THE KENYA NATIONAL EXAMINATINOS COUNCIL

Kenya Certificate of Secondary Education

MATHEMATICS Alt. A
Paper 2

MARKING SCHEME
(CONFIDENTIAL)

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This marking scheme consists of 17 printed pages.

Turnover

No.	Marking scheme	marks	comments
1.	$(x-1)(5x+3)=0$ ✓ $5x^2-5x+3x-3=0$ $5x^2-2x-3=0$ ✓	M1 A1 2	$(x+3/5)(x-1)=0$ OR $(x+0.6)(x-1)=0$ → multiplication of factors
2.	Absolute Error $=\frac{1}{7}-\frac{14}{100}$ ✓ $=\frac{1}{350}$ % Error $=\frac{1}{350}\div\frac{1}{7}\times 100$ ✓ $=\frac{1}{350}\times\frac{7}{1}\times 100$ $=2\%$ ✓	M1 M1 A1 3	OR $\frac{1}{7}-\frac{7}{50}$ Dont award M1 if student writes $\frac{1}{7}-0.14$ but wait till 0.14 is converted into $\frac{14}{100}$. If not, then award M1 at $\frac{1}{350}$
3. (a)	M:S:M:O = 1:2:5:1 Cost of 1kg of mixture $=\frac{90+2(120)+5(30)+150}{9}$ ✓ $=\frac{630}{9}$ = Ksh 70 ✓	M1 A1	Accept when denominator is not added i.e accept 1+2+5+1
(b)	$\frac{130}{100}\times 70=$ [illegible] ✓ = Ksh 91 ✓	M1 A1 4	

(2) $\frac{1-0.98}{1}\times 100\%$ — M1 M1

2% — A1

④ $\frac{5}{6}\times 6\log 2 + \log\frac{100}{2} - 4\log 2$

$5\log 2 + \log 100 - \log 2 - 4\log 2$ --- M1

$\log 100$ --- M1

$= 2$ --- A1

4.	$\frac{5}{6}\log_{10} 64 + \log_{10} 50 - 4\log_{10} 2$ $\log_{10}(2^6)^{\frac{5}{6}} + \log_{10} 50 - \log_{10} 2^4$ ✓ $= \log_{10}\left(\frac{2^5\times 50}{2^4}\right)$ ✓ $= \log_{10}(100)$ $= 2$ ✓	M1 M1 A1 3	interpretation of log laws (elimination of coefficients) for single logs
5. (a)	$\angle PSR = 180 - 105 = 75°$ ✓	B1	
(b)	$\angle PQS = \angle SRP$ $\angle SRP = 180 - (37.5 + 75)$ ✓ $= 67.5°$ ✓	M1 A1 3	or equivalent $(105° - 37.5°)$
6.	$S^2 = \frac{3d(t-d)}{8}$ ✓ $8S^2 = 3dt - 3d^2$ ✓ $t = \frac{8S^2 + 3d^2}{3d}$ ✓	M1 M1 A1 3	squaring both sides removal of brackets including division line
7.	$\frac{3}{3-\sqrt{7}}\times\frac{3+\sqrt{7}}{3+\sqrt{7}} = \frac{9+3\sqrt{7}}{9-7}$ ✓ $= = \frac{9+3\sqrt{7}}{2}$ ✓	M1 A1 2	for rationalising the denominator i.e $(9-7)$ and correct expression of the fraction or $\frac{3}{2}(3+\sqrt{7})$

