5.0 MATHEMATICS (121)

This Mathematics report is based on an analysis of performance of candidates who sat the year 2009 KCSE Mathematics examinations. Candidates' abilities were tested in two papers. **Paper 1 (121/1)** and **paper 2 (121/2)**. The papers are equally weighted with each having two sections; Section 1 (50 marks) short answer questions of not more than four marks each and Section II (50 marks), a choice of eight questions of 10 marks each where candidates answer any five.

Paper 1 (121/1) tests mainly Forms 1 and 2 work while Paper 2 (121/2) tests mainly forms 3 and 4 work.

It is hoped that this report will be helpful to teachers in the teaching/learning process as well as in preparing candidates for future examinations.

5.1 CANDIDATES' GENERAL PERFORMANCE

The table below shows the overall performance for both papers in the last four years.

Table 10: Candidates' Overall Performance in Mathematics for the last four years

Year	Paper	Candidature	Maximum Score	Mean Score	Standard Deviation
2006	1	**238684**	100	22.71	20.09
	2		100	15.36	15.97
	Overall		**200**	**38.08**	**35.00**
2007	1	**273504**	100	19.55	19.09
	2		100	19.91	20.74
	Overall		**200**	**39.46**	**39.83**
2008	1	**304908**	100	22.76	22.76
	2		100	19.82	19.56
	Overall		**200**	**42.59**	**41.53**
2009	1	**335615**	100	22.37	19.71
	2		100	19.89	18.78
	Overall		**200**	**42.26**	**37.65**

From the table the following observations can be made:

5.1.1 The overall performance in Mathematics has slightly declined from a mean of 42.59 in year 2008 to 42.26 in year 2009.

5.1.2 There is a slight improvement in the performance of Paper 2 (121/2) from a mean of 19.82 in year 2008 to a mean of 19.89 in year 2009. However, there is decline in Paper 1 (121/1) from a mean of 22.76 in year 2008 to a mean of 22.37 in year 2009.

5.1.3 There has been a significant increase in the candidature over the years.

5.2 INDIVIDUAL QUESTION ANALYSIS

Questions in which candidates' performance was poor have been identified and are analysed in the following discussion.

5.2.1 Paper 1 (121/1)

Question 3

Given that the ratio $x : y = 2 : 3$, find the ratio $(5x - 2y) : (x + y)$

The question tested on candidates' knowledge of ratios given one ratio then find another.

Weaknesses
Candidates did not seem to understand the meaning of ratios. They used x:y = 2:3 to mean x=2 and y=3, which is a misconception.

Expected Response

$$x : y = 2 : 3 \Rightarrow \frac{x}{y} = \frac{2k}{3k}$$

(where k is a constant)

$x = 2k$, $y = 3k$
Thus $(5x - 2y) : (x + y)$
$= (5 \times 2k - 2 \times 3k) : (2k + 3k)$
$(10 - 6)k : 5k$
$4k : 5k$
$\Rightarrow 4 : 5$

Advice to Teachers
Teachers are expected to be thorough when teaching ratios and ratio proportions. Give more general examples to erase the misconceptions that if x:y = 2:3 then x=2 and y=3.

Question 4
A bus travelling at an average speed of 63 km/h left a station at 8.15 a.m.
A car later left the same station at 9.00 a.m. and caught up with the bus at 10.45 a.m. Find the average speed of the car.

This question tested on relative motion between two vehicles moving in the same direction.

Weaknesses
Candidates had difficulty interpreting the relative speed.

Expected Response
Distance covered by bus
$= 63 \times (10.45 - 8.15)$
$= 63 \times 2.5$
$= 157.5$
Speed of car
$= \frac{157.5}{1.75}$
$= 90$ km/h

Advice to Teachers
Take more time teaching this topic and explore different scenarios e.g. relative motion of bodies moving in the same direction and relative motion of bodies moving in opposite directions.

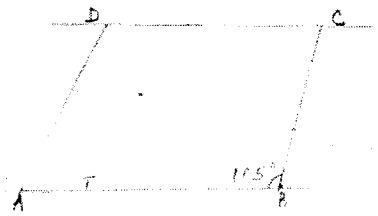
Question 11
Line AB shown below is a side of a trapezium ABCD in which angle ABC = 105°, BC = 4 cm, CD = 5 cm and CD is parallel to AB.

