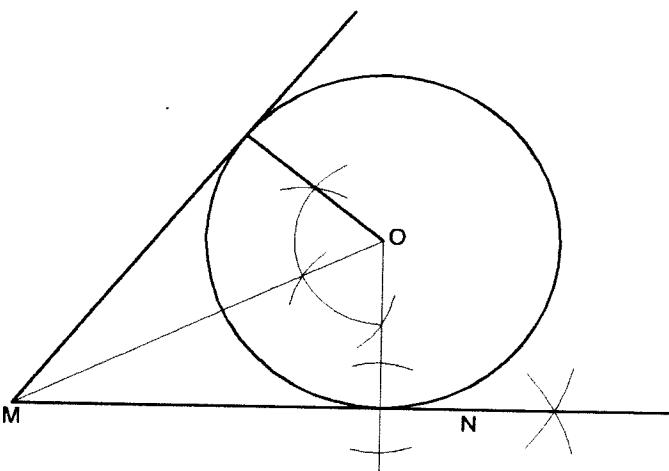


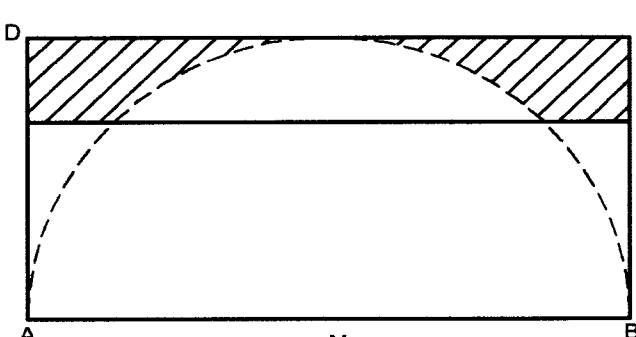
4.3.2 Mathematics Alternative A Paper 2 (121/2)

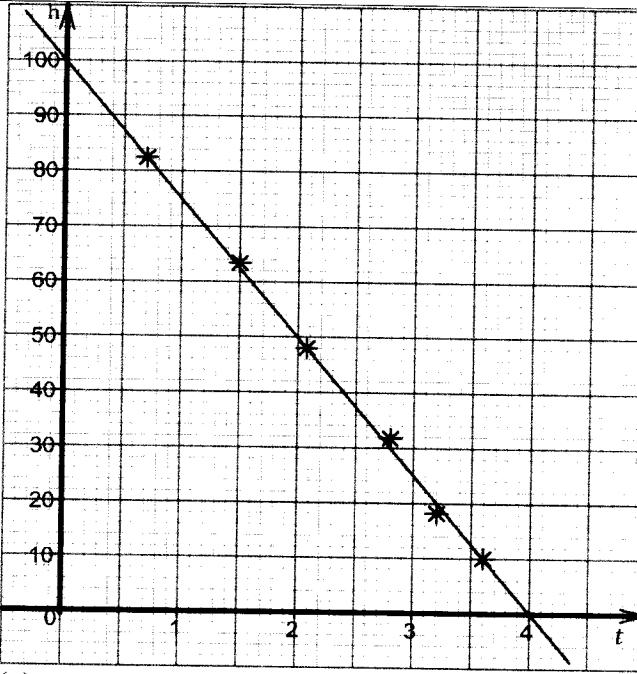
SECTION I

No.	Marking scheme	Marks	Comments
1.	<p>Let the ratio of maize to millet = $x : y$</p> $\frac{60x + 90y}{x + y} = 85$ $60x + 90y = 85x + 85y$ $25x = 5y$ $\frac{x}{y} = \frac{1}{5}$ $x:y = 1:5$ <p>% of maize flour = $\frac{1}{6} \times 100\%$</p> $= 16\frac{2}{3}\%$	M1 M1 A1 3	or equivalent
2.	<p>Let the first term be a and the common difference r</p> $\left. \begin{array}{l} a + ar = 20 \dots\dots\dots(i) \\ ar + ar^2 = 30 \dots\dots\dots(ii) \end{array} \right\}$ <p>from (i), $a(1+r) = 20$</p> <p>from (ii), $ar(1+r) = 30$</p> <p>Thus</p> $\frac{ar(1+r)}{a(1+r)} = \frac{30}{20}$ $r = \frac{3}{2}$	M1 M1 M1 4	