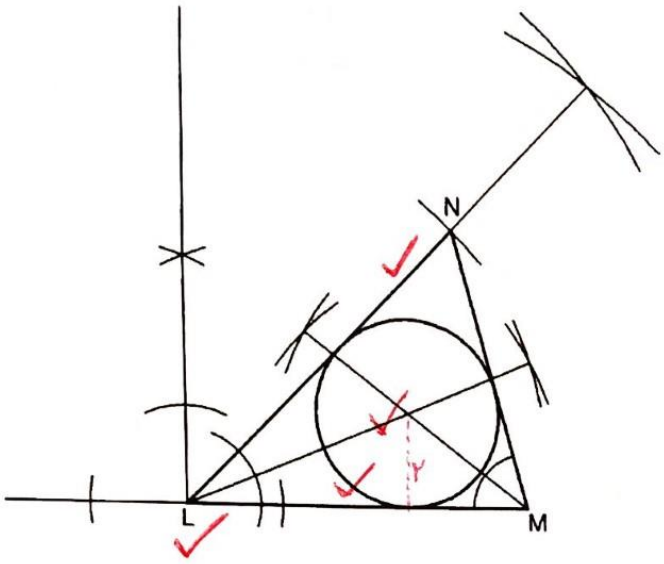
6. $s^2 = \frac{3d(t-d)}{8}$

$8s^2 = 3d(t-d)$ ✓ M1

$\frac{8s^2}{3d} = t - d$ ✓ M1

$\frac{8s^2}{3d} + d = t$ ✓ A1

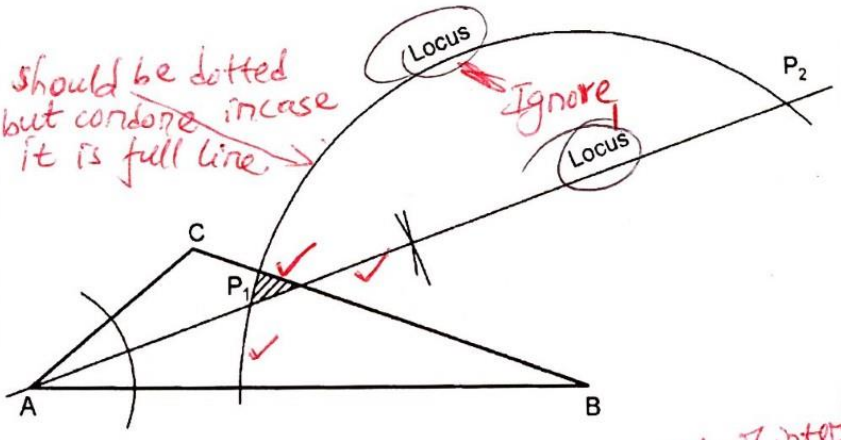
8.



B1	For ∠NLM correctly constructed.	allow for ±1° for the angle
B1	Complete Δ	Lengths must be correct ±0.1cm
B1	Angle bisector (two) constructed.	
B1	Circle inscribed.	evidence of construction of radius must be shown. No trial & error.
4		

- second B1 mark, can be earned even if the first B mark is lost.

9.



should be dotted but condone incase it is full line.

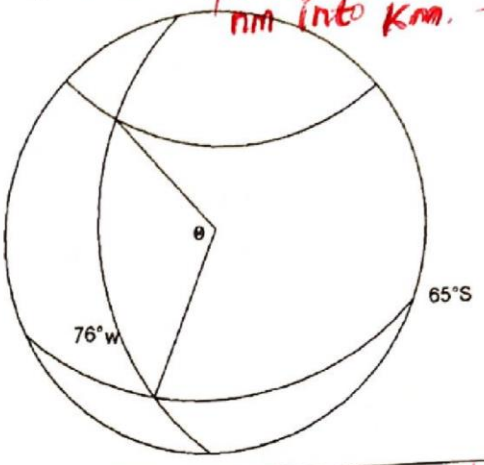
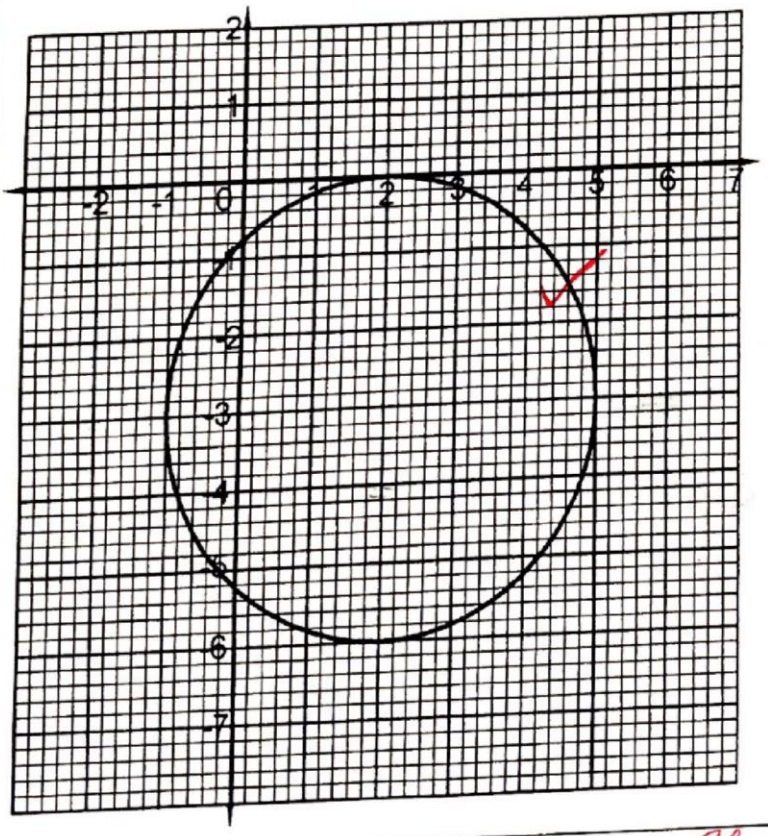
point of intersection identified i.e P1

