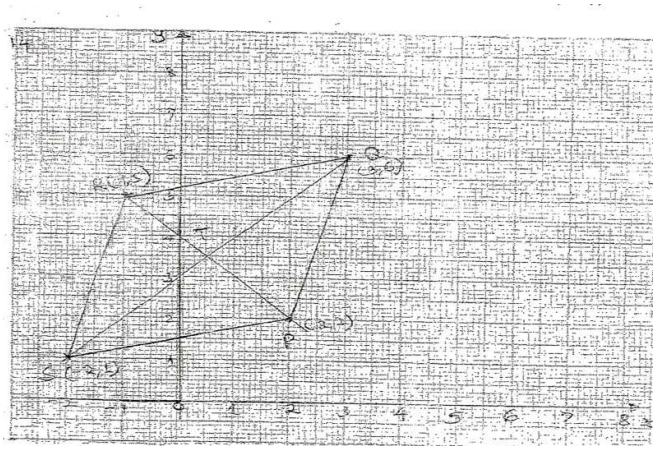
B1 for 30°

04

Different scales on x and y axis leads to a parallelogram

B0

B1 if T (0.5,3.5)



(a) Rhombus PQRS ly drawn B1 NB 5(-2,1) is critical

(b) Co-ordinates of T(0.5,3.5) B1

02

15. Commission earned

0.225 x 0.2 x 3800 M1

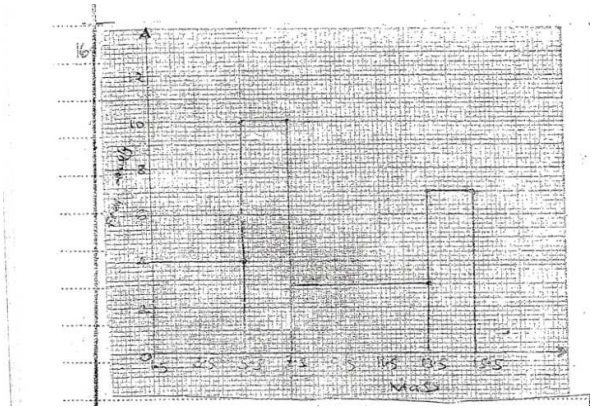
191 A1

1.5 – 5.5 bar B1

5.5-1.5 bar B 1

7.5-13.5 bar B1

Check height B



Check Heights

1.5 – 5.5 - 4

5.5 – 7.5 - 10

7.5 – 13.5- 3

13.5 – 15.5 - 7 given

17. BC2 = $6^2 + 8^2 - 2 \times 6 \times 8 \times \cos 5°$ M1 if drawn to scale the line 23 is not a

= 100 – 61.71 line 23 is not at a straight line there BC =

$\sqrt{38.2912}$ = 6.19 are so many possibilities

(b) let <ABC be β°

$\sin\beta = \sin 50° = \sin\beta = 65.450$ M1 Accept 48.16°,48.15°

6 6.19 6.19 47.94° ,47.96° depending

$\therefore \beta = 47.95°$ A1 on method used

(c) let <CAD be x°

$2.82^2 = 7^2 + 6^2 - 2x7 \times 6 \cos \propto$

$\cos \propto = \frac{49 + 36 - 7.9534}{84}$

$\propto = 23.48°$ A1 22.89 is possible

(d) Area of Δ ACD = ½ x 7 x6 x sin 23.48° $\sqrt{77.1 \times 1.92 \times 2.91 \times 9.0}$

= $837cm^2$ A1 8.37

10

18. (a) (i) model class 60-69 B1

(ii) class where medium task lies

0 - 9		1		
10 – 19	3	Medium is 35	B1 for c4 column	
20 – 29	7			BI Class centers
30 – 39	14	median class is 50-59	B1	m1-deviations
40 – 49	24			B1 fd
50 – 59	40			Σf=70 B1
60 -69		60		
70 – 79	66			Σfd=-33 A1
80 – 89	69			mean=54.4-33/70 M1
90 – 99	70			=53.93 A1

Class	Centres x	Fd	D = x-A

0-9	4.5	-49.9	-449
20-29	24.5	-119.6	-29.9
30-39	34.5	-139.3	19.9
40-49	44.5	-99.0	-9.9
50-59	54.5	1.6	0.1
60-69	64.5	20.2	10.1
70-79	74.5	120.6	20.1
80-89	84.5	90.3	30.1
90-100	94.5	40.1	40.1

19. (i) original price = $\frac{16200}{x}$ B1

(ii) price after discount $\frac{16200}{x+3}$ B1

(b) (ii) $\frac{16200}{x} - 60 = \frac{16200}{x+3}$ M1 or equivalent

$\Rightarrow (16200 - 600x)(x+3) = 16200x$

$16200x + 48600 - 60x2 - 180x = 16200x$

$60x2 + 180x - 48600 = 0$ M1 removal of denominator

$x^2 + 3x - 810 = 0$ M1 for quadratic equation

$(x + 30)(x-27) = 0$

$X = -30$ or $x=27$ M1 for factorization of quad. eqn

No of calculation bought = 30 A1 C.A.O. or

(c) Initial cost of calculators

$\frac{16200}{27} = 600$ M1

Discount offered as a percentage

$\frac{\frac{16200}{27} - \frac{16200}{30}}{600} \times 100$ M1

$= 10\%$ A1

10

20. (i) $ON = \frac{1}{2}(-8) = \begin{pmatrix} -4 \\ 2.5 \end{pmatrix}$ 20 (a) (ii) alt m is -6)B1

N is (-4,2.5) B1

$M = \left(\frac{-8+12}{2}, \frac{5-5}{2}\right)$ M1

M is (2,0) A1

(ii) $NM = \begin{pmatrix} 6 \\ -2 \end{pmatrix}$ B1

$NM = \sqrt{6^2 + (2.5)^2}$ M1

$= 6.5$ A1

(b) $OB = \begin{pmatrix} 12 \\ -5 \end{pmatrix}$ $NM = \begin{pmatrix} 6 \\ 2\frac{1}{2} \end{pmatrix}$

$\therefore nm = \frac{1}{2} OB$ B1

(c) $OP\ 2 + 2(2\frac{1}{2}) = (-10)$ M1

$OP = (-10) + (-5) + (-15)$ M1

$\begin{matrix} 0 & & 5 \\ 5 & 8 & 13 \end{matrix}$

$\therefore$ P' IS (-15,13) A1

10

21. Volume of water $\frac{6}{9+x} = \frac{2}{x}$ $x = 4.5$ M1 follow thro'

$\therefore$ vol = $1/3 \times 3.142 (6^2 \times 13.5 - 2^2 \times 4.5)$ M1 lsf 14.5 : 4.5

29 : 9

$= 508.94 - 18.25 = 490.09$ A1 24389 : 729

(b) (i) volume of sphere

Top radius $^{r}/_{14.5} = {}^{2}/_{4.5}$ r=6.44 M1 v = 24389 x 18.849 =630

Volume = $^{1}/_{3}$ x 3.142 (6.444 x 14.5 – 6 x 13.5)

= 121.6 $121^{11}/_{15}$ A1

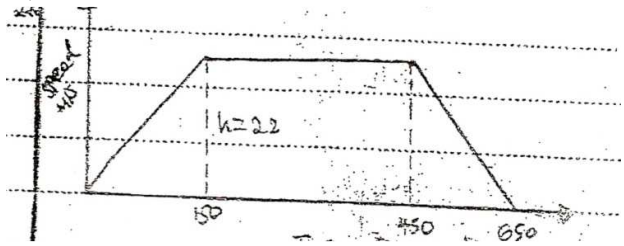
(iii) $^{4}/_{3}\pi$ x 3 = 121.6 M1

$r^3 = 121.6 \times {}^{3}/_{4}x$ M1

r = 3.073 A1

10

22.



(a) ½ x 150h + ½ x 200h + 300h = 10450 M1

475h = 10450

H = 22m/s A1

Max speed = $\frac{22 \times 60 \times 60}{1000}$ = 79.2km/hr B1

(b) Accelation $\frac{22m/s}{150}$ M1

$= {}^{11}/_{25}$ A1 or $0.1467m/s^2$

Or $1900.8km/h^2$

(c) ½ x 100 x 11 M1

=550

(d) Time for half of journey

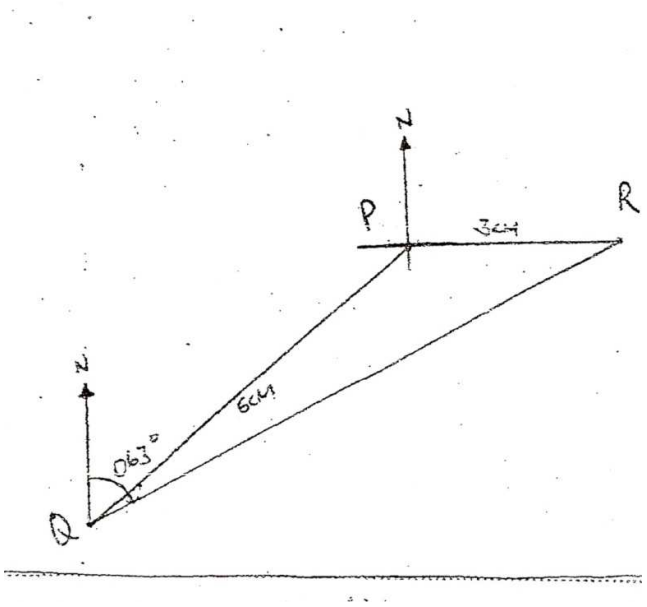
½ x 22 (150 +t +t) = ½ x 10450 M1

B = 162.5 A1

Total time = 150 +162.5

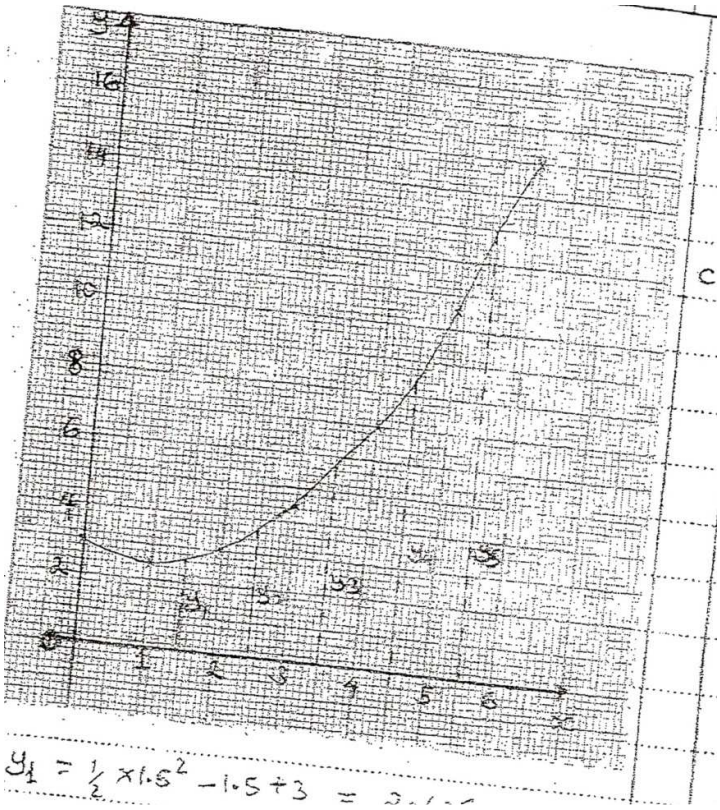
= 312.5 B1

10



a) Direction and distance of Q from P	B1	
Direction and distance of R from P	B1	
B(i) Distance conversion		
8.5 x 40	M1	8.51 + 0.1 8.4 X 40 =336
= 340		
(ii) Northline at Q		B1
Bearing 063 stated		B1
C(i) Distance from the top of the		
Post at Q to the top of post at P		follow through
X = 240 or x cos9 =240	M1	if calculated
= 243m	A1	B1 for calculated angle
(iii) speed of bird		
243 x 60 x 60		B1 for angle in form
1000 x 18		of bearing
= 48.6km/h	A1	240 =x
		Sin81
		10

X	0	1	2	3	4	5	6
Y=1/2 x2-x+3	3	2 ½	3	4 ½	7	10 ½	15



y_1 = ½ x 1.52 – 1.5 +3 = 2.625
y_2 = ½ x 2.52 – 2.5 + 3 = 3.625
y_3 = ½ x 3.52 – 3.5 + 3 = 5.625 B1 ordinates calculated
y_4 = ½ x 4.52 – 4.5 + 3 = 8.625
y_5 = ½ x 5.52 – 5.5 + 3 = 12.625

Approximate area = 1(2.625 + 3.625 + 5.625 + 8.625 +12.625)M1
= 33.125 square units A1

