Name: Marking Scheme Index No. .... 9 copies

Adm. No. .... Class .... Signature ....

121/2
MATHEMATICS
Paper 2
July 2017
2 ½ hours

ALLIANCE HIGH SCHOOL
TRIAL EXAMINATIONS - 2017
Kenya Certificate of Secondary Education (K.C.S.E)

INSTRUCTIONS TO CANDIDATES:

- Write your name and index number in the spaces provided at the top of this page.
- The paper contains Two sections: **Section I and Section II.**
- Answer ALL the questions in Section 1 and any FIVE questions from Section II question.
- All working and answers must be written on the question paper in the spaces provided below each question.
- **Show all the steps in your calculations, giving your answers at each stage in the spaces below each question.**
- Non-programmable silent electronic calculators and KNEC mathematical tables may be used, except where stated otherwise.

For Examiner's use only

Section I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
R	R	R	R	Q	Q	Q	Q	K	K	K	M	M	M	G	G	

Section II

17	18	19	20	21	22	23	24	Total
D	D	C	C	B	B	A	A	

Grand Total

This paper consists of 15 printed pages
Candidates should check the question paper to ensure that all the printed pages are printed as indicated and no questions are missing

JULY 2017 TRIALS, MATHEMATICS PAPER 2 Marking Scheme

Section 1 (50 MKS) Attempt ALL the questions

1. Simplify;

$$\frac{\frac{1}{2} \text{ of } 16-10+2\left(\frac{1}{2}\div\frac{1}{4}\right)}{\frac{1}{3}\times 3\frac{3}{4}\div\frac{1}{4}} = \frac{8-10+4}{\frac{1}{3}\times 15} \quad A_1 \; M_1$$ (3mks)

$$= \frac{2}{5} \quad A_1$$

2. Given $z = \frac{a^2-x^2}{aw-xw}$ express x in terms of a, z and w (3mks)

$$z = \frac{(a+x)(a-x)}{w(a-x)} \; M_1 \Rightarrow z = \frac{a+x}{w} \; B_1$$

$$\therefore x = zw - a \; A_1$$

3. Use binomial expansion to expand and simplify $(x-2y)^5$ up to the third term. Hence use the expansion to evaluate $(2.02)^5$. (4mks)

$$x^5(-2y)^0 + x^4(-2y)^1 + x^3(-2y)^2 \; M_1$$

$$\Rightarrow x^5 - 2yx^4 + 4x^3y^2 \Rightarrow x^5 - 10yx^4 + 40x^3y^2 \; A_1$$

$= 2$

$= -0.01$

$$\therefore 2^5 - 10(-0.01)2^4 + 40(2^3)(-0.01)^2 \; M_1$$ Correct substitution

$$= 33.632 \; A_1$$ CAO

4. Determine the possible value of x for which the matrix below is singular. (2mks)

$$\begin{pmatrix} 2x & 12 \\ 6 & x \end{pmatrix}$$

$$2x^2 - 72 = 0 \; M_1$$

$$x^2 = 36 \quad \therefore x = \pm 6 \; A_1$$

5. Find the distance between the centre O of a circle whose equation is $2x^2 + 2y^2 + 6x + 10y + 7 = 0$, and a point B(-4, 1) (3mks)

$$x^2 + y^2 + 3x + 5y + \left(\tfrac{3}{2}\right)^2 + \left(\tfrac{5}{2}\right)^2 = -\tfrac{7}{2} + \tfrac{9}{4} + \tfrac{25}{4}$$

$$\left(x + \tfrac{3}{2}\right)^2 + \left(y + \tfrac{5}{2}\right)^2 = 5 \quad B_1$$

$$BO \Rightarrow \sqrt{\left(\tfrac{3}{2}+4\right)^2 + \left(\tfrac{5}{2}-1\right)^2} \; M_1 = \sqrt{32\tfrac{1}{2}} = 5.701 \text{ units} \quad A_1$$

6. The length and breadth of a rectangular paper were measured as 18cm and 12cm to the nearest 1mm; find the percentage error in the area of the paper, correct to 2 significant figures. (4mks)

1mm = 0.1 cm

$\Rightarrow$ error = 0.05

$\therefore$ Max Area $= 18.05 \times 12.05 = 217.5025$ B_1

min Area $= 17.95 \times 11.95 = 214.5025$ B_1

$\Rightarrow$ error $= \frac{3}{2} = 1.5$

Actual $= 18 \times 12 = 216$

$\therefore \frac{1.5}{216} \times 100$ M_1 $= 0.69\%$ A_1

7. A stone is thrown vertically downwards form the top of a cliff at 24 ms^{-1}. Taking acceleration due to gravity as $10ms^{-2}$, find the expression for its velocity. (2mks)