B1	For bisector of ∠A	
B1	For arc r = 5cm centre B	P1 identified or marked
B1	Shaded region within the triangle	
3		

(9)

2nd B. mark → Award Bo if P1 is not identified' can be identified by use of a dot or labelling it P1.

(10) $(65-x)/60 = 5400$ -- M1 1nm = 1·853 km.

10.	$d = 60 \times \theta$ $5400 = 60 \times \theta$ ✓ $\frac{5400}{60} = \theta$ $\theta = 90^o$ ✓ Position of Q is (25°N, 76°W) ✓	M1 A1 B1 3	Or equivalent may include use of formula converting nm into km. 
11.	$x^2 - 4x + (-2)^2 + y^2 + 6y + (3)^2 = -4 + (-2)^2 + (3)^2$ ✓ ~~$(x-2)^2 + (y+3)^2 = 3^2$~~ $r = 3$ ✓ Centre (2,-3), ~~3~~ ✓ 	M1 ~~A1~~ B1 B1 4	R·H·S must be correct. May be stated or seen in the circle. Correct circle (scale must be correct) ~~M1A0 OW-1~~ ~~B1B1~~

If a circle is drawn without any working shown, then mark as follows M1, A1 OW-1 B1B1

B1 ✓1

B1 can be a double tick earned if M1 is earned but A lost due to a numerical error.

12.	$y = \frac{5}{2} sin\ (4\theta + 60°)$ Amplitude = 2½ ✓ Period = 90° ✓ Phase angle = 60° ✓	B1 B1 B1 **3**	or 2.5

13.

Score	d = x - a	d^2
10	-5	25
12	-3	9
14	-1	1
16	1	1
28	13	169
30	15	225
n = 6	$\Sigma d = 20$	$\Sigma d^2 = 430$

B1 – For correct column of deviations & all values correct

B1 For correct d^2 column

$S.d = \sqrt{\frac{430}{6} - \left(\frac{20}{6}\right)^2}$ ✓

$s.d = \sqrt{60.56} =$ [illegible]