Area = (½ x 2 – x + 3) $x = \left(\frac{x^3}{6} - \frac{x^2}{2} + 3x\right)_1^6$ M1

$= 6 - \frac{6}{3} + 3 \times 6 - \frac{1}{6} - \frac{1^2}{2} + 3 = 33.3$ M1

$\frac{33.3 - 33.125}{33.3} \times 100 = 0.651\%$

$\frac{33\frac{1}{3} - 33\frac{1}{8}}{33\frac{1}{3}} A + 100\% = 0.625\%$

MATHEMATICS

K.C.S.E PAPER 121/ 2 2010

MARKING SCHEME

1. $\dfrac{7.55\times5.25-7.45\times5.15}{2}$

$\dfrac{0.635}{7.5\times5.2}\times100\%$

$\left(\dfrac{0.05}{7.5}+\dfrac{0.05}{5.2}\right)\times100$

$=1.628\%$

2. $\dfrac{4(\sqrt{5}-\sqrt{2})-3(\sqrt{5}+\sqrt{2})}{(\sqrt{5}+\sqrt{2})(\sqrt{5}-\sqrt{2})}$

$\dfrac{4\sqrt{5}-4\sqrt{2}-3\sqrt{5}-3\sqrt{2}}{5-2}$

$=\dfrac{\sqrt{5}-7\sqrt{2}}{3}$

3. $\angle OCT = 36°$

$\angle OTC = 36°$ OR $\angle COT = 108°$

$\angle CTB = 54°$

4. Let the ratio be x : y

$\dfrac{68x+53y}{x+y}=62$

$\Leftrightarrow 6x=9y$

$\Rightarrow x:y=3:2$

5. Let the width be x

Area = (2x − 2)x = 60

$\Leftrightarrow x^2-x-30=0$

$(x-6)(x+5)=0$

X = 6

Length = (6 × 2 − 2) = 10m

6. $\dfrac{6}{3}\times\dfrac{21}{15}\times5$

= 14 people

7. $3800=\dfrac{40000\times R\times5}{100}$

R = 1.9

$3420 = \dfrac{P\times1.9\times7.5}{100}$

P = sh.24000

8. Cf: 9, 25, 44, 70, 90, 100

Lower quartile = $19.5+\frac{16}{16}\times10 = 29.5$

Upper quartile = $49.5+\frac{5}{20}\times10 = 52$

Quartile deviation = $\dfrac{52-29.5}{2}$

= 11.25cm

9. P(WW) = $\frac{2}{5}$ x $\frac{1}{4}$ = $\frac{1}{10}$

10.(a) $=\begin{pmatrix}1 & K\\ 0 & 1\end{pmatrix}\begin{pmatrix}3\\2\end{pmatrix}=\begin{pmatrix}3+2K\\2\end{pmatrix}$

X – coordinate = 3 + 2k

(b) Δ ⊥ed at A

3+2K = 4 ⇒ K = ½

Δ ⊥ed at O

3 + 2K = 0 ⇒ K = ⁻1.5

11.(a) $S = \dfrac{3}{2}t^2-\dfrac{1}{3}t^3+C$

(b) When t = 0, S = 0 ⇒ C =

$S = \dfrac{3}{2}t^2-\dfrac{1}{3}t^3=0$

$t^2(\dfrac{3}{2}-\dfrac{1}{3}t)=0$

T = 4.5s

12. (a)

$(2-x)^5 = 2^5 - 5(2)^4x + 10(2)^3x^2 - 10(2)^2x^3 + 5(2)x^4 - (x^5)$

$= 32 - 80x + 80x^2 - 40x^3 + 10x^4 - x^5$

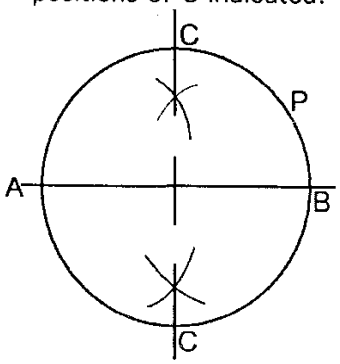
(b) $(2-0.2)^5 \sim 32 - 80(0.2) + 80(0.2)^2 - 40(0.2)^3$

$= 18.88$

13. Locus of P drawn

⊥ bisector of AB constructed.

✓ positions of C indicated.



14. $2y(q + \frac{1}{x}) = P$

$q + \frac{1}{x} = \frac{P}{2y}$

$\frac{1}{x} = \frac{P}{2y} - q$

$x = \frac{2y}{P - 2yq}$ *or* $\frac{-2y}{2yq - p}$

15. $Log\left(\frac{15-5x}{10}\right) = \log(3x-2)$

$\frac{15-5x}{10} = 3x - 2$

$x = 1$

16. (a) co-ordinates of centre: (1, - 1)

$r = \sqrt{1^2 + 3^2} = 3.162$

(b) Equation: $(x-1)^2 + (y+1)^2 = (\sqrt{10})^2$

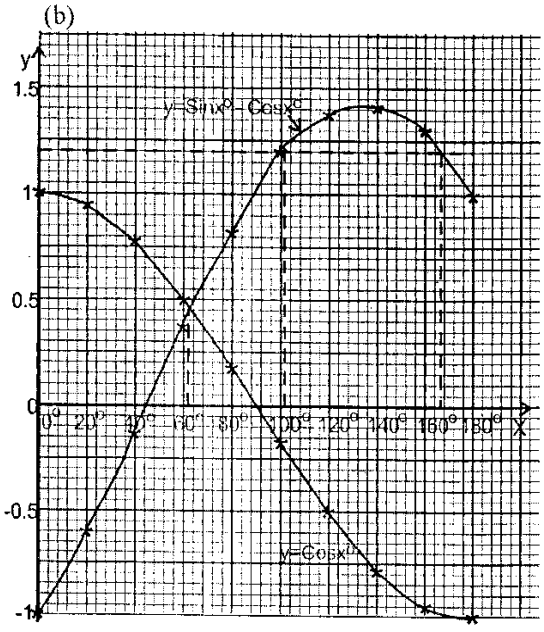
$\Leftrightarrow x^2 - 2x + 1 + y^2 + 2y + 1 = 10$

$\Leftrightarrow x^2 + y^2 - 2x + 2y = 8$

17. (a)

x°	40°	60°	80°	100°	120°	140°	160°
cosx°			0.17		-0.50		-0.[illegible]
sinx°- cosx°	-0.13 (2)			-0.15(6)		1.41	

(b)



18. (a) $\underset{\sim}{QB} = 3\underset{\sim}{P} + 3\underset{\sim}{r}$

$\underset{\sim}{AJ} = 2\underset{\sim}{P} - 2\underset{\sim}{r}$

(b)(i) $\underset{\sim}{QX} = m\underset{\sim}{QB} = m(3\underset{\sim}{P} + 3\underset{\sim}{r})$

$= 3m\underset{\sim}{P} + 3m\underset{\sim}{r}$

(ii) $\underset{\sim}{QX} = 2\underset{\sim}{r} + \underset{\sim}{P} + n(2\underset{\sim}{P} - 2\underset{\sim}{r})$

$= (2n+1)\underset{\sim}{P} + (2 - 2n)\underset{\sim}{r}$

(iii) $3m\underset{\sim}{P} + 3m\underset{\sim}{r} = (2n+1)\underset{\sim}{P} + (2-2n)\underset{\sim}{r}$

$3m = 2n + 1$

$3m = 2 - 2n$

$2n + 1 = 2 - 2n$

$\Rightarrow n = \frac{1}{4}$

$m = \frac{1}{3}(2 \times \frac{1}{4} + 1) = \frac{1}{2}$

$\underset{\sim}{AX} = n\underset{\sim}{AJ} = \frac{1}{4}\underset{\sim}{AJ}$

division ratio = 1:3

19. (a) (i) Longitude difference = 40°

Arc AB = (60 × cos 34°)×40

≃ 1990nm

(ii) Latitude difference = 60°

Arc AC = 60 × 60 = 3600nm

(b)(i) Local time at B = $1330 + \frac{40}{15}hr$ = 1610hr

(ii) Time taken $= \frac{1990\ nm}{40\ knots}$

=49h 45min

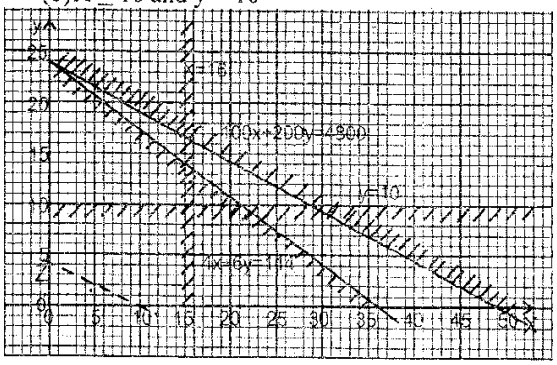
Arrival time = Wed. 1610 + 1hr 45 min

=Wed. 1755h

20. (a) $4x + 6y \geq 144$

$100x + 200y \leq 4800$

(b) $X \geq 16$ and $y > 10$



(c) $Z = 40x + 100y$ drawn OR 2 feasible pts inspected

Profit $= 40\times16 + 100\times16$

= sh.2240

21. Let number of lows be r and persons be P.

(a) $pr = 600$

$(r + 5)(P - 6) = 600$

$(r + 5)\left(\frac{600}{r} - 6\right) = 600$

$\Leftrightarrow 600r - 6r^2 + 3000 - 30r = 600r$

$\Leftrightarrow r^2 + 5r - 500 = 0$

$(r+25)(r - 20) = 0$

$r = 20$

(b) New no. of rows = 20 + 5 = 25

No of empty chairs = 600 – 450

= 150

Empty chairs/row $= \frac{150}{25}$

= 6 chairs

22. (a) $T_6 = P + 5c$ and $T_5\ P + 4d$

$P + 5c = P + 4d$

$d = \frac{5}{4}C$

(b) $(P + 3d) - (P + 3c) = 1\frac{1}{2}$

$3d - 3c = 1\frac{1}{2}$

$3(\frac{5}{4}c) - 3c = 1\frac{1}{2}$

$C = 2$

$d = \frac{5}{4}(2) = 2\frac{1}{2}$

(c) $S_6 = \frac{6}{2}(2P + 5\times2)$

$S_5 = \frac{5}{2}(2p + 4\times2\frac{1}{2})$

$(6P + 30) = (5P + 25) + 10$

$P = 5$

23. (a) $S = at + bt^2$

$80 = 2a + 4b$ and $135 = 3a + 9b$

$270 = 6a + 18b$

$-240 = 6a + 12b$

$30 = 6b$

$b = 5$

$a = \frac{(80 - 4\times5)}{2} = 30$

$s = 30t + 5t^2$

(b) (i) at t = 5, $S = 30(5) + 5(5^2)$

= 275m

(ii) $560 = 30t + 5t^2$

$(t + 14)(t - 8) = 0$

$t = 8$ sec

24. (a) (i) $\angle OSR = 40°$ OR $\angle SOR = 100°$

$\angle ORS = 40°$

(ii) $\angle OSP = 80°$

(iii) $\angle PSR = 50° \Rightarrow \angle PQR = 130°$

(b) (i) $(PR + 7) \times 7 = 9^2$

PR = 4.57 cm

(ii) $\frac{4.57}{Sin50^o} = 2r$

$r = \frac{4.57}{2\sin50^o}$

= 2.98cm

MATHEMATICS

K.C.S.E PAPER 121/ 2 2011

MARKING SCHEME

1	No log $83.46 \rightarrow 1.9215$ + $0.0054 \rightarrow \bar{3}.7324$ $\bar{1}.6539$ $1.56^2 \rightarrow 0.1931 \times 2 = 0.3862$ $\bar{1}.6539$ $\bar{1}.2677$ $\bar{1}.2677 \div 3 = \frac{\bar{3} + 2.2677}{3}$ $0.5700^{(1)} \leftarrow \bar{1}.7559$	M1 M1 M1 A1 4	ALT ✓ logs ✓ operations (+, ×2, −) ✓ attempt to divide by 3 Accept 0.57 Accept std form 5.7×10^{-1}
a)	$1\,Kg \rightarrow \frac{120\times3 + 90\times4 + 60\times5}{12}$ $= Sh.\ 85$	M1 A1	
b)	$5\,Kg$ Mixture $\rightarrow \frac{108}{100} \times 85 \times 5$ $= Sh.\ 459$	M1 A1 4	
3	$w^3 = \frac{s+t}{s}$ $w^3 s - s = t$ $s = \frac{t}{w^3 - 1}$	M1 M1 A1 3	Removing the cube root Collecting terms in s on one side
x)	$2x - 5 > -11$ $\Rightarrow x > -3$ $3 + 2x \leq 13$ $\Rightarrow x \leq 5$ Combined: $-3 < x \leq 5$	B1 B1 B1	
y)	$-2, -1, 0, 1, 2, 3, 4, 5$	B1 4	
	$\angle BAD = 30° + 40° = 70°$ $\angle BCD = 110°$	B1 B1 2	Reflex $\angle BOD = 220°$