No.	Marking scheme	Marks	Comments
3.	$\begin{aligned} \frac{1}{\sin 75^\circ} &= \frac{4}{\sqrt{6} + \sqrt{2}} \\ &= \frac{4(\sqrt{6} - \sqrt{2})}{(\sqrt{6} + \sqrt{2})(\sqrt{6} - \sqrt{2})} \\ &= \frac{4(\sqrt{6} - \sqrt{2})}{6 - 2} \\ &= \sqrt{6} - \sqrt{2} \end{aligned}$	M1 A1 2	
4.	<p>(a) $\left(1 - \frac{3}{10}x\right)^5 = 1 + 5 \times 1 \times \left(\frac{-3x}{10}\right) + 10 \times 1 \times \left(\frac{-3x}{10}\right)^2 + 10 \times 1 \times \left(\frac{-3x}{10}\right)^3 + 5 \times 1 \times \left(\frac{-3x}{10}\right)^4 + \left(\frac{-3x}{10}\right)^5$</p> $= 1 - \frac{3}{2}x + \frac{9}{10}x^2 - \frac{27}{100}x^3 + \frac{81}{2000}x^4 - \frac{243}{100000}x^5$ <p>(b) When $x = 0.1$,</p> $\begin{aligned} \left(1 - \frac{3}{10} \times \frac{1}{10}\right)^5 &\approx 1 - \frac{3}{2} \times \frac{1}{10} + \frac{9}{10} \times \left(\frac{1}{10}\right)^2 \\ (0.97)^5 &\approx 1 - 0.15 + 0.009 \\ &\approx 0.859 \end{aligned}$	M1 A1 4	
5.	$\begin{aligned} AC &= \sqrt{(15^2 + 8^2)} = \sqrt{289} = 17 \\ OC &= 8.5 \\ OF &= \sqrt{5^2 + 8.5^2} = \sqrt{97.25} \\ &= 9.862 \\ \sin \frac{1}{2}\theta &= \frac{7.5}{9.862} \\ \frac{1}{2}\theta &= \sin^{-1} 0.7605 \\ \theta &= 2 \times 49.51 \\ &= 99.02^\circ \end{aligned}$	M1 A1 3	Using cosine rule $\cos \theta = \frac{2 \times 9.862^2 - 15^2}{2 \times 9.862^2} = -0.1567$ $\theta = 99.01$

No.	Marking scheme	Marks	Comments
6.	$y = kx^n$ $320 = k \times 16^n \quad (i)$ $2560 = k \times 64^n \quad (ii)$ $\frac{320}{16^n} = \frac{2560}{64^n} \Rightarrow \frac{1}{2^{4n}} = \frac{8}{2^{6n}}$ $\frac{2^{6n}}{2^{4n}} = 2^3$ $2^{2n} = 2^3$ $2n = 3$ $n = \frac{3}{2} = 1.5$	M1 M1 A1 3	
7.	(a)  (b)	B1 B1 B1 3	Tangent at N √ ly constructed { √ location of point of intersection of the tangents { √ construction of tangent intersecting MN at 60°
8.	$3(5x - 4) = 2^7$ $15x - 12 = 128$ $15x = 140$ $x = 9\frac{1}{3}$	M1 M1 A1 3	

No.	Marking scheme	Marks	Comments
9.	 <p>D C A M B</p>	B1 B1 B1 3	Line 3.5cm from AB and parallel to AB Semi circle, centre M, radius AM and broken arc. Shaded area
10.	<p>NM = Single matrix that would map P onto P'</p> $= \begin{pmatrix} 1 & 1 \\ -1 & 2 \end{pmatrix} \begin{pmatrix} 1 & -1 \\ 2 & 3 \end{pmatrix}$ $= \begin{pmatrix} 3 & 2 \\ 3 & 7 \end{pmatrix}$ <p>$(NM)^{-1}$ = Single matrix that would map P' onto P^l</p> <p>det = $21 - 6 = 15$</p> $(NM)^{-1} = \frac{1}{15} \begin{pmatrix} 7 & -2 \\ -3 & 3 \end{pmatrix}$ $= \begin{pmatrix} \frac{7}{15} & -\frac{2}{15} \\ -\frac{1}{5} & \frac{1}{5} \end{pmatrix}$	M1 A1 B1 3	

No.	Marking scheme	Marks	Comments
11.	 <p>(a)</p> <p>(b)</p> <p>Rate of change of h with t = $\frac{100 - 50}{0 - 2}$ $= -25 \text{ cm/h}$</p>	B1 B1 B1 3	✓ plotting of all 7 coordinates ✓ line of best fit ✓ gradient
12.	$\Sigma d = 0$ $-4 + 5 + -3 + -2 + d + 1 = 0$ $d - 3 = 0$ $d = 3$ $\text{Variance} = \frac{(-4)^2 + 5^2 + (-3)^2 + (-2)^2 + 3^2 + 1^2}{6}$ $= \frac{64}{6}$ $= 10\frac{2}{3}$	B1 M1 A1 3	