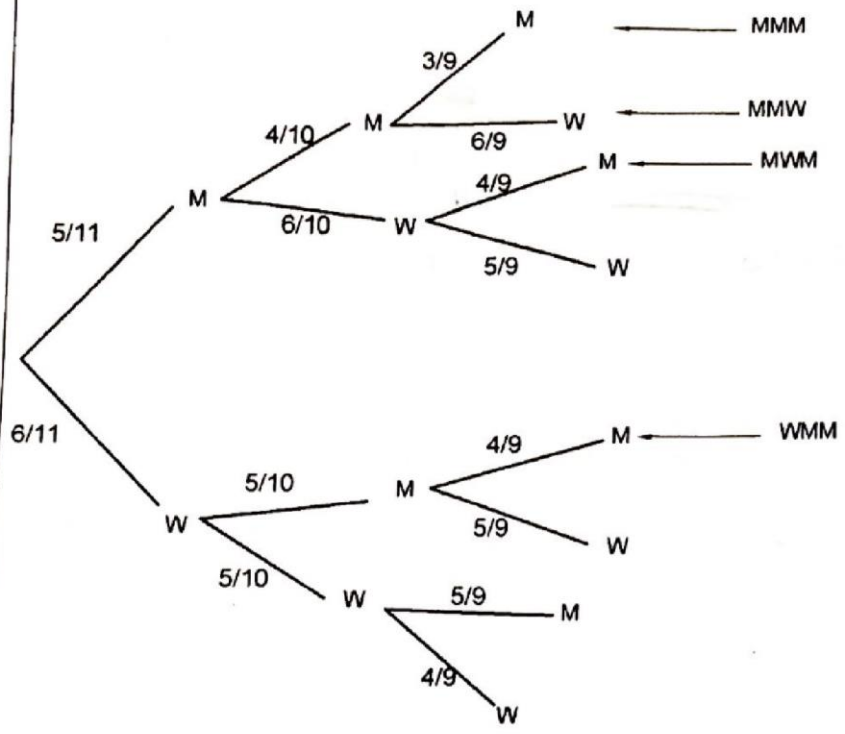
$S.d = 7.78$ ✓

M1 Allow if candidate uses $\sqrt{\frac{430}{6} - \left(\frac{430}{6}\right)^2}$ cos of the error in the KNEC table and mark $M_1 A_0$

A1 C.A.O

4

14.



P (more men than women)

= P ([redacted] or MMW or MWM or WMM) ✓ B1 Identification of three correct combinations

$= \left([redacted] \times [redacted] \times [redacted]\right) + \left(\frac{5}{11} \times \frac{4}{10} \times \frac{6}{9}\right)$

$+ \left(\frac{5}{11} \times \frac{6}{10} \times \frac{4}{9}\right) + \left(\frac{6}{11} \times \frac{5}{10} \times \frac{4}{9}\right)$ ✓ M1 For 3 correct probabilities.

$= [redacted] + \frac{4}{33} + \frac{4}{33} + \frac{4}{33}$ ✓ M1 For correct addition of 3 probabilities.

A1

$\frac{13}{33} = \frac{4}{11}$

4

Allow M1, M1 if the student included the probabilities of All men i.e (MMM) and had lost the B mark.

$\frac{x}{24} = 9$

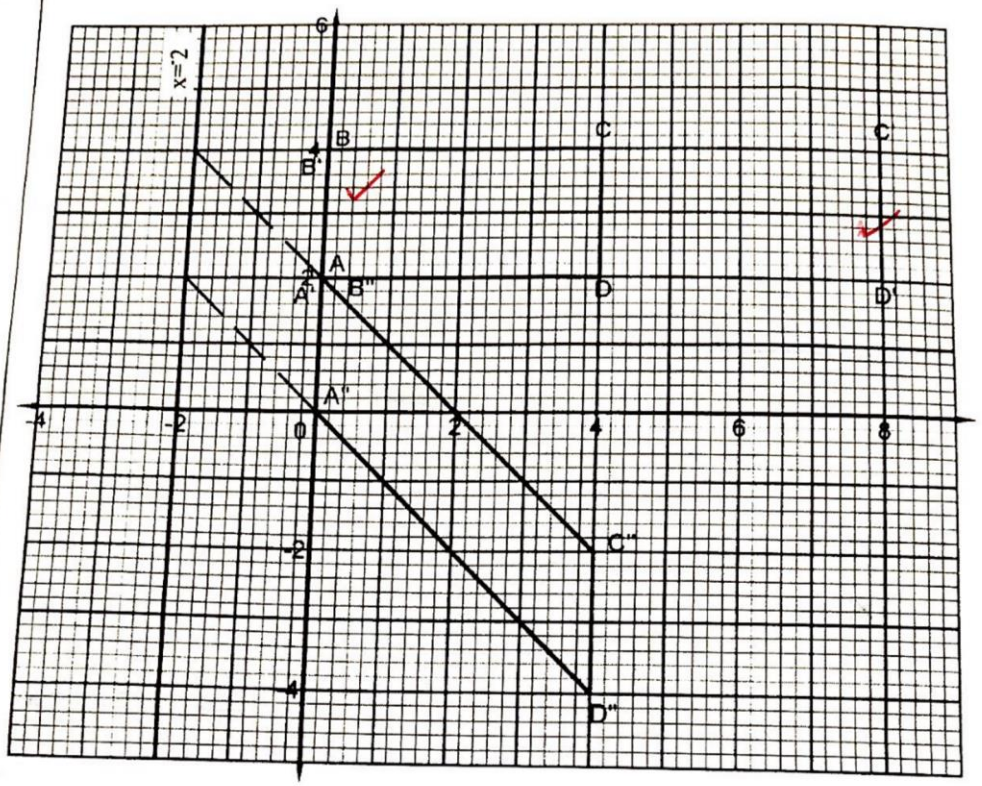
15.	$\det \begin{pmatrix} 6 & 5 \\ 3 & 4 \end{pmatrix} = 24 - 15 = 9$ area image = 9×24 = ~~216 sq units~~ ✓ = 216 sq units ✓	M1 A1 2	or ↗ when image area has been related to area of object and determinant
16.	$\mathbf{AB} = \begin{pmatrix} 4 \\ 3 \\ 9 \end{pmatrix} - \begin{pmatrix} 3 \\ 4 \\ 7 \end{pmatrix} = \begin{pmatrix} 1 \\ -1 \\ 2 \end{pmatrix}$ ✓ $\mathbf{AC} = \begin{pmatrix} 1 \\ 6 \\ 3 \end{pmatrix} - \begin{pmatrix} 3 \\ 4 \\ 7 \end{pmatrix} = \begin{pmatrix} -2 \\ 2 \\ -4 \end{pmatrix}$ $\mathbf{AC} = -2\,\mathbf{AB}$ ✓ **AB // AC** and A is a common point ✓ ∴ A, B and C are collinear.	B1 B1 B1 3	For **AB** or **AC** or BC Allow if student works in $\underset{\sim}{i}$, $\underset{\sim}{j}$ and $\underset{\sim}{k}$ forms. or equivalent or equivalent *condone omission of vector signs.