6 a)		B1	✓ probability space (C.A.O)

+	7	8	9	10	11
4	11	12	13	14	15
5	12	13	14	15	16
6	13	14	15	16	17
7	14	15	16	17	18
8	15	16	17	18	19

b)	$P(\text{Sum of ages at least } 17) = \frac{6}{25}$	B1	
		2	

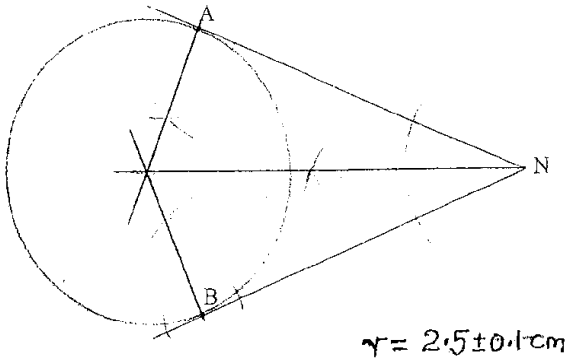
7 (a)	$\underset{\sim}{T} = \begin{pmatrix} 6 \\ -2 \end{pmatrix} - \begin{pmatrix} 4 \\ 1 \end{pmatrix} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$	B1	
(b)	$\underset{\sim}{OA'} = \begin{pmatrix} 1 \\ 2 \end{pmatrix} + \begin{pmatrix} 2 \\ -3 \end{pmatrix} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$		
	$A'(3, -1)$	B1	
	$\underset{\sim}{OB'} = \begin{pmatrix} 3 \\ 5 \end{pmatrix} + \begin{pmatrix} 2 \\ -3 \end{pmatrix} = \begin{pmatrix} 5 \\ 2 \end{pmatrix}$		
	$B'(5, 2)$	B1	
		3	

8	$\sin 45° = \frac{1}{\sqrt{2}}$	B1	
	$\frac{\sqrt{8}}{1 + \sin 45°} = \frac{\sqrt{8}(1 - \frac{1}{\sqrt{2}})}{(1 + \frac{1}{\sqrt{2}})(1 - \frac{1}{\sqrt{2}})}$		
	$= \frac{\sqrt{8} - \frac{\sqrt{8}}{\sqrt{2}}}{1 - \frac{1}{2}}$	M1	Rational denominator with the numerator expanded
	$= 2\sqrt{8} - 4$	A1	accept other forms $\frac{4\sqrt{2} - 4}{4(\sqrt{2} - 1)}$
		3	

	$\text{Max}_A = 4\pi(7.5)^2$ & $\text{Min}_A = 4\pi(6.5)^2$	M1	$\frac{0.5}{7}$ ---M1--R.E.
	$\text{Absolute error} = \frac{4\pi(7.5^2 - 6.5^2)}{2}$	M1	$\frac{0.5}{7} \times 2$ ---M1 Absolute Error
	$\%\ \text{Error} = \frac{28\pi}{4\pi \times 7^2} \times 100\%$	M1	$\frac{0.5}{7} \times 2 \times 100$---M1 allow for use of {Max − Min, Max − Actual, Actual − min}
	$= 14.29\%$	A1	14.29% A1
		4	

10

(a)



B1 ✓location of centre by construction
- draw ⊥ at A or B or bisect angle ANB and line ⊥ at A or B

B1 Circle drawn
Use of ruler pencil and B1

(b) $r = 2.5 \pm 0.1$ cm B1

3

11

$(a+\frac{1}{2})^4 = a^4 + 4a^3(\frac{1}{2}) + 6a^2(\frac{1}{2})^2 + 4a(\frac{1}{2})^3 + (\frac{1}{2})^4$ M1

$= a^4 + 2a^3 + \frac{3}{2}a^2 + \frac{1}{2}a + \frac{1}{16}$

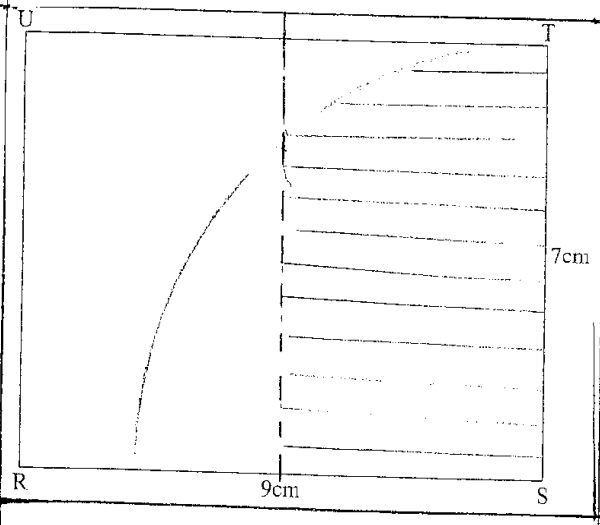
$(a-\frac{1}{2})^4 = a^4 + 4a^3(-\frac{1}{2}) + 6a^2(-\frac{1}{2})^2 + 4a(-\frac{1}{2})^3 + (-\frac{1}{2})^4$ M1

$= a^4 - 2a^3 + \frac{3}{2}a^2 - \frac{1}{2}a + \frac{1}{16}$

$(a+\frac{1}{2})^4 + (a-\frac{1}{2})^4 = 2a^4 + 3a^2 + \frac{1}{8}$ A1

3

12



B1 ⊥ bisector of TU drawn
Continuous or dotted.

B1 Arc radius 7 centre S drawn
Continuous or dotted.

B1 ✓Region shaded with bisector dotted and arc full line

3

13

$\underset{\sim}{PQ} = -(6i+j) + (-2i+5j)$ M1

$= -8i + 4j$

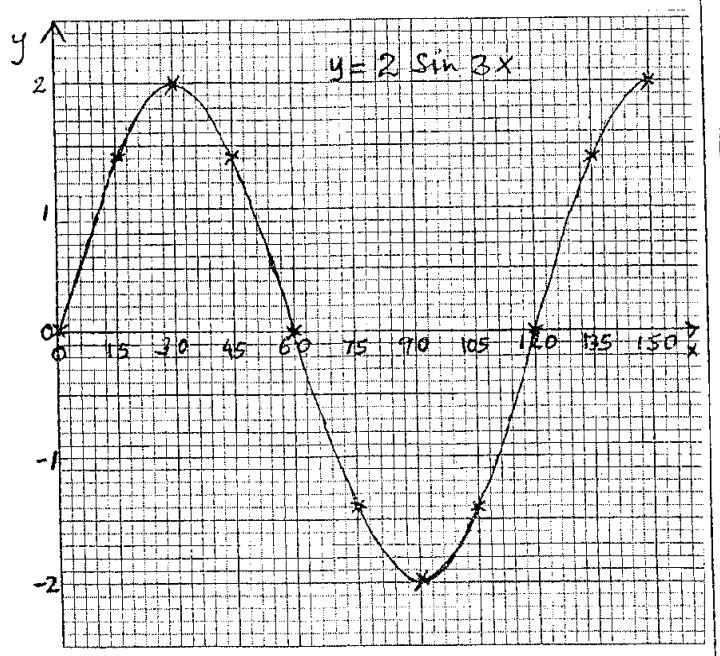
$\underset{\sim}{PN} = \frac{3}{4}(-8i+4j)$ M1

$= -6i + 3j$ A1

$\underset{\sim}{ON} = \frac{3}{4}(-2i+5j) + \frac{1}{4}(6i+j)$

$= 4j$

$\underset{\sim}{PN} = -(6i+j) + 4j$

14 (a)	Let longitude difference be θ $\theta \times 60\cos 60^\circ = 630$ $\theta = \dfrac{630}{60\cos 60^\circ}$ $= 21^\circ$	M1 A1	Give (where 1st is in km; follow through
(b)	21° East of longitude 18°E is 39°E N(60°N, 39°E)	B1 3	
15	$x^2 - 6x + 9 + y^2 - 10y + 25 = -30 + 9 + 25$ $\pm 2a = \pm 6$ or $(x-3)^2 = (x-a)^2$ $\pm 2b = \pm 10$ or $(y-5)^2 = (y-b)^2$ $a = 3$ and $b = 5$	B1 B1 B1 3	allow for $(x-3)^2$ seen allow for $(y-5)^2$ seen Allow if (3, 5)
Q16 (a)		P1 C1	✓ plotting Smooth Sine Curve
(b)	Period = 120°	B1 3	If curve drawn, $\frac{360}{3} = 120^\circ$ + this

17 (a) (i) Ike cost = Ksh (7500 + 11 × 6000) — M1
= Ksh 73500 — A1

(ii) Ike % increase = $\frac{73500 - 60000}{60000} \times 100$ — M1
= 22.5 % — A1

(b) Ike amount paid = Ksh 60000 × 25 × 0.95 — M1
= Ksh 1425000 — A1

(c) Institution X; Ksh 73500 × 25 — M1
= Ksh 1837500
Institution Y; Ksh $60000 \times 25 \times \left(1 + \frac{12}{100}\right)^2$ — M1
= Ksh 1881600
Difference = Ksh (1881600 − 1837500) — M1
= Ksh 44100 — A1
10

18 (a) (i) $r = \frac{64+4d}{64}$, $r = \frac{64+6d}{64+4d}$ — B1B1 or equivalents $64+4d = 64r$, $64+6d = 64r^2$

(ii) $\frac{64+4d}{64} = \frac{64+6d}{64+4d}$ — M1 or equivalent.
$16d^2 + 128d = 0$
$16d(d+8) = 0$ — M1
$d = -8$
$\therefore r = \frac{64 + 4 \times -8}{64}$
$= \frac{1}{2}$. — A1

$64r^2 = 64 + 6(16r - 16)$
$2r^2 - 3r + 1 = 0$
$(2r-1)(r-1) = 0$
$\therefore r = \frac{1}{2}$ or $r = 1$.
$\therefore r = \frac{1}{2}$

B1 $d = \frac{32 - 64}{4} = -8$

(b) (i) $S_{10} = 10/2\{2 \times 64 + 9 \times -8\}$ — M1
$= 280$ — A1

(ii) $S_{10} = \frac{64\left(1 - (1/2)^{10}\right)}{1 - 1/2}$ — M1 — Any substitution for r
$= 127.875$. — A1 — Accept $127\frac{7}{8}$ and when rounded off to at least 4 s.f.
10

19(a) Rectangle ABCD drawn B1

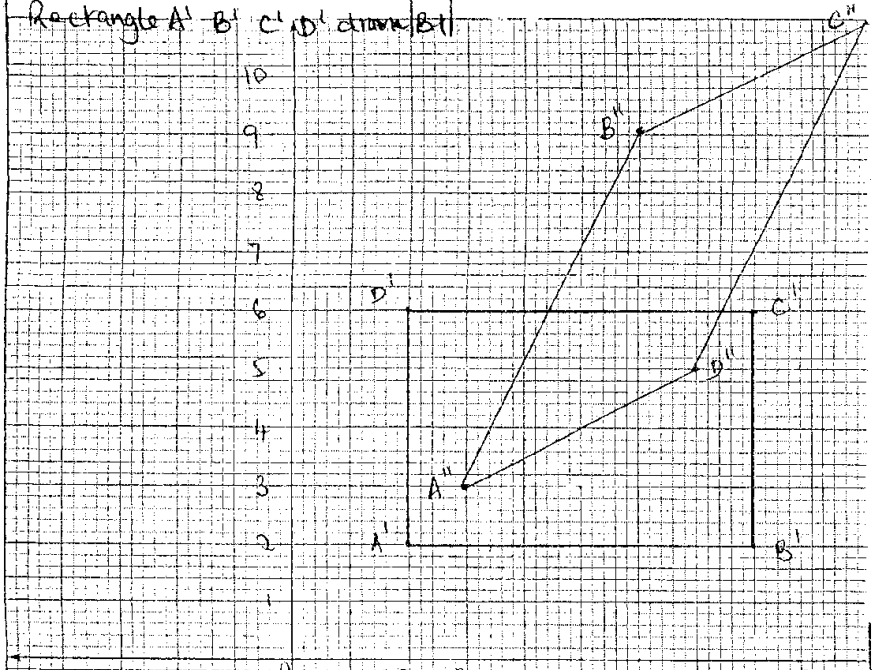
$\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}\begin{pmatrix} -1 & -4 & -4 & -1 \\ -1 & -1 & -3 & -3 \end{pmatrix}$ M1

$A'\ B'\ C'\ D'$

$= \begin{pmatrix} 2 & 8 & 8 & 2 \\ 2 & 2 & 6 & 6 \end{pmatrix}$ A1

May be implied in the diagram

Rectangle $A'B'C'D'$ drawn B1



(b)(i) $\begin{pmatrix} \frac{1}{2} & \frac{1}{4} \\ 1 & \frac{1}{2} \end{pmatrix}\begin{pmatrix} 2 & 8 & 8 & 2 \\ 2 & 2 & 6 & 6 \end{pmatrix} = \begin{pmatrix} 3 & 6 & 10 & 7 \\ 3 & 9 & 11 & 5 \end{pmatrix}$ M1 ✓ attempt to multiply

$A''(3,3),\ B''(6,9),\ C''(10,11),\ D''(7,5)$ A1 ✓ 1 if A alone is true

Rectangle $A''B''C''D''$ drawn B1 ✓

(c) Det of P $= -\frac{3}{4}$ B1 or equivalent

Area $A''B''C''D'' = \frac{3}{4} \times 6 \times 4$ M1

$= 18$ sq units. A1

10

20(a)(i) $x - 5$ B1

(ii) $[x + (x-5)] \times 2$ B1

$= 4x - 10$

(b)(i) $(x+20),\ (x+15),\ (4x+10)$ B1

$(x+20)(x+15) = 15(4x+10)$ M1 allow when two ages are ✓

$x^2 - 25x + 150 = 0$

$(x-10)(x-15) = 0$ M1 for ✓ attempt to solve or equivalent

$x = 10$ or $x = 15$ A1

(ii) $4 \times 10 - 10$ or $4 \times 15 - 10$ M1

$= 30$ $\quad 50$ A1 for both ages

(iii) $(10-5) + 20$ or $(15-5) + 20$ M1

$= 25$ $\quad 30$ A1 for both ages.