No.	Marking scheme	Marks	Comments
13.	<p>Amount borrowed = $27\ 500 - 17\ 250 = 10\ 250$</p> <p>Amount paid back = $6 \times 2100 = 12\ 600$</p> $10250 \left(1 + \frac{r}{100}\right)^6 = 12600$ $1 + \frac{r}{100} = \sqrt[6]{1.229}$ $1 + \frac{r}{100} = 1.035$ $r = 3.5\% \text{ p.m}$	M1 M1 A1 3	
14.	$\sin^2 \theta - \cos^2 \theta = -\frac{1}{2}$ $\sin^2 \theta - (1 - \sin^2 \theta) = -\frac{1}{2}$ $2\sin^2 \theta = \frac{1}{2}$ $\sin^2 \theta = \frac{1}{4}$ $\sin \theta = \pm \frac{1}{2}$ $\theta = 30^\circ, 150^\circ, 210^\circ, 330^\circ$	M1 A1 B2 4	Allow A1 for $\sin \theta = \frac{1}{2}$ Allow B1 for 2 or 3 ✓
15.	$\mathbf{PQ} = \begin{pmatrix} 3 \\ 3 \\ 1 \end{pmatrix} - \begin{pmatrix} 1 \\ -1 \\ 3 \end{pmatrix} = \begin{pmatrix} 2 \\ 4 \\ -2 \end{pmatrix}$ $\mathbf{PR} = \begin{pmatrix} 6 \\ 9 \\ -2 \end{pmatrix} - \begin{pmatrix} 1 \\ -1 \\ 3 \end{pmatrix} = \begin{pmatrix} 5 \\ 10 \\ -5 \end{pmatrix}$ $\begin{pmatrix} 2 \\ 4 \\ -2 \end{pmatrix} = k \begin{pmatrix} 5 \\ 10 \\ -5 \end{pmatrix}$ $k = \frac{2}{5}$ $\mathbf{PQ} = \frac{2}{5} \mathbf{PR}. \text{ Thus } \mathbf{PQ} \parallel \mathbf{PR}$ <p>P is a common point P, Q and R are collinear.</p>	M1 A1 B1 3	

No.	Marking scheme	Marks	Comments
16.	$S = \int_0^4 (t^2 - 4t + 6) dt$ $= \left[\frac{t^3}{3} - 2t^2 + 6t \right]_0^4$ $= \left(\frac{64}{3} - 2 \times 16 + 6 \times 4 \right) - 0$ $= 13\frac{1}{3}$	M1 M1 A1 3	

SECTION II (50 MARKS)

No.	Marking scheme	Marks	Comments
17.	(a) Tractor Q alone takes $(5 - 1\frac{2}{3}) = 3\frac{1}{3}$ h Fraction of work done by tractor P and Q in 1 hour $= \frac{1}{5} + \frac{1}{3\frac{1}{3}} = \frac{1}{5} + \frac{3}{10}$ $= \frac{1}{2}$ Together P and Q take 2 hours	B1 M1 A1	
	(b) Fraction of work done by P and Q in 40 minutes $= \frac{2}{3} \times \frac{1}{2}$ $= \frac{1}{3}$ Balance $= 1 - \frac{1}{3} = \frac{2}{3}$ Tractor Q alone to do $\frac{2}{3}$ of work $= \frac{2}{3} \div \frac{3}{10} = \frac{2}{3} \times \frac{10}{3}$ $= \frac{20}{9} = 2\frac{2}{9}$ hours = 2hrs 13 min Total time $= 2\frac{2}{9} + \frac{2}{3}$ $= 2\frac{8}{9}$ hours = 2hrs 53 min	 B1 M1 M1 A1	
	(c) In 1 h both P and Q do $\frac{1}{2}$ of the work Fraction of work done by P and Q in 1h 12 min $= \frac{6}{5} \times \frac{1}{2} = \frac{3}{5}$ Balance $= 1 - \frac{3}{5} = \frac{2}{5}$ Payment for tractor R $= \frac{2}{5} \times 20\,000$ $= \text{Ksh } 8\,000$	 B1 M1 A1	
		10	