17. (a)	Total earning/Taxable income = Ksh (28600 + 15000 +3200 +540) ✓ = Ksh 47340 ✓	M1 A1	Addition of the earnings.
	Tax charged: Up to 9680 → 9680×10% = Ksh 968 9681 – 18800 → 9120 ×15% = Ksh 1 368 18801 – 27920 → 9120 × 20% = Ksh 1 824 27924 – 37040 → 9120 × 25% = Ksh 2 280 Above 37040 → 10300 × 30% = Ksh 3 090	M1	1st 4 slabs process (correct)
	Total tax [redacted] (968 +1 368+1 824 +2 280+3 090) [redacted] Ksh 9530 ✓ [redacted]	M1 A1	5th slab correct sum of taxes in the slabs.
(b)	Monthly deductions: 2% of Ksh 28 600 = Ksh 572	M1	for calculation of 2%
	Total deductions Ksh (8 474 + 500 + 1 200 + 572) ✓ = Ksh 10 746	M1	[redacted] for summation of deductions
	Net income = Ksh (47 340 – 10 746) ✓ = Ksh 36 594 ✓	M1 A1	Difference of gross income and total deductions.
		10	

– Incase a student makes a numerical error in summing total taxable income, A mark is lost but subsequent M marks are earned

– 17 (a) wrong figure for last bracket M0.
wrong last bracket used in adding, M0, A0.

18. (i)



ABCD correctly drawn — B1

A′B′C′D′ correctly drawn — B1

(ii) T is a stretch — B1

S.F. = 2 — B1

x = 0 invariant (y-axis) — B1 or point & its image

(iii) $T = \begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$ — B1

For two pairs of simultaneous eqns & correct attempt to solve them (one pair) — M1