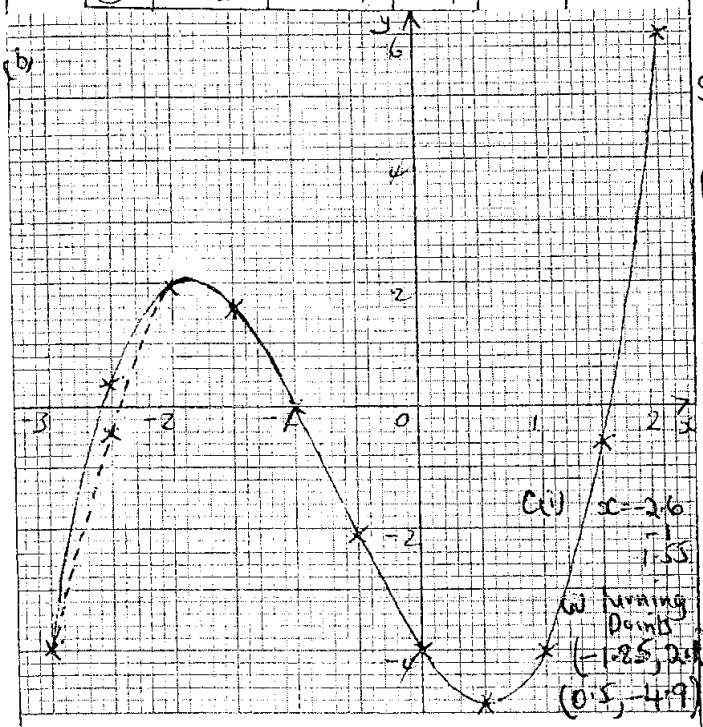
10

21 (a)

x	-2	-0.5	1	1.5
y	2	-2.1	-4	-0.6

B2 B1 for 3 ✓

(b)



S1 for ✓ scale

P1 for ✓ plotting

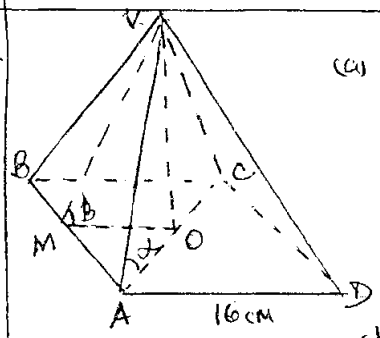
C1 for ✓ smooth curve

(c) (i) $x = -2.6$ B1 Accept -2.45 for use of -0.4
-1 B1
1.55 B1

(ii) Turning Points
$(-1.85, 2.9)$ B1 Allow readings within 1 small square
$(0.5, -4.9)$ B1

10

22.



(a) $AC^2 = 16^2 + 12^2 = 400$ M1 or equivalent
$AC = \sqrt{400} = 20\text{cm}$
$AO = 10\text{ cm}$.
$VO^2 = 26^2 - 10^2$ M1
$VO = \sqrt{576}$ M1
$= 24\text{cm}$. A1

(b) The angle between VA and ABCD is α B1
$\tan\alpha = \frac{24}{10}$ M1 or equivalent
$\alpha = 67.38°$ A1
(3)

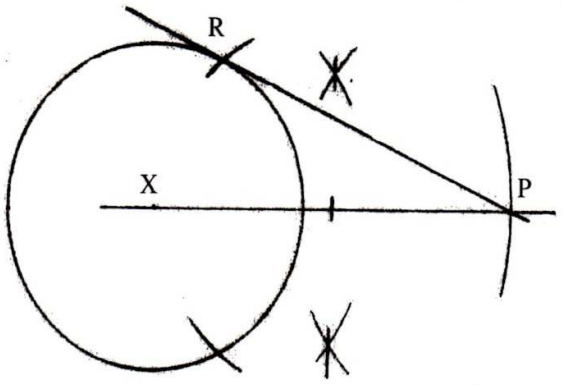
(c) The angle between the planes is β B1
$\tan\beta = \frac{24}{8}$ M1 or equivalent
$\beta = 71.57°$ A1 Accept 71.6
(5)

MATHEMATICS

K.C.S.E PAPER 121/ 2 2012

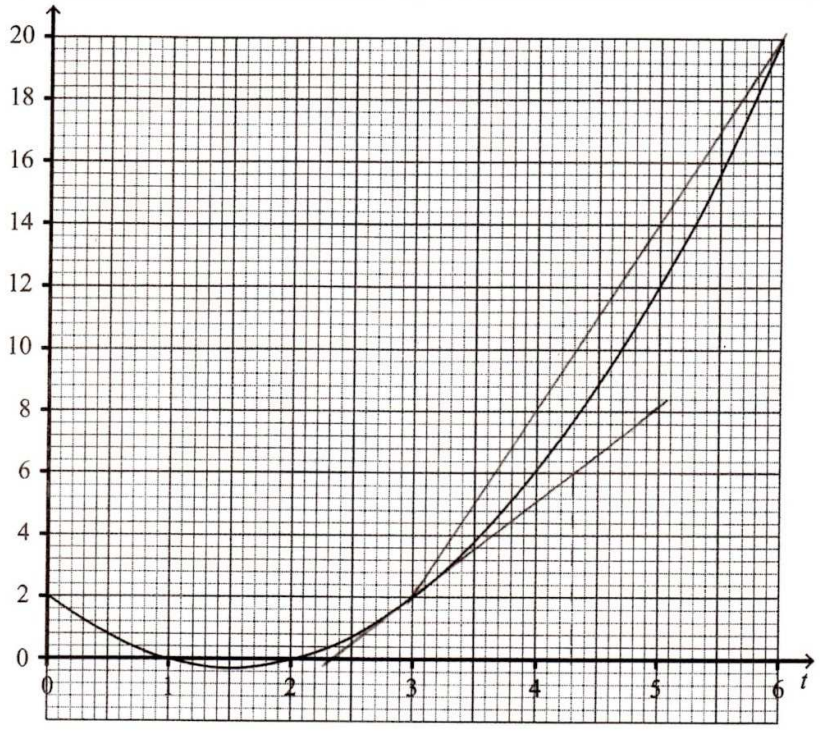
MARKING SCHEME

1.	$\frac{5\log 4 - 4\log 5}{\frac{1}{5}\log 4 + \frac{1}{4}\log 5}$ $= \frac{3.010299957 - 2.795880017}{0.120411998 + 0.174742501}$ $= 0.726466785$ $\simeq 07265$ (4 s.f.)	M1 A1 2	
2.	$\left(\frac{r}{p}\right)^2 = \frac{m^2}{n-1}$ $n - 1 = \left(\frac{mp}{r}\right)^2$ $n = \left(\frac{mp}{r}\right)^2 + 1$	M1 M1 A1 3	squaring
3.	Fraction filled by inlet tap in $1h = \frac{1}{6}$ Fraction filled when two taps open in $1h = \frac{1}{10}$ $\therefore$ fraction emptied by outlet tap in $1h = \frac{1}{6} - \frac{1}{10}$ $= \frac{1}{15}$ Time for outlet tap to empty tank = 15h	B1 M1 A1 3	for $\frac{1}{6}$ or $\frac{1}{10}$
4.	$\underset{\sim}{R} = 6\underset{\sim}{i} - 9\underset{\sim}{j} + 3\underset{\sim}{k} + 6\underset{\sim}{i} - 8\underset{\sim}{j} - 6\underset{\sim}{k}$ $= 12\underset{\sim}{i} - 17\underset{\sim}{j} - 3\underset{\sim}{k}$ $\lvert R\rvert = \sqrt{12^2 + 17^2 + 3^2}$ $= \sqrt{442}$ $= 21.02 \simeq 21$ (2 s.f.)	B1 M1 A1 3	
5.	Sin $(2t + 10)° = 0.5$ $2t + 10 = 30°, 150°$ $t = 10°, 70°$	B1 B1 2	

6.			
	Drawing circle Fixing point P Bisecting XP and drawing tangent RP = $5.4 \pm 0.1cm$	B1 B1 B1 B1 4	
7.	Amount for Kago $= 30000 + \frac{12}{100} \times 30000 \times 5$ $= 48000$ Compound interest rate for Nekesa $30000\left(1 + \frac{r}{100}\right)^5 = 48000$ $\left(1 + \frac{r}{100}\right)^5 = \frac{48000}{30000} = 1.6$ $1 + \frac{r}{100} = \sqrt[5]{1.6}$ $r = 100(1.098560543 - 1)$ $= 9.9\%$	 B1 M1 M1 A1 4	
8.	Differences from assumed mean $-6 - 2 + 0 + 2 + 3 + 6 + 9 - 5 + 6 + 3 + 9$ $-2 + 3 - 6 - 2 + 3 + 2 + 0 + 6 + 9 = 38$ $\therefore mean = 96 + \frac{38}{20}$ $= 97.9$	 M1 M1 A1 3	differences from the assumed mean

9.	$x + y = 17$.....(i) $xy - 5x = 32$.....(ii) from (i) $y = 17 - x$ substituting $y = 17 - x$ in (ii) $x(17 - x) - 5x = 32$ $17x - x^2 - 5x = 32$ $x^2 - 12x + 32 = 0$ $(x - 4)(x - 8) = 0$ $x = 4$ *or* $x = 8$ substituting x = 4 in (i) $4 + y = 17 \Rightarrow y = 13$ substituting x = 8 in (ii) $8 + y = 17 \Rightarrow y = 9$	M1 M1 A1 B1 4	for substitution or elimination for both 4 and 8 for both 13 and 9
10	$\frac{\sqrt{5}}{\sqrt{5}-2} = \frac{\sqrt{5}}{\sqrt{5}-2} \times \frac{\sqrt{5}+2}{\sqrt{5}+2}$ $= \frac{5 + 2\sqrt{5}}{5 - 4}$ $= 5 + 2\sqrt{5}$	M1 A1 2	
11.	minimum possible area $= \frac{1}{2}(6.35 \times 3.45)$ $= 10.95375$ cm² maximum possible area $= \frac{1}{2} \times 6.45 \times 3.55$ $= 11.44875$ cm² maximum absolute error in area $= \frac{11.44875 - 10.95375}{2}$ $= 0.2475$ cm²	 M1 M1 A1 3	 for both expressions - min. and max. areas
12.	(a) $(1 + x)^7 = 1^7 + 7 \times 1^6 \times x + 21 \times 1^5 \times x^2 + 35 \times 1^4 \times x^3 + \ldots$ $= 1 + 7x + 21x^2 + 35x^3$ (b) $(0.94)^7 = [1 + (-0.06)]^7$ $= 1 + 7 \times (-0.06) + 21 \times (-0.06)^2 + 35 \times (-0.06)^3$ $= 1 - 0.42 + 0.0756 - 0.00756$ $= 0.64804$	B1 M1 A1 3	