$a = 10 \Rightarrow v = \int 10 \cdot dt$

$\Rightarrow V = 10t + c$ B_1

but at $t = 0$ $v = 24$

$\therefore V = 10t + 24$ A_1

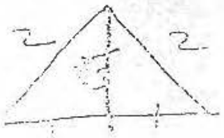
8. Without using tables, evaluate; (3mks)

$$\frac{5\tan^4 45^0 - \cos 60^0}{\sin^2 30^0}$$

$$\Rightarrow \frac{5(1)^4 - \frac{1}{2}}{\left(\frac{1}{2}\right)^2}$$

M_1 numerator all correct

M_1 denominator



$$= \frac{4\frac{1}{2}}{\frac{1}{4}} = 18 \quad A_1$$

$\frac{7}{9}x = 5$

9. The ratio of boys to girls in a class is 5:4. On a certain day, ¼ of the girls were absent while $^1/_5$ of the boys were absent too. If 5 more pupils were absent, $^1/_3$ of the total class would have been absent. How many pupils are there in that class? ~~(3mks)~~ 4mks

Students $= x$

Boy present $\Rightarrow \frac{4}{5}\left(\frac{5}{9}x\right) = \frac{4}{9}x$ B1

Girls present $\Rightarrow \frac{3}{4}\left(\frac{4}{9}x\right) = \frac{1}{3}x$ B1

$\therefore \left(\frac{4}{9}x + \frac{1}{3}x\right) - 5 = \frac{2}{3}x$ M1

$\frac{7}{9}x - \frac{2}{3}x = 5$

$\therefore x = 45$ students

10. Find the acute angle between the lines $4y + 3x = 7$ and $4y - 3x = 7$ (3mks)

$y = \frac{7}{4} - \frac{3}{4}x$

and

$y = \frac{7}{4} + \frac{3}{4}x$

$\therefore \tan^{-1}\left(\frac{3}{4}\right) = 36.87°$ M1 M1

$\times 2$

Hence $73.74°$ A1

to 4 s.f

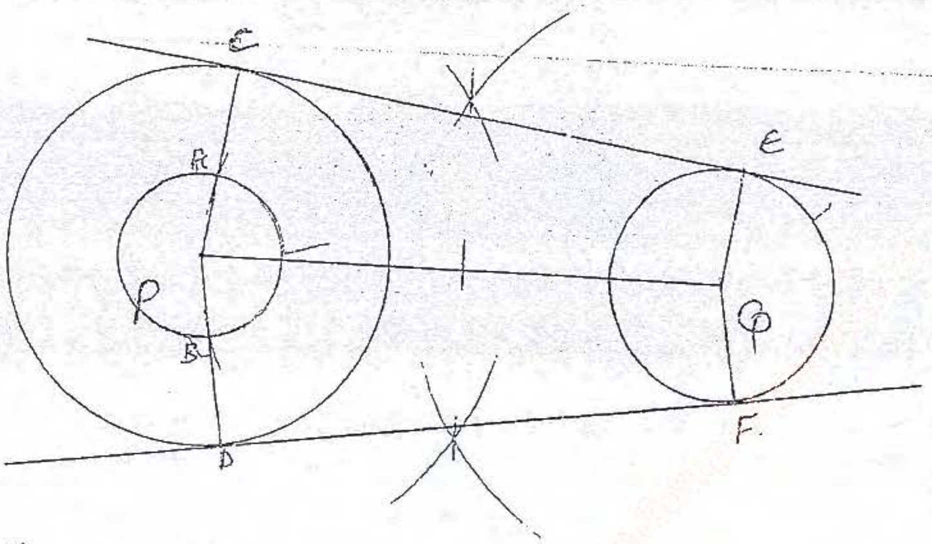
11. If $y = 3x^2 - 2x - 5$, find the coordinates of the point at which the tangent is perpendicular to the line $4y + x - 28 = 0$ (3mks)

$y = 7 - \frac{x}{4} \Rightarrow M_2 = 4$ B1

and $\frac{dy}{dx} = 6x - 2 = 4 \Rightarrow x = 1$ B1

and $y = 3 - 2 - 5 = -4 \quad \therefore (1, -4)$ A1

12. The diagram below shows two circles centres P and Q and radii 2.5cm and 1.5cm respectively. The centres P and Q are 7cm apart.
Construct the direct common tangents to the two circles. ~~(5mks)~~ 4mks