For each column — A1

(b) Invariant line identified and used — B1

A″,B″,C″ and D″ plotted — B1 plotting

A″B″C″D″ drawn correctly — B1

10

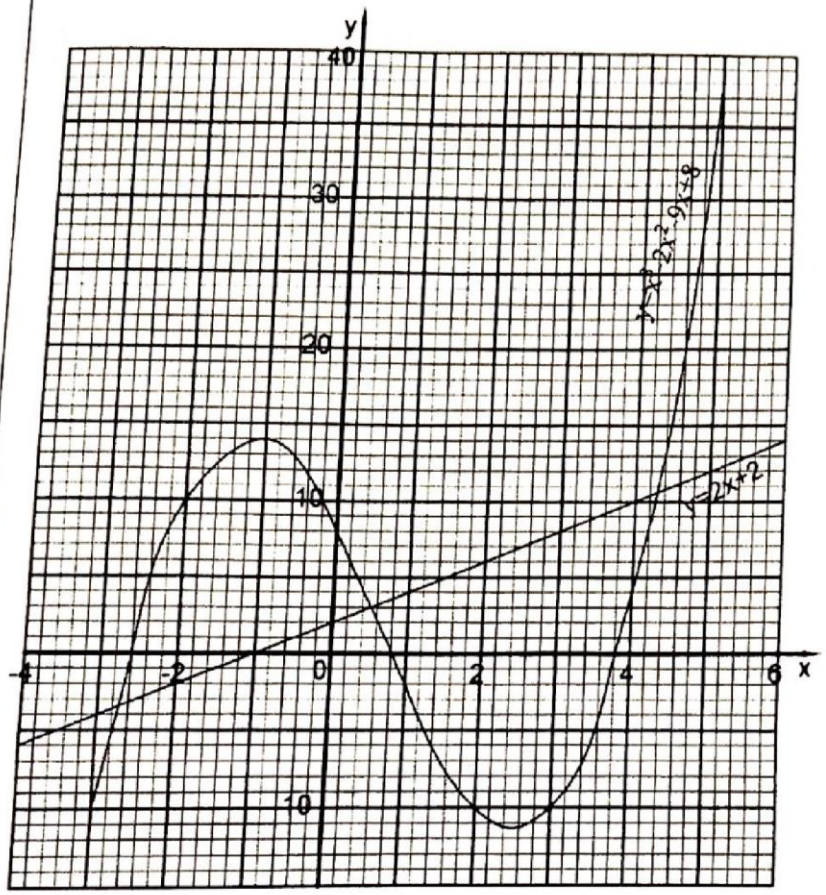
(iii) can also use general matrix for a stretch. In such case M is implied.

19. (a)

x	-3	-2	-1	0	1	2	3	4	5
$y = x^3 - 2x^2 - 9x + 8$	-10	10	14	8	-2	-10	-10	4	38

B2 For all correct
B1 for 3 correct

(b)



S1 correct use of given scale
P1 ✓ if B1 awarded in table
C1 Allow plotting of (0,0) instead of (0,8)
Accept with plotting of (0,0)

(c) (i) Roots $x = -2.6, 0.8, 3.8$ ✓

B1 Accept $-2.6, 0, 3.8 \pm 0.1$ for the values.