13

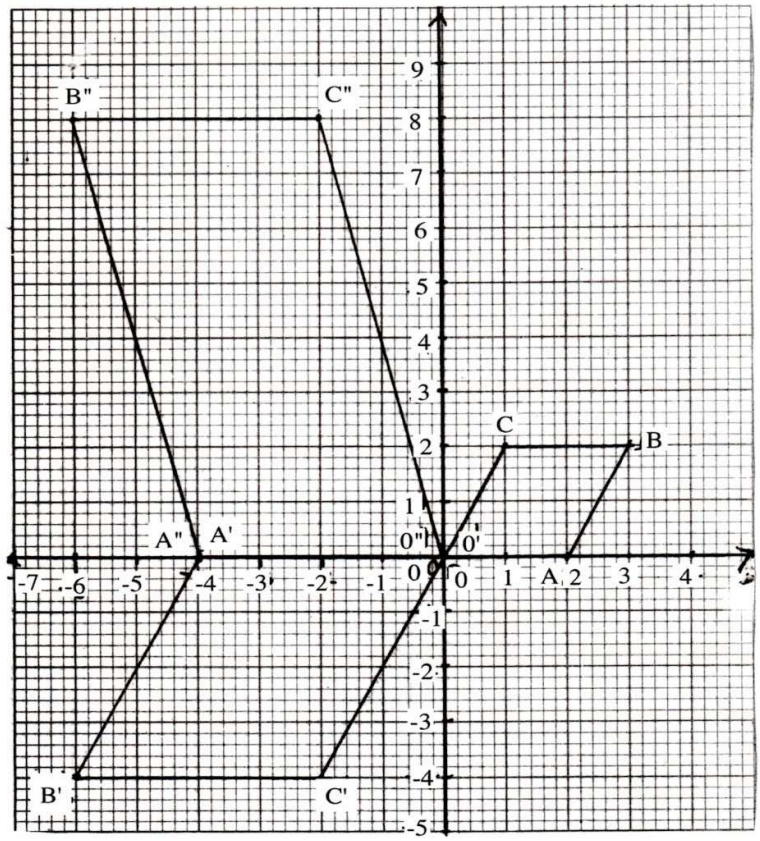


(a)	Average rate of change between t = 3 and t = 6 $\frac{20-2}{6-3}$	M1 A1	
	$= \frac{18}{3} = 6$		
(b)	Gradient at t = 3 seconds $\frac{6-0}{4.3-2.3} = \frac{6}{2}$	M1 A1	or equivalent
	$= 3 \pm 0.1$	4	

14.	(a) Let UV be x cm: $VT \times UT = ST^2$ $(x + 8)8 = 12^2$ $8x = 144 - 64$ $= 80$ $x = 10$ cm (b) $VX = \frac{2}{5} \times 10 = 4$ cm $XU = 10 - 4 = 6$ cm $SX \times XW = VX \times XU$ $SX \times 3 = 4 \times 6$ $SX = 8$ cm	M1 A1 M1 A1 4	
15.	$P \propto \frac{Q}{\sqrt{R}} \Rightarrow P = \frac{kQ}{\sqrt{R}}$ $8 = \frac{k \times 10}{\sqrt{16}}$ $k = 3.2$ $P = \frac{3.2Q}{\sqrt{R}}$	M1 A1 B1 3	
16.	$OC = \frac{\sqrt{24^2 + 10^2}}{2}$ $= 13$ $\angle VCO = \cos^{-1}\frac{13}{26}$ $=60°$	M1 M1 A1 3	

17.	(a) (i) $180000 + (11-1)x = 288000$ $10x = 108000$ $x = 10800$ (a) (ii) $S_{11} = \frac{11}{2}(180000 + 288000)$ $= 2574000$ (b) $\frac{150000 \times 1.1^{10}}{12}$ $= 32422$ (c) (i) $\frac{[150000 \times (1.1^{11} - 1)]}{(1.1-1)}$ $= 2779675$ (c) (ii) Difference between monthly averages for the 11 years $\frac{2779675 - 2574000}{11 \times 12}$ $= 1558$	M1 A1 M1 A1 M1 A1 M1 A1 10	
18.	(a) $\begin{matrix} & O & A & B & C \end{matrix}$ $\begin{matrix} & O' & A' & B' & C' \end{matrix}$ $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}\begin{pmatrix} 0 & 2 & 3 & 1 \\ 0 & 0 & 2 & 2 \end{pmatrix} = \begin{pmatrix} 0 & -4 & -6 & -2 \\ 0 & 0 & -4 & -4 \end{pmatrix}$ co-ordinates of O'A'B'C' O' (0, 0), A' (-4, 0), B' (-6, -4), C' (-2, -4)	M1 A1	

18. continued



B1 OABC √ drawn
B1 O'A'B'C' √ drawn
B1 O"A"B"C" √ drawn

(b)

$$\begin{pmatrix}1 & 0\\ 0 & -2\end{pmatrix}\begin{pmatrix}0 & -4 & -6 & -2\\ 0 & 0 & -4 & -4\end{pmatrix} = \begin{matrix}O'' & A'' & B'' & C''\end{matrix}\begin{pmatrix}0 & -4 & -6 & -2\\ 0 & 0 & 8 & 8\end{pmatrix}$$

M1
A1

(c)

$$\begin{pmatrix}1 & 0\\ 0 & -2\end{pmatrix}\begin{pmatrix}-2 & 0\\ 0 & -2\end{pmatrix} = \begin{pmatrix}-2 & 0\\ 0 & 4\end{pmatrix}$$

M1 or equivalent

inverse $\frac{1}{-8}\begin{pmatrix}4 & 0\\ 0 & -2\end{pmatrix}$

M1

$= \begin{pmatrix}-\frac{1}{2} & 0\\ 0 & \frac{1}{4}\end{pmatrix}$

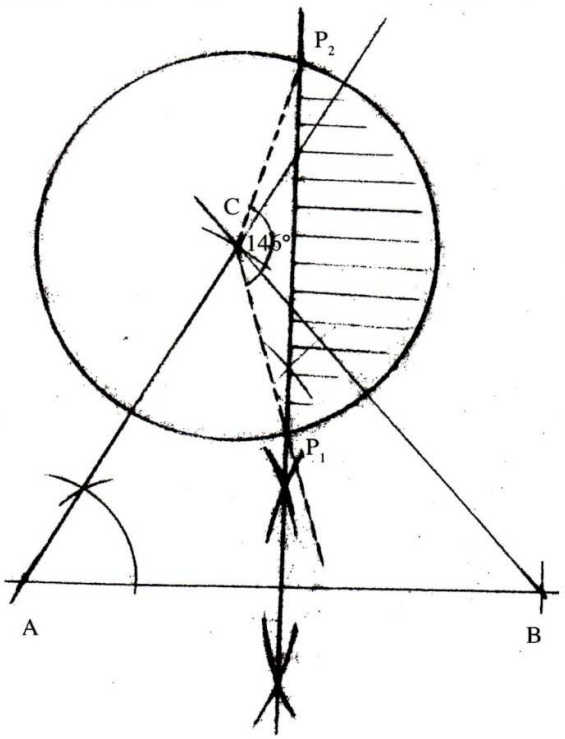
A1

10

19.	(a) (i) $\underset{\sim}{PN} = \frac{5}{6}\underset{\sim}{q} - \underset{\sim}{p}$	B1	
	(ii) $\underset{\sim}{QM} = \frac{2}{5}\underset{\sim}{p} - \underset{\sim}{q}$	B1	
	(b) (i) $\underset{\sim}{OX} = \underset{\sim}{p} + k\left(\frac{5}{6}\underset{\sim}{q} - \underset{\sim}{p}\right)$	B1	
	$\underset{\sim}{OX} = \underset{\sim}{q} + r\left(\frac{2}{5}\underset{\sim}{p} - \underset{\sim}{q}\right)$	B1	
	(ii) $\underset{\sim}{p} + k\left(\frac{5}{6}\underset{\sim}{q} - \underset{\sim}{p}\right) = \underset{\sim}{q} + r\left(\frac{2}{5}\underset{\sim}{p} - \underset{\sim}{q}\right)$	M1	
	$\underset{\sim}{p}(1-k) + \frac{5}{6}k\underset{\sim}{q} = \underset{\sim}{q}(1-r) + \frac{2}{5}r\underset{\sim}{p}$		
	$1-k = \frac{2}{5}r$ and $1-r = \frac{5}{6}k$	M1	
	$1-r = \frac{5}{6}\left(1 - \frac{2}{5}r\right)$	M1	
	$1-r = \frac{5}{6} - \frac{1}{3}r$		
	$\frac{1}{6} = \frac{2}{3}r \Rightarrow r = \frac{1}{4}$		
	$k = 1 - \frac{2}{5}r \Rightarrow k = 1 - \frac{2}{5}\times\frac{1}{4} = \frac{9}{10}$	A1	for both values of **r** and **k**
	(iii) $\underset{\sim}{QX} = \frac{1}{4}\underset{\sim}{QM}$	M1	
	$\underset{\sim}{MX} = \frac{3}{4}\underset{\sim}{QM}$		
	$\therefore \underset{\sim}{MX} : \underset{\sim}{XQ} = \frac{3}{4} : \frac{1}{4} = 3 : 1$	A1	
		10	

20.	(a) (i) July basic salary = 17000 × 1.02 = 17340	M1 A1	
	(ii) Total taxable income = 17340 + 6000 + 2500 + 1800 = 27640	M1 A1	
	(b) Gross tax		
	1st bracket: 9680 × 10% = 968	M1	
	2nd bracket: (18800 - 9680) × 15% = 1368	M1	
	3rd bracket: (27640 - 18800) × 20% = 1768	M1	[27649 - (9680 + 9120)]20%
	Gross tax: 968 + 1368 + 1768 = 4104	M1 A1	
	Net tax: 4104 - 1056 = 3048	B1	
		10	

21.

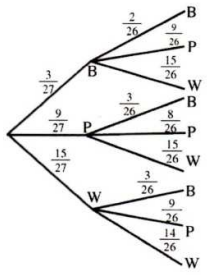


B1 construction of 60°

B1 completion of Δ

(a) locus of P locus of Q	B1 B1	
(b) (i) shading region R	B2	
(ii) area of shaded region area of minor sector P_1CP_2 $= \frac{146}{360} \times \pi \times 3.5^2$ $\simeq 15.6\ cm^2$	M1	($\angle P_1CP_2 = 146° \pm 1°$)
area of ΔP_1CP_2 $\frac{1}{2} \times 3.5^2 \sin 146°$ $\simeq 3.4\ cm^2$	M1	
$\therefore$ shaded area 15.6 - 3.4 =12.2 cm²	M1 A1	
	10	

22.	(a) distance from T to U $= 2 \times 6370 \times \frac{22}{7} \times \frac{12}{360}$	M1	
	$\text{speed} = \frac{2 \times 6370 \times \frac{22}{7} \times \frac{12}{360}}{1\frac{1}{3}}$	M1	
	$= 1001$ km/h	A1	
	(b) $\text{time} = \frac{2 \times 6370 \times \frac{22}{7} \times \frac{30}{360} \cos 9°}{1001 \times \frac{90}{100}}$	M1 M1	
	$= 3.658104965$ h $\simeq 3$ h 39 min	A1	
	(c) Arrival time at U 0700 + 1h 20 min = 0820 h		
	Departure time at U 0820 + 30 min = 0850 h	M1	
	Time difference between U and V $\frac{35-5}{360} \times 24$	M1	or equivalent
	= 2h		
	Arrival time at V (local time) 0850h + 3h 39min - 2h	M1	
	= 1029h	A1	
		10	