No.	Marking scheme	Marks	Comments
18.	(a)(i) Mora's monthly taxable income $= 40\ 000 + 11\ 090 + 7\ 000$ $= \text{ksh } 58\ 090$	B1	
	(ii)		
	Tax in 1 st slab = $\frac{10}{100} \times 11180 = 1118$ Tax in 2 nd slab = $\frac{15}{100} \times 10534 = 1580.1$	M1	
	Tax in 3 rd slab = $\frac{20}{100} \times 10534 = 2106.8$ Tax in 4 th slab = $\frac{25}{100} \times 10534 = 2633.5$	M1	
	Tax in 5 th slab = $\frac{30}{100} \times 15308 = 4592.4$	M1	
	Total income tax $= 1118 + 1580.1 + 2106.8 + 2633.5 + 4592.4$ $= 12\ 030.8$	A1	
	(b) Relief = $12\ 030.80 - 10\ 750.8$ $= \text{ksh } 1\ 280$	B1	
	(c)(i) Tax in proposed 1 st band $= 11180 \times 1.5 \times \frac{10}{100}$ $= \text{ksh } 1677$	B1	
	(ii) Amount in last band $= 58090 - (16770 + 10534 \times 3)$ $= 9718$	M1	
	Tax = $\frac{30}{100} \times 9718$ $= 2915.40$	M1	
		A1	
		10	

No.	Marking scheme	Marks	Comments
19.	(a)(i) Price of a pen = $\frac{180}{2x-1}$	B1	
	(ii) Price of a pencil = $\frac{200}{3x+1}$	B1	
	(b) $\frac{180}{2x-1} - \frac{200}{3x+1} = 4$	M1	
	$180(3x+1) - 200(2x-1) = 4(2x-1)(3x+1)$		
	$(2x-1)(3x+1) = 45(3x+1) - 50(2x-1)$		
	$6x^2 - x - 1 = 35x + 95$	M1	
	$6x^2 - 36x - 96 = 0$		
	$x^2 - 6x - 16 = 0$		
	$(x+2)(x-8) = 0$	M1	
	$x = -2 \text{ or } x = 8$		
	$x = 8$	A1	
	(c) New price of a pen = $\frac{125}{100} \times \left(\frac{180}{16-1} \right)$		
	$= \text{Ksh } 15$	B1	
	Price of pencil = $\frac{200}{25} = \text{Ksh } 8$	B1	
	Let number of pens be p		
	$\therefore 15p = 8(46 - p)$	M1	
	$15p + 8p = 8 \times 46$		
	$23p = 8 \times 46$		
	$p = \frac{8 \times 46}{23} = 16$	A1	
			10

No.	Marking scheme	Marks	Comments
20.	(a)(i) Longitude difference between A and B $= 15^\circ + 75^\circ = 90^\circ$ $\frac{90}{360} \times 2 \times \frac{22}{7} \times 6370 \cos x = 5005$ $\cos x = \frac{5005 \times 7 \times 360}{90 \times 2 \times 22 \times 6370} = 0.5000$ $x = 60^\circ$ B(60°N, 75°W)	B1 M1 A1	
	(ii) Distance between B and C = $910 \times 3\frac{2}{3} = 3336\frac{2}{3}$ $\frac{\theta}{360} \times 2 \times \frac{22}{7} \times 6370 = 3336\frac{2}{3}$ $\theta = \frac{3336\frac{2}{3} \times 360 \times 7}{2 \times 22 \times 6370} = 30^\circ$ C(30°N, 75°W)	M1 M1 A1	
	(b) Time for entire journey + stop over $= \frac{5005}{910} + 1\text{h } 30\text{ min} + 3\text{h } 40\text{ min}$ $= 10\text{ h } 40\text{ min}$ Time difference due to longitude difference $= \frac{90 \times 4}{60} = 6\text{ h}$	M1 M1	
	Local time at C when aircraft reached $\begin{array}{r} 0720 \\ - 0600 \\ \hline \end{array}$ $\begin{array}{r} 0120 \\ + 1040 \\ \hline \end{array}$ $\underline{1200\text{ h}}$	M1 A1	
		10	