B1 circle radius P

B1 perpendicular bisector of PQ

B1 radii PC, QE

B1 Tangent C

13. Calculate the mean and the mean absolute deviation from the mean of the following set of scores:
1, 3, 4, 6, 6, 7, 9, 12 (3mks)

$\bar{x} \Rightarrow \frac{48}{8} = 6$ ✓ B1

$d = -5 \ -3 \ -2 \ 0 \ 0 \ 1 \ 3 \ 6$

$\frac{\Sigma|d|}{N} = 5+3+2+0+0+1+3+6 = \frac{20}{8}$ ✓ M1 $= 2.5$ ✓ A1

14. Complete the square for the quadratic expression $3x^2 + 6x - 1$ expressing the answer in the form $p(x + q)^2 + r$ where p, q, and r are constants. Hence determine the value of p, q, and r (3mks)

$x^2 + 2x - \frac{1}{3}$ and $x^2 + 2x + (1)^2 - \frac{1}{3}$ ✓ M1

Hence $(x+1)^2 - \frac{1}{3}$ ✓ M1 $\therefore$ $p = 1$

$q = 1$ ✓ A1 all

$r = -\frac{1}{3}$

15. A body starts from rest and after t seconds its velocity in ms^{-1} was recorded as shown below:

Time (secs)	0	1	2	3	4	5	6
Velocity m/s	0	2.9	5.4	7.7	9.7	11.4	12.7

Use the trapezoidal rule to estimate the distance covered by the body between 1 and 6 seconds. (2mks)

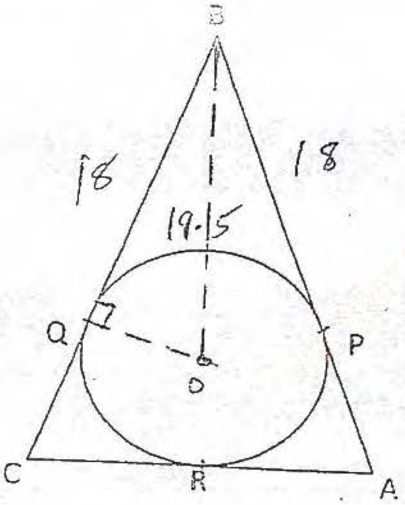
$A = \frac{1}{2} \times 1 \left[(0+12.7) + 2(2.9+5.4+7.7+9.7+11.4)\right]$ M1

$= \frac{1}{2}(12.7 + 74.2) = 43.45$ M1

$\Rightarrow \frac{1}{2} \times 1 \left[(2.9+12.7) + 2(5.4+7.7+9.7+11.4)\right]$

$= 0.5(15.6 + 68.4) = 42$

16. The figure below shows a circle inscribed in an isosceles triangle ABC. If Q, P and R are the points of contact between the triangle and the circle, O is the centre of the circle, BO = 19.5 and BQ = 18cm. find the radius of the circle and hence determine the length of minor arc PQ. (4mks)



$\angle QOP \Rightarrow 2\sin^{-1}\left(\frac{18}{19.5}\right) = 134.76°$ B1
$= 67.38°$

$\therefore$ arc $PQ \Rightarrow \frac{134.76}{360} \times \frac{22}{7} \times 15$ M1
22.62

radius $\Rightarrow \sqrt{19.5^2 - 18^2} = 7.5$ cm B1

$\therefore$ Arc. $PQ = 17.65$ cm A1

Section 2 (50 MKS) Attempt **ONLY FIVE** questions

17. Eighty boxes of matches were selected at random and the number of sticks in each box counted. The table below shows the distribution of the number of sticks per box:

No. of sticks	32-33	34-35	36-37	38-39	40-41	42-43
No. of boxes	1	3	14	27	20	15

Using an Assumed mean of 36.5, determine to 4 significant figures;

a) The mean number of sticks per box (4mks)
b) The standard deviation (4mks)
c) The median (2mks)

x	f	$t = x - A$	ft	t^2	ft^2
32.5	1	-4	-4	16	16
34.5	3	-2	-6	4	12
36.5	14	0	0	0	0
38.5	27	2	54	4	108
40.5	20	4	80	16	320
42.5	15	8	120	64	960
	$\Sigma = 80$ B1		$\Sigma = 244$ B1	M1	$\Sigma = 1416$ B1

(a) $\bar{t} = \frac{244}{80} = 3.05$ B1 and $\bar{x} = A + \bar{t} = 36.5 + 3.05$