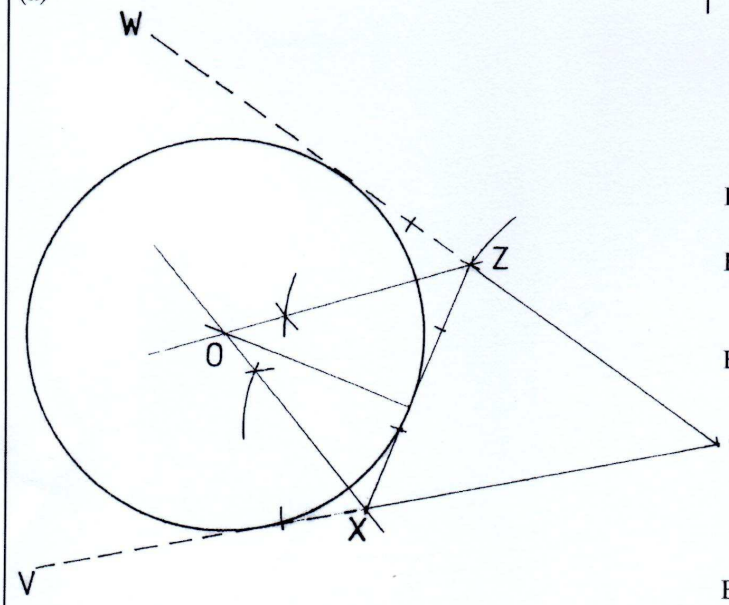
23.	(a) (i) P (brown) $= \frac{3}{27}$	B1	
	(ii) P(pink or white) $= \frac{9}{27} + \frac{15}{27}$	M1	
	$= \frac{8}{9}$	A1	
	(b) (i) P(white and brown) $= \frac{15}{27} \times \frac{3}{26} + \frac{3}{27} \times \frac{15}{26}$	M1	
	$= \frac{5}{78} + \frac{5}{78} = \frac{5}{39}$	M1 A1	
	(ii) white, white + pink, pink + brown, brown $= \frac{15}{27} \times \frac{14}{26} + \frac{9}{27} \times \frac{8}{26} + \frac{3}{27} \times \frac{2}{26}$	M1	
	$= \frac{35}{117} + \frac{4}{39} + \frac{1}{117} = \frac{16}{39}$	M1 M1 A1	
		10	
24.	(a) (i) $\frac{dv}{dt} = 4 - t$		
	$V = \int (4 - t)dt$		
	$= 4t - \frac{1}{2}t^2 + c$	B1	
	when t = 0, v = 3 m/s		
	$\therefore 3 = 4 \times 0 - \frac{1}{2} \times 0^2 + c$	B1	
	$3 = c$		
	$\therefore V = 4t - \frac{1}{2}t^2 + 3$	B1	
	(ii) when t = 2 seconds		
	$V = 4 \times 2 - \frac{1}{2} \times 2^2 + 3$	M1	
	$= 8 - 2 + 3$		
	$= 9\ m/s$	A1	
	(b) (i) At maximum velocity $\frac{dv}{dt} = 0$		
	i.e. 4 - t = 0	M1	
	t = 4 seconds	A1	
	(ii) $\int_0^4 4t - \frac{1}{2}t^2 + 3 = \frac{4}{2}t^2 - \frac{1}{2} \times \frac{1}{3}t^3 + 3t \Big]_0^4$	M1	
	$= 2t^2 - \frac{1}{6}t^3 + 3t \Big]_0^4$	M1	
	$= [2 \times 16 - \frac{1}{6} \times 64 + 12] - 0$		
	$= 32 - 10\frac{2}{3} + 12 = 33\frac{1}{3}$	A1	
		10	

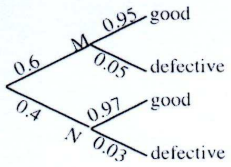
MATHEMATICS

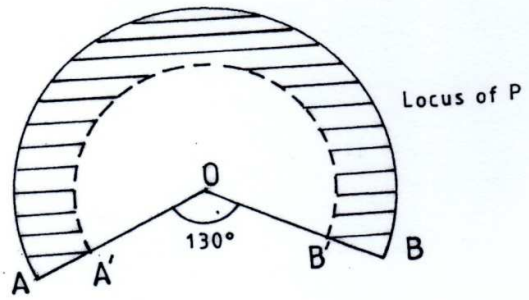
K.C.S.E PAPER 121/ 2 2013

MARKING SCHEME

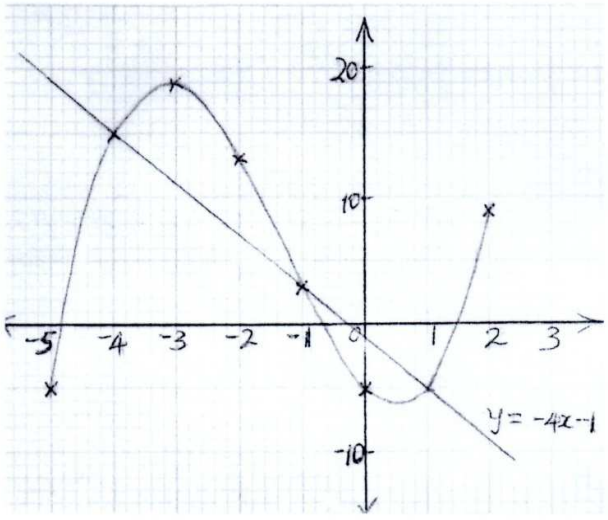
1.	1st term, a = 3; common difference, d = 6 $7500 = \frac{n}{2}\{2 \times 3 + (n-1) \times 6\}$ $3n^2 = 7500$ $n = \sqrt{2500} = 50$	B1 M1 A1 3	
2.	$y = (x + 2)(x - 1)$ $y = x^2 + x - 2$	M1 A1 2	
3.	$P = \frac{1}{2}mn^2 - \frac{qd^2}{n}$ $\frac{qd^2}{n} = \frac{1}{2}mn^2 - P$ $d^2 = \frac{\frac{1}{2}mn^3 - nP}{q}$ $d = \sqrt{\frac{\frac{1}{2}mn^3 - nP}{q}}$	 M1 M1 A1 3	
4.	$Log\left(\frac{x^2}{(x-2)}\right) = \log 3^2$ $\frac{x^2}{x-2} = 9$ $x^2 - 9x + 18 = 0$ $(x - 6)(x - 3) = 0$ $x = 6$ or $x = 3$	M1 M1 A1 3	

5.	(a)  (b) radius = 3.1	B1 B1 B1 B1 4	extending YX and YZ bisecting $\angle s$ VXZ and XZW escribed circle drawn allow ± 0.1
6.	Completing square on L.H.S. $x^2 + 4x + 4 + y^2 - 2y + 1 = 4 + 4 + 1$ $(x + 2)^2 + (y - 1)^2 = 9$ $\therefore$ centre of circle : (-2, 1) radius of circle: 3 units	B1 B1 B1 3	
7.	(a) $(1 - x)^5 = 1 + 5(-x) + 10(-x)^2 + 10(-x)^3 + 5(-x)^4 + (-x)^5$ $= 1 - 5x + 10x^2 - 10x^3 + 5x^4 - x^5$ (b) $(0.98)^5 = (1 - 0.02)^5 \Rightarrow x = 0.02$ $\therefore (0.98)^5 = 1 - 5(0.02) + 10(0.02)^2 - 10(0.02)^3$ $= 1 - 0.1 + 0.004 - 0.00008$ $= 0.90392$	B1 M1 A1 3	

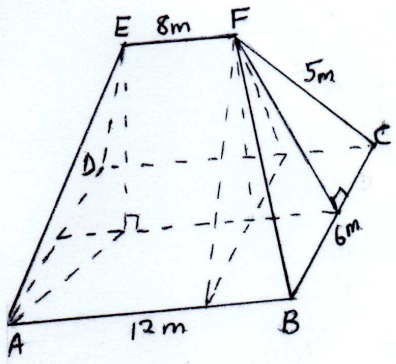
8.	$\underset{\sim}{h} = \frac{-1}{4+(-1)}\underset{\sim}{f} + \frac{4}{4+(-1)}\underset{\sim}{g}$ $= \frac{-1}{3}\underset{\sim}{f} + \frac{4}{3}\underset{\sim}{g}$	M1 A1 2	
9.	P(defective) : M → 0.6 × 0.05 = 0.03 N → 0.4 × 0.03 = 0.012 P(defective) 0.03 + 0.02 = 0.042	M1 M1 A1 3	For 0.6 × 0.05 or 0.4 × 0.03 
10.	(a) Fraction filled if A and R are open for 5h $5 \times \left(\frac{1}{3} - \frac{1}{6}\right) = \frac{5}{6}$ Fraction of tank still empty = $1 - \frac{5}{6} = \frac{1}{6}$ (b) Fraction filled if A, B and R are open for 1h $\frac{1}{3} + \frac{1}{2} - \frac{1}{6} = \frac{2}{3}$ Time taken to fill the tank = $\frac{1}{6} \div \frac{2}{3} = \frac{1}{6} \times \frac{3}{2}$ $= \frac{1}{4}$h or 15 min	B1 B1 M1 A1 4	
11.	$\frac{\sqrt{48}}{\sqrt{5}+\sqrt{3}} = \frac{4\sqrt{3}(\sqrt{5}-\sqrt{3})}{(\sqrt{5}+\sqrt{3})(\sqrt{5}-\sqrt{3})}$ $= \frac{4\sqrt{3}(\sqrt{5}-\sqrt{3})}{5-3}$ $= 2\sqrt{3}(\sqrt{5}-\sqrt{3})$ $= 2\sqrt{15} - 6$	M1 M1 A1 3	

12.	 $\angle AOB = 130°$ arc AB - solid curve arc A′B′ - broken curve region shown	B1 B1 B1 B1 4	
13.	$9680 \times 0.1 = 968$ 9120×0.15; 9120×0.2; 4580×0.25 $= 1368$ $= 1824$ $= 1145$ Net tax $= (968 + 1368 + 1824 + 1145) - 1056$ $= 4249$	M1 M1 M1 A1 4	
14.	$6(1 - \sin^2 x) + 7 \sin x - 8 = 0$ $6 - 6 \sin^2 x + 7 \sin x - 8 = 0$ $6 \sin^2 x - 7 \sin x + 2 = 0$ $(3 \sin x - 2)(2 \sin x - 1) = 0$ $\sin x = \frac{2}{3}$ *or* $\sin x = \frac{1}{2}$ $x = 41.81°$ or $x = 30°$	M1 M1 M1 A1 4	

15.	Distance between towns K and S $= 2\pi \times 6370 \cos 2° \times \frac{37.4 - 30}{360}$ $= 822.2121281$ $= 822$ km	M1 A1 2	
16.	$\begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} 1 & 4 & 3 \\ 2 & 2 & 4 \end{pmatrix} = \begin{pmatrix} \frac{1}{2} & 2 & \frac{3}{2} \\ 1 & 1 & 2 \end{pmatrix}$ $a + 2b = \frac{1}{2}$ $4a + 2b = 2$ $3a = \frac{3}{2} \Rightarrow a = \frac{1}{2}$ $\frac{1}{2} + 2b = \frac{1}{2} \Rightarrow b = 0$ $c + 2d = 1$ $4c + 2d = 1$ $3c = 0 \Rightarrow c = 0$ $0 + 2d = 1 \Rightarrow d = \frac{1}{2}$ $\therefore \quad M = \begin{pmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{pmatrix}$	M1 M1 A1 3	√ formation and solution of simultaneous equations √ formation and solution of simultaneous equations
17.	(a) (i) $\frac{276000 - 60000}{18}$ $= 12\,000$ (ii) 276000×0.9 $= 248400$ (b) 248400×0.95 $= 235980$ 235980×1.2^2 $= 339811.2$ (c) $339811.2 - 276000$ $\frac{63811.2}{276000} \times 100$ $= 23.12\ \%$	M1 A1 M1 A1 M1 M1 A1 M1 M1 A1 10	

18.	(a) $\angle QPR = 90° - 72° = 18°$ $\angle PQR = 90°$ - angle subtended by diameter (b) $\angle PQS = 180° - 2(72) = 36°$ $\angle PSQ = 72°$ - angle subtended at the circumference by chord PQ equal and base $\angle$'s of isosceles $\Delta QPS = 72°$ (c) $\angle OQS = 36° - 18° = 18°$ base angles of isosceles Δ OPQ = 18° (d) $\angle RTS = 180 - (36 + 18) = 126°$ extension angle RTS equal to sum of opposite interior angles TSP and TPS (e) $\angle RSV = 90° - 36° = 54°$ $\angle RSV = \angle RPS$ - angle in alternate segment.	B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 10	 or equivalent
19.	(a) x: -5, -4, -3, -2, -1, 0, 1, 2 y $=x^3+4x^2-5x-5$: -5, 15, , 13, 3, , -5, 9 (b)  (c) (i) x = -4.8, -0.7, 1.5 (ii) y = -4x - 1 Solutions x = -4, -1, 1.	B2 S1 P1 C1 B2 P1 L1 B1 10	allow B1 for 4 correct Suitable scale All correctly plotted ±0.1 allow B1 for 2 values √ plotting for line

20.	(a) ⊥ distance of EF from place ABCD		
	slant height from F to BC		
	$= \sqrt{5^2 - 3^2}$	M1	
	$= 4$		
	$\therefore$ ⊥ distance of EF from plane ABCD		
	$= \sqrt{4^2 - 2^2}$	M1	
	$= \sqrt{12} = 3.46$ m	A1	
	(b) (i) angle between planes		
	ADE and ABCD		
	$= \tan^{-1}\frac{\sqrt{12}}{2}$	M1	or equivalent
	$= 60°$	A1	
	(ii) angle between line AE and plane ABCD		
	$= \sin^{-1}\frac{\sqrt{12}}{5}$	M1	or equivalent
	$= 43.9°$	A1	
	(iii) angle between planes		
	ABFE and DCFE		
	$= 2\left(\tan^{-1}\frac{3}{\sqrt{12}}\right)$	M1	$\tan^{-1}\frac{3}{\sqrt{12}}$ or equivalent
	$= 81.8°$	M1	doubling
		A1	
		10	