(ii) $y = x^3 - 2x^2 - 9x + 8$

$o = x^3 - 2x^2 - 11x + 6$ ✓

$y = 2x + 2$ ✓

M1 for the subtraction

A1 for $y = 2x + 2$

~~Plotting of line~~ Drawing of the line $y = 2x + 2$ ✓

L1

Roots are -2.7, 0.5, 4.3 ✓

B1 Accept $-2.7, -0.1$ and 4.3

10

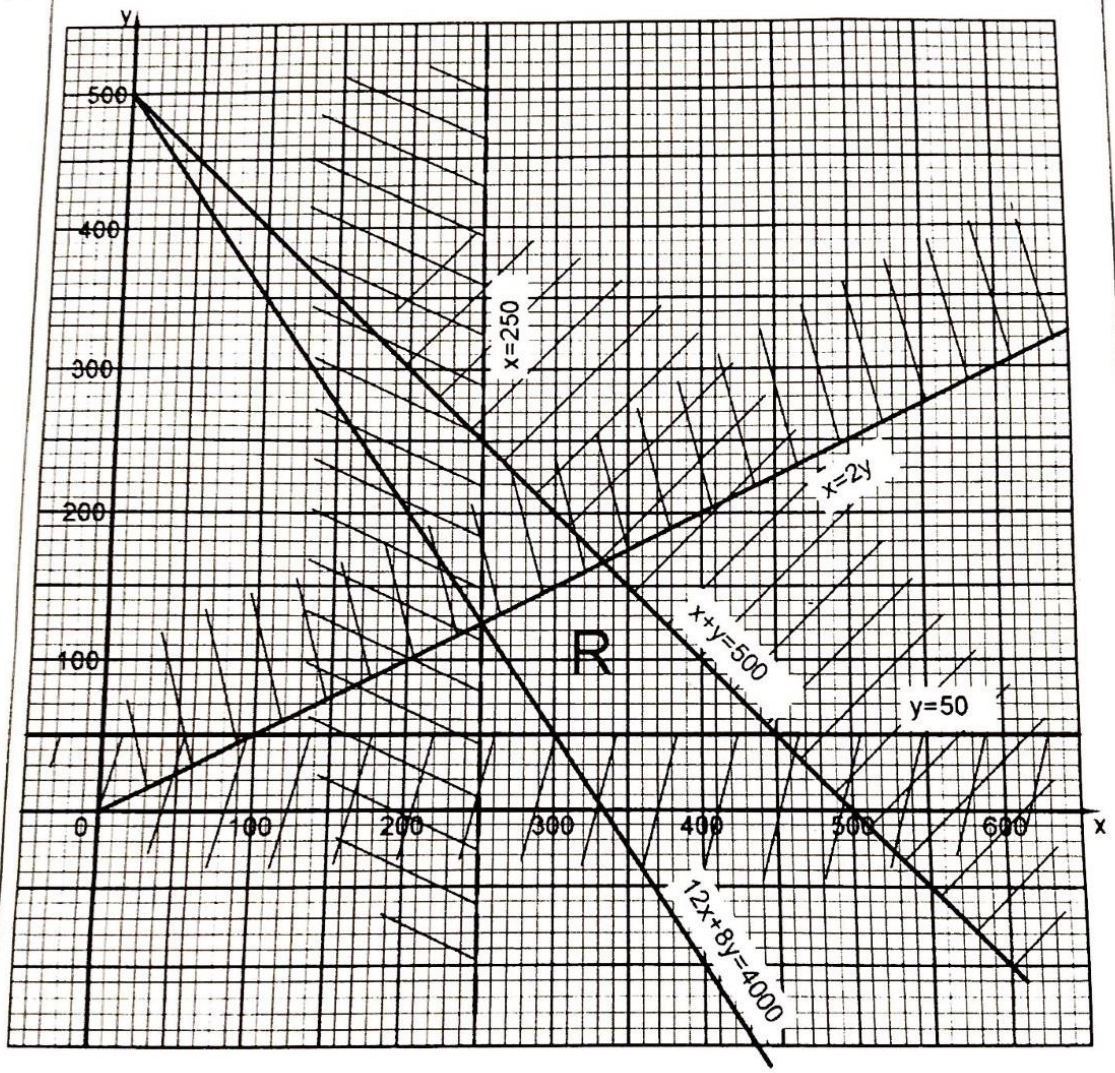
20. (a)	Projection of BE is BD ✓ or DB	B1	
(b)(i)	Angle between line AD and BF		
	$= \tan^{-1}\left(\frac{6}{12}\right)$ or $\tan\theta = \frac{6}{12}$ ✓	M1	or equivalents
	$= 26.6°$ ✓	A1	
(ii)	Angle between line BE and plane ABCD		
	$BD = \sqrt{12^2 + 16^2}$		
	$= 20$ ✓	B1	
	Tan (DBE) $= \frac{6}{20}$ ✓ or $\tan^{-1}\left(\frac{6}{20}\right)$	M1	
	$\angle DBE = \tan^{-1}\frac{6}{20}$		
	$= 16.7°$ ✓	A1	
(iii)	Angle between HBCE and BCFG.		
	$= \tan^{-1}\frac{16}{6}$ or $\tan\theta = \frac{16}{6}$ ✓	M1	or equivalents, e.g $\sin\theta = \frac{16}{\sqrt{292}}$ or $\cos\theta = \frac{6}{\sqrt{292}}$
	$= 69.4°$ ✓	A1	
(c)	$BF = \sqrt{12^2 + 6^2}$		
	$= \sqrt{180}$		
	$BN = \sqrt{180 + 8^2}$ ✓ or $\sqrt{12^2 + 8^2 + 6^2}$	M1	working must be shown
	$= 15.6$cm ✓	A1	
		10	

21. (a)	$X = \frac{k\sqrt{Y}}{\sqrt[4]{Z}}$ ✓	B1	
	$64 = \frac{k\sqrt{16}}{\sqrt[4]{625}}$ ✓	M1	correct substitution of X, Y & Z
	$k = 64 \times \frac{5}{4}$		
	$= 80$ ✓	A1	
	$X = \frac{80\sqrt{Y}}{\sqrt[4]{Z}}$ ✓	B1	
(b)	$160 = \frac{80\sqrt{36}}{\sqrt[4]{Z}}$	M1	Awarded when $\sqrt[4]{Z}$ is made the subject
	$\sqrt[4]{Z} = \frac{80 \times 6}{160} = 3$ ✓		
	$Z = 3^4 = 81$ ✓	A1	for obtaining 81
(c)	New $X = \frac{80\sqrt{1.44Y}}{\sqrt[4]{Z}}$ ✓ for New value of X	M1	or equivalents. (may use any constant) for K
	$= X = \frac{80 \times 1.2\sqrt{Y}}{\sqrt[4]{Z}}$ ✓	M1	for obtaining the $\sqrt{1.44}$ as 1.2
	% change $= \frac{\frac{80 \times 1.2\sqrt{Y}}{\sqrt[4]{Z}} - \frac{80\sqrt{Y}}{\sqrt[4]{Z}}}{\frac{80\sqrt{Y}}{\sqrt[4]{Z}}} \times 100\%$ ✓	M1	may be implied in the answer.
	$= 20\%$ ✓ increase	A1	Accept 20% i.e. where student fails to write increase
		10	