M1 $= 39.55$ sticks A1

(b) $S = c\sqrt{\frac{\Sigma ft^2}{\Sigma f} - (\bar{t})^2} = \sqrt{\frac{1416}{80} - (3.05)^2} = 2.898$ A1

(c) median $\Rightarrow$ 40th & 41st [illegible] $37.5 + \left(\frac{40.5 - 18}{27}\right) \times 2 = 39.17$

M1

13.

a) Complete the table below, filling in the blank spaces: (2mks)

X	0^0	30^0	60^0	90^0	120^0	150^0	180^0	210^0	240^0	270^0	300^0	330^0	360^0
Sin (x +30)	0.5	0.87	1.0	0.87	0.5	0	-0.5	-0.87	-1	-0.87	-0.5	0	0.5
2cos x	-2.0	1.73	1.0	0	-1	-1.73	-2.0	-1.73	-1	0	1.0	1.73	2.0

b) Using the scale 1cm to represent 30^0 on the horizontal axis and 1cm to represent 0.5 units on the vertical axis, draw on the grid provided, the graphs of y = sin (x + 30^0) and y = 2cos x on the same axis, for $0^0 \leq x \leq 360^0$. (5mks)

c) Use the graph to solve sin (x + 30^0) – 2cos x = 0 (1mks)

$\Rightarrow x = 60^\circ$ and 240° ✓ B1 (both)

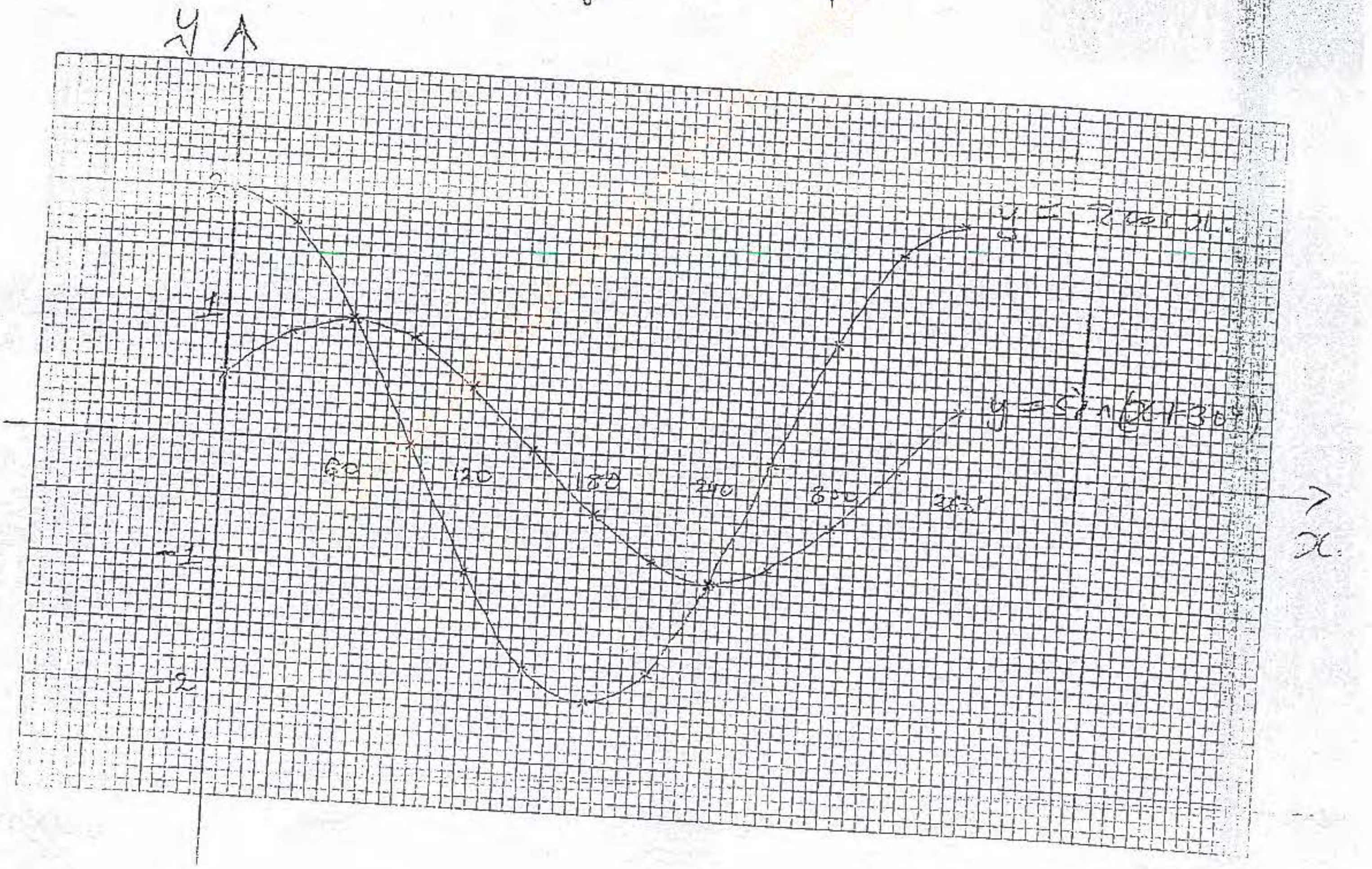
d) State the amplitudes of the functions;