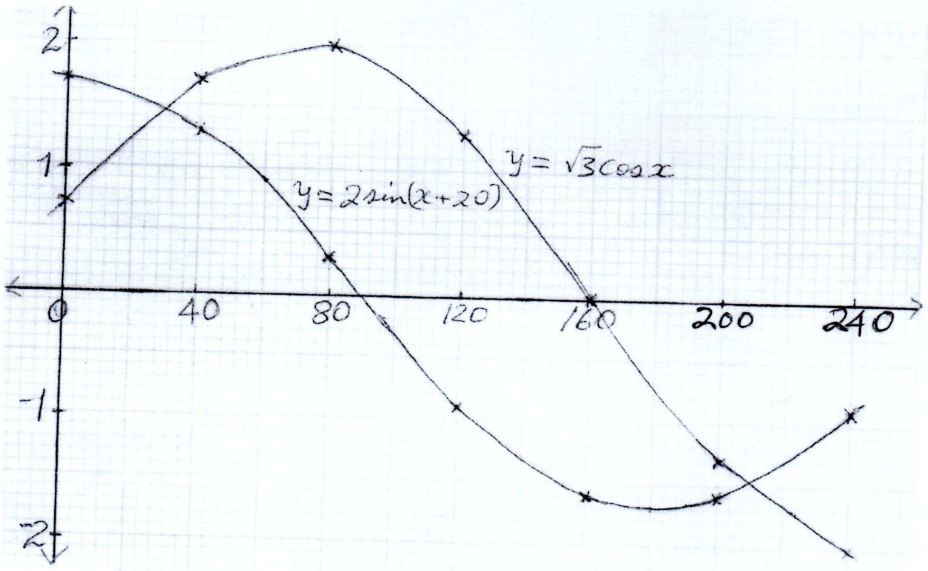
21. (a)

x	0	40	80	120	160	200	240
$y = 2 \sin x + 20$		1.7		1.3		-1.3	
$y = \sqrt{3} \cos x$			0.3		-1.6		-0.9

B1

B1

(b)



S1	suitable scale used
P1	plotting 2 Sin (x + 20)
P1	plotting $\sqrt{3}$ cos x
C1	curve for 2 sin x + 20
C1	curve for $\sqrt{3}$ cos x

(c) (i) $2 \sin (x + 20) = \sqrt{3} \cos x$

$x = 30°$

and $x = 210°$

B1

B1

(ii) amplitude difference

$2 - 1.7 = 0.3$

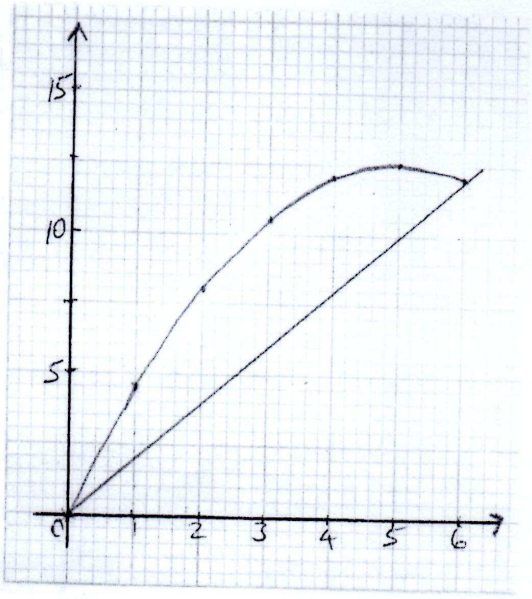
B1

10

23.	(a)		

x	0	1	2	3	4	5	6
y $= 5x - \frac{1}{2}x^2$	0	4.5	8	10.5	12	12.5	12

B1 table may be implied



P1 √ plotting

C1 √ curve

(b)

$$\int_0^6 \left(5x - \frac{1}{2}x^2\right) dx$$

$$= \left[\frac{5}{2}x^2 - \frac{1}{2\times 3}x^3\right]_0^6$$ M1 √ integral

$$= \left[\frac{5\times 6^2}{2} - \frac{1}{6}\times 6^3\right] - [0-0]$$ M1 √ substitution

$$= [90-36] - [0] = 54$$ A1

(c) (i) Drawing line y = 2x L1

(ii) Area of Δ : $\frac{1}{2}\times 6\times 12$ M1

$= 36$ A1

$\therefore$ Bounded area = 54 - 36 = 18 B1

10

24. (a)

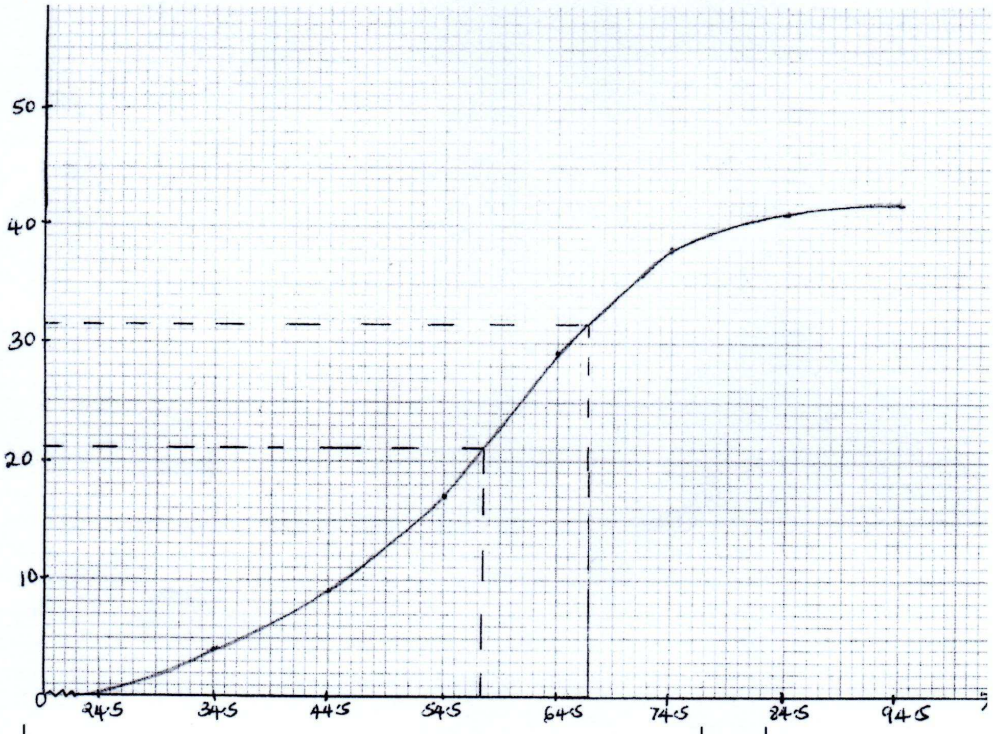
Marks	Frequency	cf	
25-34	4	4	
35-44	5	9	
45-54	8	17	
55-64	12	29	
65-74	9	38	
75-84	3	41	
85-94	1	42	

B1 √ marks class column

B1 √ frequency column

(b) (i) cfs

B1



S1 √ scale
P1 √ plotting
C1 √ curve

(c) (i) Identification of median B1
= 57.5 ± 0.5 B1

(ii) Identification of upper quartile mark B1
= 66.5 ± 0.5 B1

10

MATHEMATICS
K.C.S.E PAPER 121/ 2 2014
MARKING SCHEME

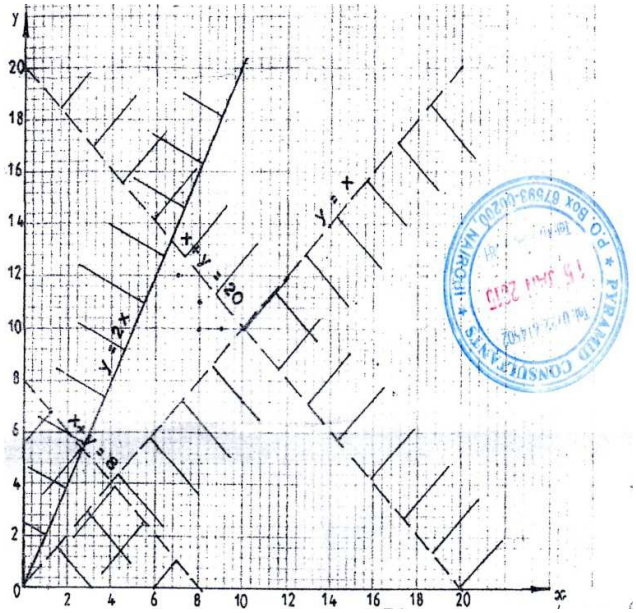
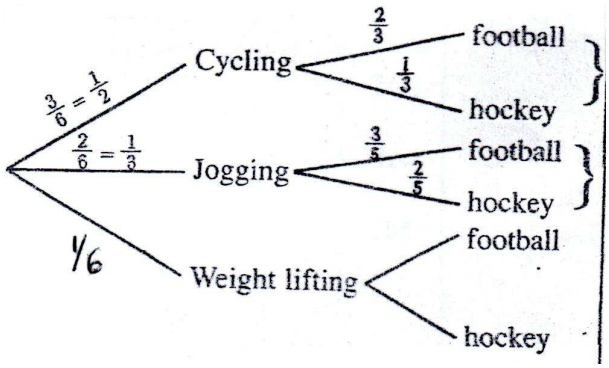
1.	Limits : 12.5 ∓ 0.05 m and 9.23 ∓ 0.005 m Maximum difference = 12.55 – 9.225 = 3.325 m	B1 M1 A1 3	Absolute errors need to be associated with their values
2.	**a) First 6 terms** **-7, -4, -1, 2, 5, 8** b) sum of 1st 50 terms $s_{50} = \frac{50}{2}\{2 \times -7 + 49 \times 3\}$ = 3325	B1 M1 A1 3	All the 50 terms listed down and being added
3.	**a) < BAC = $70^0 - 30^0 = 40^0$** **Reflex <BOC = $360^0 - 80^0$** **= 280^0** **b) <ACO = $40^0 - 30^0 = 10^0$**	B1 B1 B1 3	Allow <XAD = 50……B1 Allow B1 if on diagram Allow if DOC = 100 …..B1
4.	$L = \frac{km}{n^2}$ $2 = \frac{k \times 12}{36}$ K = 6 $\therefore equation\ L = \frac{6m}{n^2}$	B1 M1 A1 3	Allow if small letters are used for m1 → 6 x 6 or 36 M1 can be implied when k = 6 is found. Don't give if 6^2 Allow $N^2 = \frac{6M}{L}$ or others
5.	<table><tr><th>Mks</th><th>Frequency</th><th>c.f</th></tr><tr><td>1 - 10</td><td>2</td><td>2</td></tr><tr><td>11 – 20</td><td>4</td><td>6</td></tr><tr><td>21 – 30</td><td>11</td><td>17</td></tr><tr><td>31 – 40</td><td>5</td><td>22</td></tr><tr><td>41 - 50</td><td>3</td><td>25</td></tr></table> Median $20.5 + \left(\frac{25}{2} - 6\right) \times \frac{10}{11}$ 20.5 + 5.9 = 26	B1 M1 M1 A1 4	For c.f can implied Correct subst. Allow 5.909 / 5.91

	Amplitude = 2 Period $= \frac{360}{3} = 120^0$	B1 B1 2	If 13 is used MO M1, AO
6.	3x – 45 = 0 x = 15 3x – 45 = 360 x = 135 135 – 15 = 120^0		If new value is introduced M0 M0
7.	Area scale factor = $\frac{30}{5} = 6$ 4x – 2x + 2 = 6 2x = 4 x = 2	B1 M1 A1 3	May be implied in the method mk 4x – 2(x-1) = -6…..M1 X = -4……A1
8.	$(3-x)^7 = 3^7 - 7(3)^6x + 21(3)^5x^2 - 35(3)^4x^3 + 35(3)^3x^4 + \cdots$ = 2187 – 5103x + 5103x^2 – 2835x^3 + 945x^4 $(2.8)^7 = (3-0.2)^7$ = 2187 – 5103(0.2) + 5103$(0.2)^2$ -2835 $(0.2)^3 + 945(0.2)^4$ = 1349.352	B1 M1 A1 3	Expanded & simplified must be seen upto x^4 If all the terms are substitute then B0 M1 A0
9.	$log\frac{15^2}{x} = \log 5(x-4)$ $\frac{15^2}{x} = 5(x-4)$ $x^2 - 4$ x 45 = 0 $(x-9)\ (x+5) = 0$ x = 9 or -5 x = 9	M1 M1 M1 A1 4	
10.	PR = $\sqrt{60^2 + 11^2} = 61$ Tan θ $= \frac{10}{61}$ θ = 9.31	B1 M1 A1 3	Or equivalent pw = 61.81