No.	Marking scheme	Marks	Comments
21.	(a) $y < 2x$ $\left. \begin{array}{l} 3 \times 8 \times x + 2 \times 15 \times y \geq 240 \\ 24x + 30y \geq 240 \\ 4x + 5y \geq 40 \end{array} \right\}$ $x \leq 6$	(i) (ii) (iii)	B1 B1 B1
	(b)		S1
			y < 2x 4x + 5y ≥ 40 x ≤ 6
	(c) Search line $\left. \begin{array}{l} 13 \times 5000 \times x + 2 \times 12500 \times y = C \\ 15000x + 25000y = C \\ 15000x + 25000y = 75000 \\ 3x + 5y = 15 \end{array} \right\}$ For minimum cost, x = 5, y = 4 Minimum cost = 1500 × 5 + 25000 × 4 = Ksh 175 000		B1 B1 B1
		10	Search line drawn

No.	Marking scheme	Marks	Comments																
22.	(a)																		
	<table border="1"> <thead> <tr> <th>Upper class boundary</th><th>104.5</th><th>114.5</th><th>124.5</th><th>134.5</th><th>144.5</th><th>154.5</th><th>164.5</th></tr> </thead> <tbody> <tr> <td>Cumulative frequency</td><td>7</td><td>18</td><td>33</td><td>45</td><td>53</td><td>57</td><td>60</td></tr> </tbody> </table> <p style="text-align: right;">B1 All ✓</p> <p>(b) Q_1 (Blood pressure of 15th patient) = 112.5 ± 0.5 Q_3 (Blood pressure of 45th patient) = 134.5 Range = $134.5 - 112.5$ = 22</p> <p>(c) 56th patient is the 1st patient to exceed pressure of 150 No. of patients exceeding pressure of 150 = 5 Percentage = $\frac{5}{60} \times 100$ = $8\frac{1}{3}\%$</p> <p style="text-align: right;">S1 P1 C1 B1 M1 A1 B1 M1 A1 10</p>	Upper class boundary	104.5	114.5	124.5	134.5	144.5	154.5	164.5	Cumulative frequency	7	18	33	45	53	57	60		
Upper class boundary	104.5	114.5	124.5	134.5	144.5	154.5	164.5												
Cumulative frequency	7	18	33	45	53	57	60												

No.	Marking scheme	Marks	Comments
23.	(a) (i) $\angle EAD = 40^\circ$ (\angle in alt. segment) $\angle ADE = 180 - (40 + 45) = 95$ (sum of angle in Δ) $\angle BDC = 40^\circ$ (alternate angle) $\angle ADB = 180 - (95 + 40)$ $= 45^\circ$	B1 M1 A1	
	(ii) $\angle BAD = 180^\circ - (45^\circ + 40^\circ) = 95^\circ$ $\angle BCD = 180^\circ - 95^\circ = 85^\circ$ $\angle BOC = 2 \times 40^\circ$ $= 80^\circ$	B1	
	$\angle OCB = (180^\circ - 80^\circ) \times \frac{1}{2} = 50^\circ$	B1	
	$\angle OCD = 85^\circ - 50^\circ = 35^\circ$	B1	
	(b) (i) $EA = \sqrt{3.5(3.5+4.9)} = \sqrt{3.5 \times 8.4}$ $= 5.4 \text{ cm}$	M1 A1	
	(ii) $2r = \frac{4.9}{\sin 55^\circ}$ $r = 2.991$	M1	
	$r \approx 3.0 \text{ cm}$	A1	
		Follow thro'	
		10	

No.	Marking scheme	Marks	Comments
24.	<p>(a)(i) Total No. of students = $60 + 56 + 44 + 40 = 200$</p> $P(\text{Student in F4}) = \frac{40}{200} = \frac{1}{5}$ <p>(ii) $P(\text{Student wears glasses})$</p> $= \frac{\frac{10}{100} \times 60 + \frac{12.5}{100} \times 56 + \frac{25}{100} \times 44 + \frac{17.5}{100} \times 40}{200}$ $= \frac{6 + 7 + 11 + 7}{200}$ $= \frac{31}{200}$ <p>(b)(i) $P(\text{Either } F_1F_4 \text{ or } F_4F_1)$</p> $= \frac{60}{200} \times \frac{40}{199} + \frac{40}{200} \times \frac{60}{199}$ $= \frac{12}{199} + \frac{12}{199}$ $= \frac{24}{199}$ <p>(ii) $P(\text{Either } F_1GF_4G \text{ or } F_4GF_1G)$</p> $= \frac{60}{200} \times \frac{10}{100} \times \frac{40}{199} \times \frac{17.5}{100} + \frac{40}{200} \times \frac{17.5}{100} \times \frac{60}{199} \times \frac{10}{100}$ $= \frac{21}{19900} + \frac{21}{19900}$ $= \frac{21}{9950}$	B1 B1 M1 A1 M1M1 A1 M1M1 A1 10	