i. y = sin (x + 30) (1mk)

Amp = 1 ✓ B1

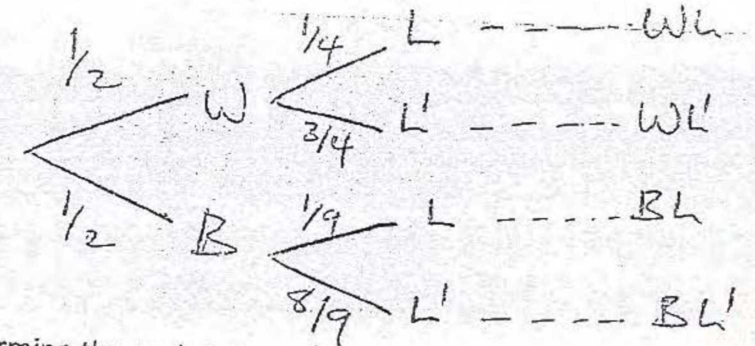
ii. y = 2cos x (1mk)

Amp = 2 ✓ B1



9. Mr Ng'etich commutes to school either by walking or riding on a bodaboda. If he walks, the probability that he will be late is ¼ while if he rides on a bodaboda, the probability that he will be late is $^1/_9$. Suppose he tosses a coin to decide whether to walk or ride on a bodaboda to school.

a) Draw a tree diagram to show the possible outcomes. (2mks)



✓B1 (branches)

✓B1 (probabilities)

b) Determine the probability that he will be late on any given day (3mks)

$\Rightarrow P(W \& L)$ or $(B \& L)$

$= \left(\frac{1}{2} \times \frac{1}{4}\right) + \left(\frac{1}{2} \times \frac{1}{9}\right) = \frac{29}{36}$ ✓A1

✓M1 ✓M1

c) If he walks to school for four successive days, determine the probability that he will be late

i. Every day (2mks)

✓M1 (all)

$\frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} = \frac{1}{256}$ ✓A1

$\left(\frac{1}{4}\right)^4$

ii. On any three days (3mks)

$\left(\frac{1}{4}\right)^3 \times \left(\frac{3}{4}\right) = \frac{3}{64}$ ✓A1

✓M1 ✓M1

20. Given that the matrix $P = \begin{pmatrix} 3 & 7 \\ 5 & 4 \end{pmatrix}$

a) Find P^{-1} the inverse of P

$\det \Rightarrow 12 - 35 = -23$ B1

(2mks)

$$\therefore P^{-1} = \frac{1}{-23}\begin{pmatrix} 4 & -7 \\ -5 & 3 \end{pmatrix} = \begin{pmatrix} -4/23 & 7/23 \\ 5/23 & -3/23 \end{pmatrix}$$ A1

b) In a certain county election campaign Mr. Seneta has to hire helicopters to transport his campaign team to the county and hire Lorries to ferry his supporters to his railies. A helicopter is hired per hour while a lorry is hired per day.
The cost of hiring 6 helicopters and 14 lorries is 1,516,000, while that of hiring 10 such helicopters and 8 lorries is shs. 1,852,000.

i. Form two equations to represent the information above

2Mks ~~(1mk)~~

$$\left.\begin{aligned} 6h + 14L &= 1516000 \\ 10h + 8L &= 1852000 \end{aligned}\right\} \Rightarrow \begin{aligned} 3h + 7L &= 758000 \\ 5h + 4L &= 926000 \end{aligned}$$ B1 B1

ii. Use matrix method to find the cost of hiring a helicopter per hour and that of hiring a lorry per day.