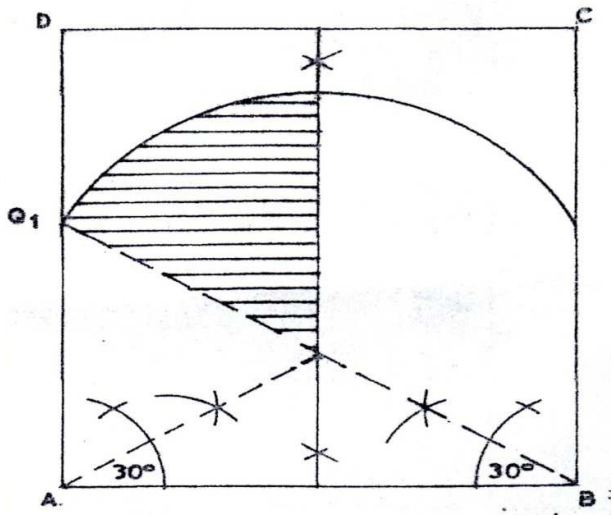
11.	$3x - y = 9$ …… x $x^2 - xy = 4$ $3x^2 - xy = 9x$ $x^2 - xy = 4$ $2x^2 = 9x - 4$ $2x^2 - 9x + 4 = 0$ $(2x - 1)(x - 4) = 0$ $x = \frac{1}{2}$ or x = 4 $y = 3\left(\frac{1}{2}\right) - 9$ *or* $3(4) - 9$ $= -7\frac{1}{2}$ *or* 3	M1 M1 A1 B1 4	Correct attempt to eliminate one value through subst. or elimination Correct attempt to solve using factorization, formula(subst.) Both Both
12.	$\left(1 + \frac{R}{100}\right)^4 = \frac{495000}{280000}$ $1 + \frac{R}{100} = 1.153$ R = 15.3	M1 M1 A1 3	$280000\left(1 + \frac{r}{100}\right)^4 = 495000$ Forth root Condone % i.e 15.3
13.	$8008 = \frac{40+\theta}{360} \times 2 \times \frac{22}{7} \times 6370$ $40 + \theta = \frac{8008 \times 360 \times 7}{2 \times 22 \times 6370} = 72$ $\theta = 72^0 - 40^0$ $= 32^0$ Position of B(32^0S, 20^0W) Condone coma & bracket	M1 M1 A1 3	Allow $\frac{\theta}{360} \times 2 \times \frac{22}{7} \times 6370 = 8008$ Or 32^0 seen
14.	$\underline{r} + \underline{s} = (7\underline{i} + 2\underline{j} - k) - \underline{i} + \underline{j} - k)$ $= 6\underline{i} + 3\underline{j} - 2\underline{k}$ $\underline{r} + \underline{s} = \sqrt{6^2 + 3^2 + (-2)^2}$ $= 7$	B1 M1 A1 3	
15.	$Y = \int (x^2 - 4x + 3)dx$		

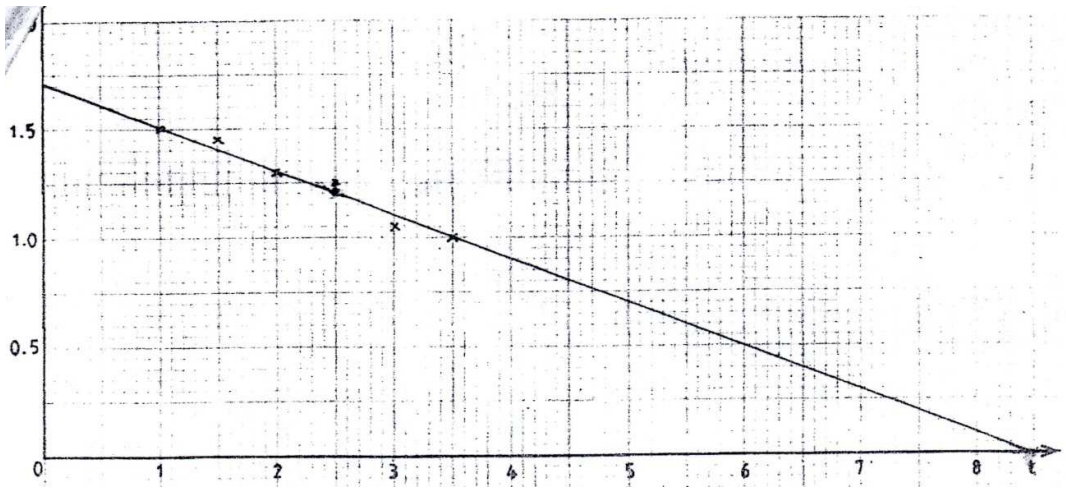
	$= \frac{1}{3}x^3 - 2x^2 + 3x + c$ $0 = \frac{1}{3} + 2 + 3 + c$ $\therefore c = -\frac{4}{3}$ $\therefore y = \frac{1}{3}x^3 - 2x^2 + 3x - \frac{4}{3}$	M1 M1 A1 3	Correct interpretation (don't wait for interpretation) $\frac{x^3}{3} - \frac{4\times3}{2} + 3x + c$ Correct substitiution Allow if 2 terms are correctly interpreted (M1) Correct equation
16.	Temperature at the 2nd minute = 60^0 Temperature at the 11th minute = 18^0 Average rate of cooling $= \frac{60-18}{2-11}$ $= \frac{42}{\|9\|}$ $= 4\frac{2}{3}$ ^{0}C/min	 B1 M1 A1 3	 For both Accept 4.667 ^{0}C/min If = 4.667 AO
17.	**(a) A = $\frac{3}{4}$ B, C = 2B** **→ A: B: C= $\frac{3}{4}$ B: B: 2B** **= 3: 4: 8** **(b) $\left(\frac{168}{8} \times 4\right)$ *litres*** **= 84 *l*** **(c) (i) $\frac{3\times160+4\times205+8\times100}{3+4+8}$** **= 140** **(ii) $\frac{182-140}{140} \times 100\%$** **= 30%** **(iii) sh140 x $\frac{125}{100}$** **= 175**	 M1 A1 M1 A1 M1 A1 M1 A1 M1 A1 10	 A: B: C 3: 4 (1: 2) X 4 3: 4: 8

18.	**a) (i) (50 + 40) = 30 (30 + x)** **4500 = 900 + 30 x** **30 x = 3600** **QS = X = 120cm** (ii) RS = $\frac{1}{2}$ QS = $\frac{1}{2}$ (120) = 60 cm OR = $\sqrt{61^2 - 60^2}$ = 11 (b) (i) $\sin\theta = \frac{60}{61}$ θ = 79.6^0 (ii) angle at the centre = 2 x 79.6 = 159.2^0 Length of minor arc QS = $\frac{159.2}{360} \times 2\pi \times 61$ = 169.5 cm or 169.6 cm	M1 A1 B1 M1 A1 M1 A1 M1 M1 A1 10	- **Not a double click** Or equivalent $tan\theta = \frac{60}{11}$ $cos\theta = \frac{11}{60}$ Doubling the angle
19.	(a) (i) 38392 + 2108 = 41000 (ii) 10164 x 0.1 + 9576 x 0.15 + 9576 x 0.2 + 9576 x 0.25 + 2108 x 0.3 = 1016.4 + 1436.4 + 1915.2 + 2394 + 632.4 = 7394.4 Monthly income tax = 7394.4 – 1162 = 6232.4 (b) amount saved in coop society = $\frac{5}{100} \times 41000 - 15000$ = 1300 Net pay 41000 – (6232.4 + 1300) = 33467.6	M1 A1 B1 M1 M1 M1 A1 M1 M1 A1 10	1^{st} band 3 middle bands Last (5^{th}) band

20.	**a)** $y \leq 2x$ $x + y < 20$ $x + y > 8$ $y > x$ **b) (i)**  (ii) maximum area 9 x 10 = 90 m^2	B1 B1 B1 B1 B1 B1 B1 B1 M1 <u>A1</u> 10	Line y = 2x and √ shading Broken line x + y = 20 and √ shading Broken line x + y = 8 and √ shading Broken line y = 8 and √ shading Evidence must be there of insertion If no evidence OW - 1
21.	**a) (i)** $\frac{3}{6} + \frac{1}{6}$ $= {}^{2}/_{3}$ **(ii)** ${}^{2}/_{6} \times {}^{2}/_{6}$ $= {}^{1}/_{9}$ **b)**  	M1 A1 M1 A1 B1 B1	$^{4}/_{6}$ $^{4}/_{36}$ Accept $^{4}/_{6}$

	c) (i) P(gataro plays football) $= \frac{1}{2} \times \frac{2}{3} + \frac{1}{3} \times \frac{3}{5} + \frac{1}{6} \times \frac{1}{2}$ $= \frac{37}{60}$ **(ii) P(neither jogs nor plays football)** $= \frac{1}{2} \times \frac{1}{3} + \frac{1}{6} \times \frac{1}{2}$ $= \frac{1}{4}$	M1 A1 M1 A1 10	
22.	**a)** **(i)** $\underline{BA} = \underline{a} - \underline{b}$ **(ii)** $\underline{BN} = \frac{1}{3}\underline{BA} = \frac{1}{3}(\underline{a} - \underline{b})$ **(iii)** $\underline{ON} = \underline{b} + \frac{1}{3}(\underline{a} + \underline{b})$ $= \frac{1}{3}\underline{a} + \frac{2}{3}\underline{b}$ **b)** $\underline{BX}$ = hBM = h $\left(\frac{1}{2}\underline{a} - \underline{b}\right)$ $\underline{OX}$ = kON = k $\left(\frac{1}{3}\underline{a} + \frac{2}{3}\underline{b}\right)$ **Also** $\underline{OX} = \underline{OB} + \underline{BX}$ $= \underline{b}$ + h $\left(\frac{1}{2}\underline{a} - \underline{b}\right)$ k $\left(\frac{1}{3}\underline{a} + \frac{2}{3}\underline{b}\right)$ = h $\left(\frac{1}{2}\underline{a} - \frac{1}{2}\underline{b}\right)$ $\frac{1}{3}$k$\underline{a}$ = $\frac{1}{2}$h$\underline{a}$ $\frac{1}{3}k = \frac{1}{2}$h → k = $\frac{3}{2}$h……..(i) $\frac{2}{3}$k$\underline{b}$ = $\underline{b}$ - h$\underline{b}$ $\frac{2}{3}$k = 1 – h……..(ii)	B1 B1 M1 A1 B1 B1 M1 M1	Or equivalent If ratio theorem is used give the mks M1 A1 k $\left(\frac{1}{3}\underline{a} + \frac{2}{3}\underline{b}\right)$ = b+h$\left(\frac{1}{2}\underline{a} - \underline{b}\right)$ equating (one must be right) Two simultaneous eqns.

	Substituting k = $\frac{3}{2}h$ in (ii) $\frac{2}{3}\left(\frac{3}{2}h\right) = 1 - h \rightarrow h = \frac{1}{2}$ **Substituting $h = \frac{1}{2}$ in (i)** **k = $\frac{3}{2}\left(\frac{1}{2}\right) = \frac{3}{4}$**	M1 A1 10	Substituting one value For h = $\frac{1}{2}$ and k = $\frac{3}{4}$
23.	**a)**  **(i)** **(ii)** **b) (i) 9.2 x 10 = 92 m** **(ii) Area of region bounded y locus of P** **Locus of Q and line BQ1** **Angle = 60^0 radius = 46 m ∓ 0.1** **= $\pi \times 46^2 \times \frac{60}{360}$** **= 1107.94** ≃ 1108 m^2	B1 B1 B1 B1 B1 B1 B1 M1 A1 10	Construction arcs seen Locus of P Construction of 30^0 Correct centre Drawing of arc – centre 0 Allow BQ1 from calculation Identify region- can also be implied For radius and angle of sector

24.	**a)**  **S1 scale – linear & sufficient** **P2 (P1 for points √ plotted)**		
	b) (i) value of a $= \frac{-0.7}{3.5}$ **= - 0.2** **Value of k = 1.7** **(ii) equation : -0.2t + 1.7 = r** iii) Value of t when r = 0 **∴ 0 = -0.2t + 1.7** **0.2 t = 1.7** **t = 1.7** $t = \frac{1.7}{0.2} = 8.5$	L1 M1 A1 B1 B1 M1 A1 10	√ line Apply it if M1 earned