Using a ruler and a paid of compasses only:
(a) complete the trapezium
(b) locate point T on line AB such that angle ATD = 90°.

This question tested on basic construction of angle 105, dropping a perpendicular from a point to a line and construction of parallel lines.

Weaknesses
Candidates used protractor and set square, contrary to instructions.

Expected response



(a) Construction of 105°
Fixing point C and construction of line parallel to AB through C
Completion of trapezium ABCD

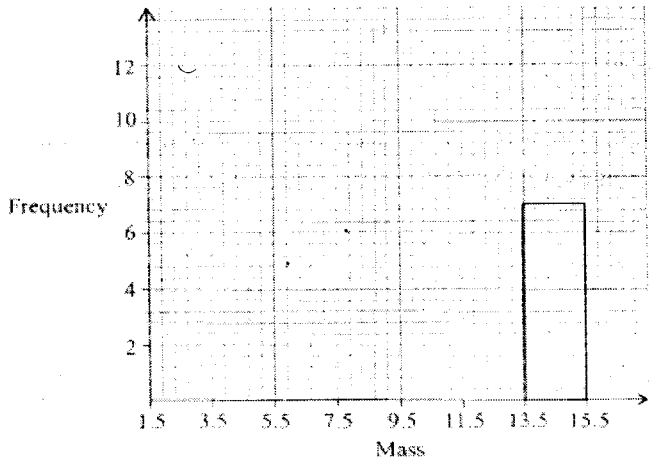
(b) Location of point T

Advice to Teachers
Advise students to do more practice on construction using a ruler and pair of compasses only.

Question 16
The following data was obtained for the masses of certain animals.

Mass (x kg)	Frequency
$1.5 \leq x < 5.5$	16
$5.5 \leq x < 7.5$	20
$7.5 \leq x < 13.5$	18
$13.5 \leq x < 15.5$	14

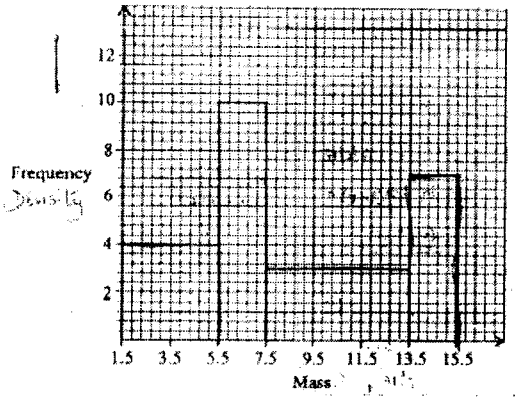
Complete the histogram on the grid provided below.



The question required construction of Histogram using frequency density.

Weaknesses
Most candidates seemed not to understand the concept of frequency density.

Expected Response



1.5 – 5.5 bar
5.5 – 7.5 bar
7.5 – 13.5 bar

Advice to Teachers
Teach the topic on drawing of histograms when the classes are of unequal width i.e. by use of frequency density.

Question 19

A school planned to buy x calculators for a total of Ksh 16 200. The supplier agreed to offer a discount of Ksh 60 per calculator. The school was then able to get three extra calculators for the same amount of money.

(a) Write an expression in terms of x, for the:
  (i) original price of each calculator;
  (ii) price of each calculator after the discount.

(b) Form an equation in x and hence determine the number of calculators the school bought.

(c) Calculate the discount offered to the school as a percentage.

The question tested skill on formation of quadratic equations and solving them given a word problem.

Weaknesses
Most candidates interpreted the question wrongly and hence forming the equation was difficult.