3Mks ~~(4mks)~~

$$\begin{pmatrix} -4/23 & 7/23 \\ 5/23 & -3/23 \end{pmatrix}\begin{pmatrix} 3 & 7 \\ 5 & 4 \end{pmatrix}\begin{pmatrix} h \\ L \end{pmatrix} = \begin{pmatrix} -4/23 & 7/23 \\ 5/23 & -3/23 \end{pmatrix}\begin{pmatrix} 758000 \\ 926000 \end{pmatrix}$$ M1

$$\therefore \begin{pmatrix} h \\ L \end{pmatrix} = \begin{pmatrix} -131826.087 + 281826.087 \\ 164782.6087 + -120782.6087 \end{pmatrix} = \begin{pmatrix} 150000 \\ 44000 \end{pmatrix}$$ B1

$\therefore$ Helicopter = Sh 150000 & Lorry Sh 44000 A1 (Both)

c) On a certain day Mr. Seneta hired 2 such helicopters from 0815h to 1715h and 8 such lorries. If a discount of 3% was allowed on each lorry, calculate the total amount paid by Mr. Seneta

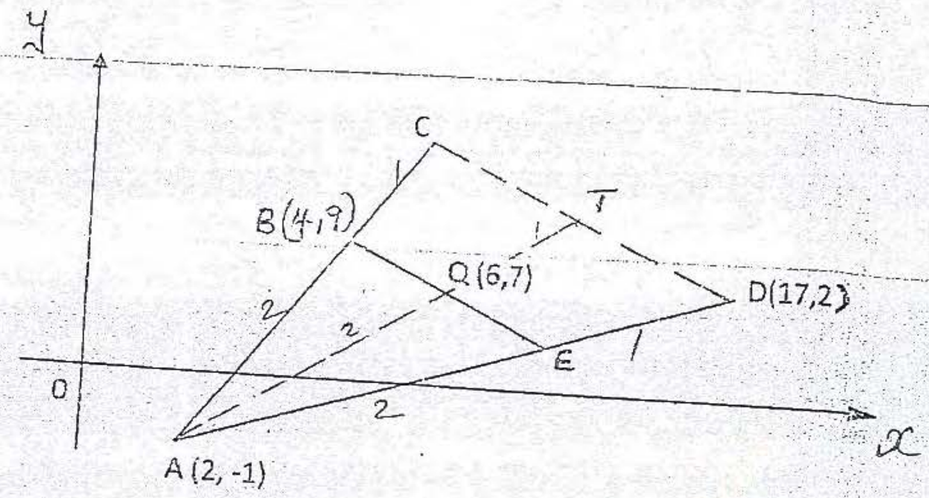
(3mks)

Lorries $\Rightarrow 0.97 \times 44000 \times 8 =$ Sh 341440 B1

Helicopter $\Rightarrow 150000 \times 9 \times 2 =$ Sh 2700000 B1

Shs. 3,041,440 A1

11. In the diagram below the coordinates of points A, B, D and Q are A(2, -1), B(4, 9), D(17, 2) and Q(6, 7). Point C is on AB such that 3AB = 2AC. Point E is on AD such that 3AE = 2AD. Point T is on AQ produced such that AQ:QT = 2:1



Find;

a) Coordinates of C

(2mks)

$AC = \frac{3}{2} AB \Rightarrow \frac{3}{2}\begin{pmatrix} 2 \\ 10 \end{pmatrix} = \begin{pmatrix} 3 \\ 15 \end{pmatrix}$ B1

$\Rightarrow C = \begin{pmatrix} 3 \\ 15 \end{pmatrix} + \begin{pmatrix} 2 \\ -1 \end{pmatrix} = \begin{pmatrix} 5 \\ 14 \end{pmatrix} \therefore C(5, 14)$ 1

b) Coordinates of E

(2mks)

$AE = \frac{2}{3} AD \Rightarrow \frac{2}{3}\begin{pmatrix} 15 \\ 3 \end{pmatrix} = \begin{pmatrix} 10 \\ 2 \end{pmatrix}$ B1

$\Rightarrow E = \begin{pmatrix} 10 \\ 2 \end{pmatrix} + \begin{pmatrix} 2 \\ -1 \end{pmatrix} = \begin{pmatrix} 12 \\ 1 \end{pmatrix} \therefore E(12, 1)$ A1

c) Coordinates of T

(2mks)

$AQ = 2QT$ and $AQ = \begin{pmatrix} 4 \\ 8 \end{pmatrix}$

$\Rightarrow QT = \frac{1}{2}\begin{pmatrix} 4 \\ 8 \end{pmatrix} = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$ B1 $\Rightarrow T = \begin{pmatrix} 2 \\ 4 \end{pmatrix} + \begin{pmatrix} 6 \\ 7 \end{pmatrix}$