21. A student who uses y^2 will loose all marks in part (a) but scores all the M marks if used correctly in (b) and (c)

22. (a)	$x + y \leq 500$ ✓ $x \geq 2y$ ✓ $y \geq 50$ ✓ $x > 250$ ✓	B1 B1 B1 B1	

(b)



$x + y \leq 500$ ✓ $x \geqslant 2y$ ✓ $y \geq 50$ ✓ $x > 250$ ✓	B1 B1 B1 B1	shown in the graph and correct region shaded. can be a ✓ incase a wrong inequality was given in part a

$x \geqslant 2y$ → B_1 mark can also be ✓
$y \geqslant 50$ → B_1 " " " " "
$x > 250$ → B_1 " " " " "
} i.e when inequalities are reversed or equal sign not included.

(c)	Search line $12x+8y=4000$ For maximum profit $x=450, y=50$ ✓ Maximum profit $=12\times450+50\times8$ $=$ Ksh 5800 ✓	B1 B1 **10**	May not draw a search line if inspection method is used. In that case more than one point has to be used for inspection & points must be from the correct region. → Regions must be correct to score this mark.

23. (a) (i)	$T_n = a+(n-1)d$ $T_5 = a+4d = 82$ $T_{12} = a+11d = 103$ $7d = 21$ $d = 3$ ✓	M1 A1	For correct attempt to solve the two correct simultaneous equations.
	$a+4(3) = 82$ $a = 70$ ✓	B1	
(ii)	$S_n = \frac{n}{2}[2a+(n-1)d]$		
	$S_{21} = \frac{21}{2}(2(70)+20(3))$ ✓	M1	correct substitution. check equivalents.
	$= 2100$ ✓	A1	
(b)	$a+5d = 85$ ✓ $a+9d = 145$ $4d = 60$ ✓ $d = 15cm$	M1 M1	If any of the two eqns is correct For correct attempt to solve the simultaneous eqns
	$a+5(15) = 85$ $a = 10\ cm$ ✓	A1	For both correct values of a & d.
(c)	$S_n = \frac{n}{2}(2a+(n-1)d)$		
	$S_{11} = \frac{11}{2}(2(10)+10(15))$ ✓	M1	For substitution check equivalents.
	$= 935$ cm ✓	A1	
		10	

Let x be the width.

24. (a)	$(3x-3)x = 60$ ✓ $3x^2 - 3x - 60 = 0$ $x^2 - x - 20 = 0$ $(x-5)(x+4) = 0$ ✓ $x = 5$ or $x = -4$ ✓ $\therefore$ width $x = 5$m ✓ Length = 12m Height $= \frac{1}{4} \times 12 = 3$m ✓	M1 M1 A1 B1 B1	For correct eqn of the area. For correct attempt to solve the quadratic eqn. For both values of x For discriminating the values of x. for correct length and height
(b)(i)	$60 - (12-2y)(5-2y) = 1.69$ ✓ $34y - 4y^2 = 1.69$ $4y^2 - 34y + 1.69 = 0$ $y = \frac{34 \pm \sqrt{(-34)^2 - 4(4)(1.69)}}{8}$ ✓ $y = 8.45$ or $y = 0.05$ ✓ $\therefore y = 0.05$m ✓	M1 M1 A1 B1	For correct expression of border area. Check for equivalents. For correct attempt to solve the quadratic eqn. For both values of y
(ii)	Dimensions of tiled area Length = 12 – 0.1 = 11.9m Width = 5 – 0.1 = 4.9m ✓	B1	For both
		10	

a(i) A_1 can be implied if a student goes straight to $x = 5$m.

24) Alternatives

i) $12(2y) + 3y(5-2y) = 1.69$

$4y^2 - 34y + 1.69 = 0$

ii) $4y^2 + 2y(12-2y) + 2y(5-2y) = 1.69$

$4y^2 - 34y + 1.69 = 0$