Expected Response

(a) (i) Original Price $= \frac{16200}{x}$

(ii) Price after discount $= \frac{16200}{x+3}$

(b) (i) $\frac{16200}{x} - 60 = \frac{16200}{x+3}$

$\Rightarrow \frac{16200 - 60x}{x} = \frac{16200}{x+3}$

$$\Rightarrow (16200-60x)(x+3)=16200x$$

$$16200x+16200\times 3-60x^2-180x=16200x$$

$$60x^2+180x-48600=0$$

$$x^2+3x-810=0$$

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

$$x=-30 \text{ or } x=27$$

No. of calculators bought = 30

(c) Initial cost of calculators

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

Discount offered as a percentage

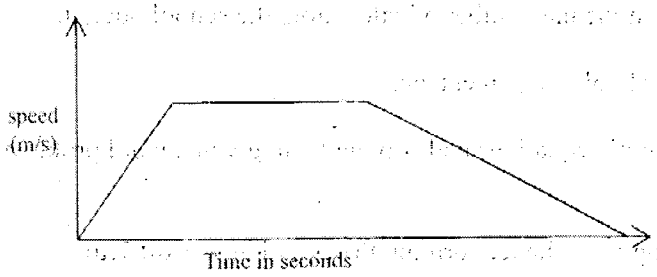
$$\frac{\frac{16200}{27}-\frac{16200}{30}}{600}\times 100=10\%$$

Advice to Teachers

Wide exposure of candidates to many problems of this nature will help the candidates to grasp the concept quite well.

Question 22

The diagram below shows the speed-time graph for a train travelling between two stations. The train starts from rest and accelerates uniformly for 150 seconds. It then travels at a constant speed for 300 seconds and finally decelerates uniformly for 200 seconds.



Given that the distance between the two stations is 104500m calculate:

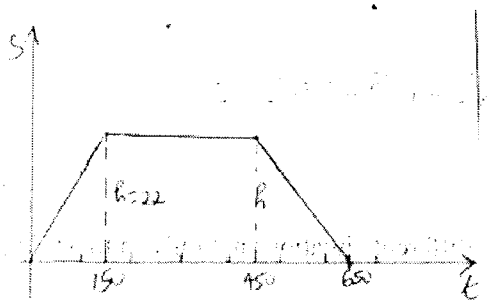
(a) maximum speed, in km/h the train attained;
(b) acceleration;
(c) distance the train travelled during the last 100 seconds;
(d) time the train takes to travel the first half of the journey.

This question tested on linear motion. Candidates were required to calculate speed, acceleration, distance and time.

Weaknesses

Most candidates could not interpret the question correctly, thus found it difficult to answer well.

Expected Response



(a) $\frac{1}{2}\times 150h+\frac{1}{2}\times 200h+300h$

10450

$475h=10450$

$h=22m/s$

Max. speed $=\frac{22\times 60\times 60}{1000}$

79.2km/h

(b) Acceleration $=\frac{22m/s}{150s}$

$\frac{11}{75}m/s^2$ or $0.1467m/s^2$

(c) $\frac{1}{2}\times 100\times 11$

550

(d) Time for half of journey

$\frac{1}{2}\times 22(150+t+t)=\frac{1}{2}\times 10450$

$t=162.5$

Total time $=150+162.5$

312.5

Advice to Teachers

Analysis of graphs in linear motion is quite important for deeper understanding of the concept.

5.2.2 PAPER 2 (121/2)

Question 2

Find a quadratic equation whose roots are $1.5+\sqrt{2}$ and $1.5-\sqrt{2}$, expressing it is the form $ax^2+bx+c=0$, where a, b and c are integers.

This question tested on formation of quadratic equations given roots. The roots were in the form of surds.

Weaknesses

Types of roots seem not familiar to the candidates.

Expected Response

$$(x-1.5-\sqrt{2})(x-1.5+\sqrt{2})=0$$

$$x^2-1.5x+x\sqrt{2}-1.5x+2.25-1.5\sqrt{2}-x\sqrt{2}+1.5\sqrt{2}-2=0$$

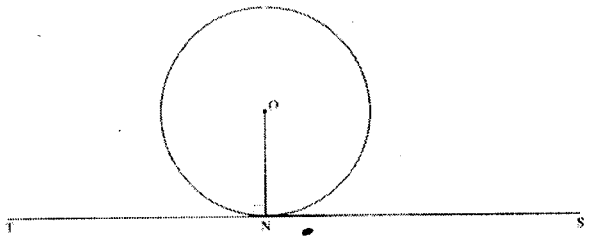
$$4x^2-12x+1=0$$

Advice to Teachers

Emphasis on teaching of surds and use them in different situations not only in their simplification.