$\therefore T(8, 11)$ A1

d) Show that C, T, and D are collinear

(3mks)

lines CT and TD have common point T B1

$$\left.\begin{array}{l} CT = \begin{pmatrix} 8 \\ 11 \end{pmatrix} - \begin{pmatrix} 5 \\ 14 \end{pmatrix} = \begin{pmatrix} 3 \\ -3 \end{pmatrix} \\ TD = \begin{pmatrix} 17 \\ 2 \end{pmatrix} - \begin{pmatrix} 8 \\ 11 \end{pmatrix} = \begin{pmatrix} 9 \\ -9 \end{pmatrix} \end{array}\right\} \Rightarrow \frac{CT}{TD} = \frac{3}{9} = \frac{1}{3}$$

B1

Hence $CT = \frac{1}{3}TD$ $\therefore CT \parallel TD$ B1

e) Determine the ratio BQ:QE

(1mk)

$BQ \Rightarrow \begin{pmatrix} 6 \\ 7 \end{pmatrix} - \begin{pmatrix} 4 \\ 9 \end{pmatrix} = \begin{pmatrix} 2 \\ -2 \end{pmatrix}$

$QE \Rightarrow \begin{pmatrix} 12 \\ 1 \end{pmatrix} - \begin{pmatrix} 6 \\ 7 \end{pmatrix} = \begin{pmatrix} 6 \\ -6 \end{pmatrix}$

$\therefore \frac{BQ}{QE} = \frac{2}{6} = \frac{1}{3}$ B1

22.

a) A series is given as;

$S_n = -3 + 3 + 9 + 15 + \dots\dots\dots\dots + 165$ where S_n denotes the sum of the First n terms. Find the value of n and Sn. (4mks)

$d = 6 \Rightarrow -3 + (n-1)6 = 165$ ✓M1

$\Rightarrow 6n - 6 = 168 \quad \therefore n = 29$ ✓A1

and $S_{29} = \frac{29}{2}[2(-3) + 28(6)] = \frac{29}{2}(-6 + 168)$ ✓M1

Also: $S_n = \frac{n}{2}(a + l) = 2349$ $\quad = 2349$ ✓A1

b) Given that a, 15, 9a are in geometric progression, find a. (2mks)

$\frac{15}{a} = \frac{9a}{15} \Rightarrow 225 = 9a^2$ ✓M1

$\Rightarrow a^2 = \frac{225}{9} \quad \therefore a = \pm 5$ ✓A1

c) A businessman deposits Ksh. 20,000 at the beginning of every year in a bank which pays interest at 12% p.a. How much money does he have in the bank at the end of 10 years? (4mks)

$T_n = a\,1.12^{n-1} + a\,1.12^{n-2} + a\,1.12^{n-3} + \dots + a\,1.12^0$

$\therefore S_n = \frac{a(1 - r^n)}{1 - r}$ where $n = 11$ $\quad r = \frac{1}{1.12}$ ✓B1 (ratio)

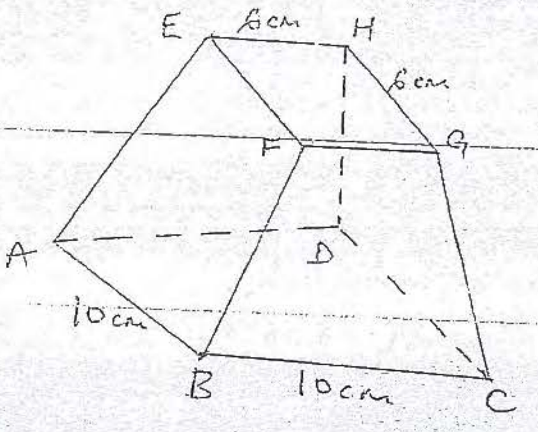
Hence: and $a = 20000$

$S_{11} = 20000\,(1.12^{10})\left(\frac{1 - \left(\frac{1}{1.12}\right)^{11}}{1 - \frac{1}{1.12}}\right)$ ✓M1 $= 413091.85$ ✓A1

$- 20000$

398091.85 ✓A1

23. The figure below represents a solid frustum. The faces ABCD and EFGH are parallel squares of sides 10cm and 6cm respectively. Each of the slanting edges AE, BF, CG, and DH are 4cm in length.



Determine to 3 significant figures;

a) Length of the projection of AE on the plane ABCD (2mks)

$$\left.\begin{array}{l} AC = 14.14 \\ EG = 8.49 \end{array}\right\} \Rightarrow \frac{14.14 - 8.49}{2} \checkmark M1 = 2.83 \text{ cm } \checkmark A1$$

b) The angle between line AE and plane ABCD (2mks)

$$\Rightarrow \sin^{-1}\left(\frac{2.83}{4}\right) \checkmark M1 = 45.0° \checkmark A1$$

Allow 44.9°

c) The angle between planes BCGF and ABCD (4mks)

$$\text{height} \Rightarrow \sqrt{4^2 - 2.83^2} = 2.83 \checkmark B1 \text{ cm.}$$

2.83, 2cm

$$\text{and } \frac{10-6}{2} = 2\text{cm} \checkmark B1 \therefore \tan^{-1}\left(\frac{2.83}{2}\right) \checkmark M1$$

$$= 54.8° \checkmark A1$$

d) The total surface area of the frustum (2mks)

$$\text{Trapezium height} \Rightarrow \sqrt{2.83^2 + 2^2} = 3.47 \text{ cm} \checkmark B1$$

$$\therefore \left(\frac{1}{2} \times 3.47 \times 16\right) \times 4 + 100 + 36 = 246.94$$

$$\therefore 247 \text{ cm}^2 \checkmark A1$$

24. Use a ruler and pair of compasses only for all constructions in this question.

a) Draw a line segment AB = 6cm and bisect it

b) On the perpendicular and on one side of AB locate a point C such that angle ABC = 37.5° (1mk)

c) A point P moves such that angle APB = 52.5°. On the same diagram and on the same side of AB as C construct the locus of P. (4mks)

(1mk)

d) On the locus of P locate a point Q such that the area of triangle AQB is maximum (1mk)

e) Find the area of this triangle AQB

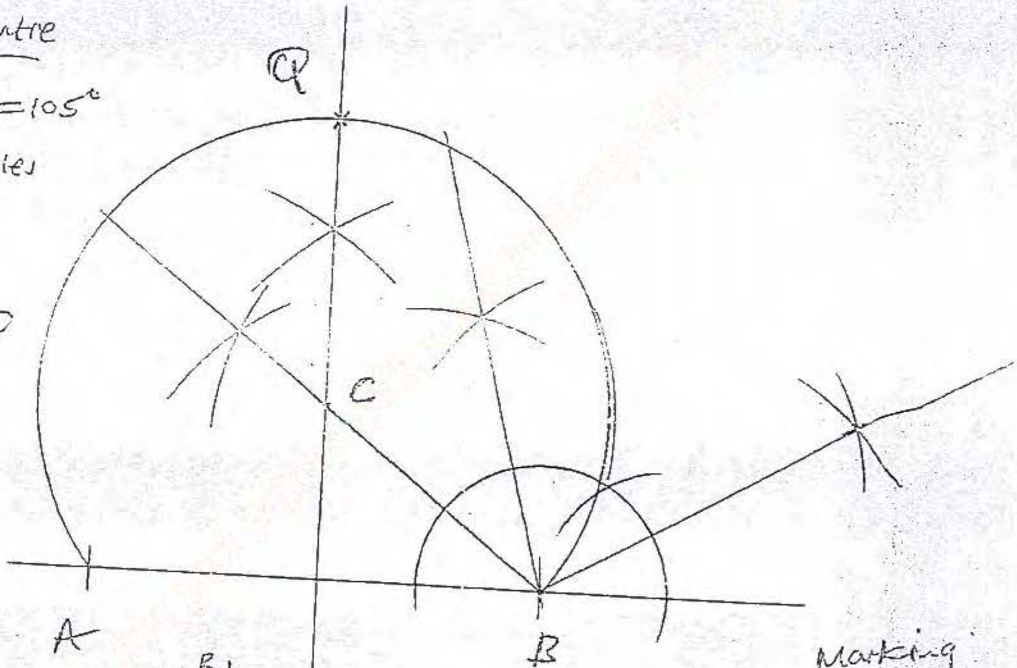
(3mks)

Angle at centre

$\Rightarrow 52.5 \times 2 = 105°$

$\therefore$ Base Angles

$= 37.5°$



(e) height = 6 cm $\pm$ 0.1 B1

$\therefore$ Area

$= \frac{1}{2} \times 6 \times 6$ M1

$= 18\ cm^2$ A1

Marking

B1 line AB & bisector

B1 150°

B1 75°

B1 37.5°

B1 locating C

B1 locus P

B1 locus Q

* Allow any other suitable method.