Question 4

In the figure below, O is the centre of the circle and radius ON is perpendicular to the line TS at N.



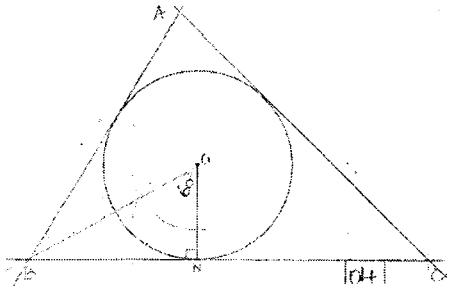
Using a ruler and a pair of compasses only, construct a triangle ABC to inscribe the circle, given that angle ABC = 60°, BC = 12 cm and points B and C are on the line TS.

This question tested on construction of a triangle to inscribe the circle.

Weaknesses

Candidates failed to get the properties of the angles in an inscribed circle. Thus were unable to construct the triangle.

Expected Responses



Advice to Teachers

Teach the properties of angles, in an inscribed circle.

Question 7

In a certain commercial bank, customers may withdraw cash through one of the two tellers at the counter. On overage, one teller takes 3 minutes while the other teller takes 5 minutes to serve a customer. If the two tellers start to serve the customers at the same time, find the shortest time it takes to serve 200 customers.

This question tested on application of LCM to real life situations.

Weaknesses

Candidates failed to understand that it was LCM being tested.

Expected Response

The LCM of 3 and 5 = 15

In 15 minutes, 8 customers will be served

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

$$= 375 \text{ min.}$$

Advice to Teachers
When teaching LCM and GCD relate them to application in real life situations.

Question 13
Point P(40°S, 45°E) and point Q(40°S and 60°W) are on the surface of the Earth.
Calculate the shortest distance along a circle of latitude between the two points.

This question tested on distance along the Earth's surface. Candidates were expected to calculate the shortest distance along a circle of latitude between two points.

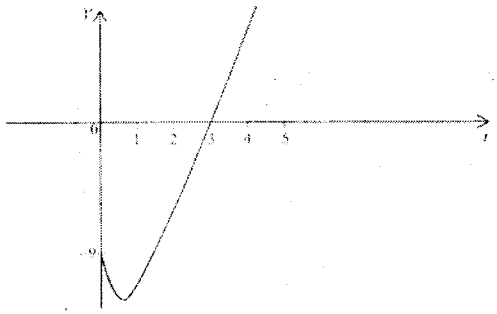
Weaknesses
Most candidates did not know the concept. Hence could not answer correctly.

Expected Response
Longitude difference $45^0 + 60^0 = 105^0$
Distance in km
$$\frac{105}{360} \times 2 \times 3.142 \times 6370 \cos 40^0$$
8943.7 km

Advice to Teachers
Teach the topic thoroughly.

Question 16
A particle moves in a straight line with a velocity V ms^{-1}. Its velocity after t seconds is given by $V = 3t^2 - 6t - 9$.

The figure below is a sketch of the velocity-time graph of the particle.



Calculate the distance the particle moves between $t = 1$ and $t = 4$.

This question tested on determination of distance using integration.

Weaknesses
Most candidates did not separate the regions below and region above the horizontal axis.

Expected Response
$$\int (3t^2 - 6t - 9)dt = t^3 - 3t^2 - 9t + c$$
$$\left[t^3 - 3t^2 - 9t\right]_1^3 = \left[3^3 - 3(3^3) - 9(3)\right] - \left[1^3 - 3(1)^2 - 9(1)\right]$$
$$= -16$$
$$\left[t^3 - 3t^2 - 9t\right]_3^4 = \left[4^3 - 3(4)^2 - 9(4)\right] - \left[3^3 - 3(3^2) - 9(3)\right]$$
$$= 7$$
Distance travelled $= 16 + 7$
$23\ m$

Question 19
The table below shows the number of goals scored in handball matches during a tournament.

Number of goals	0-9	10-19	20-29	30-39	40-49
Number of matches	2	14	24	12	8

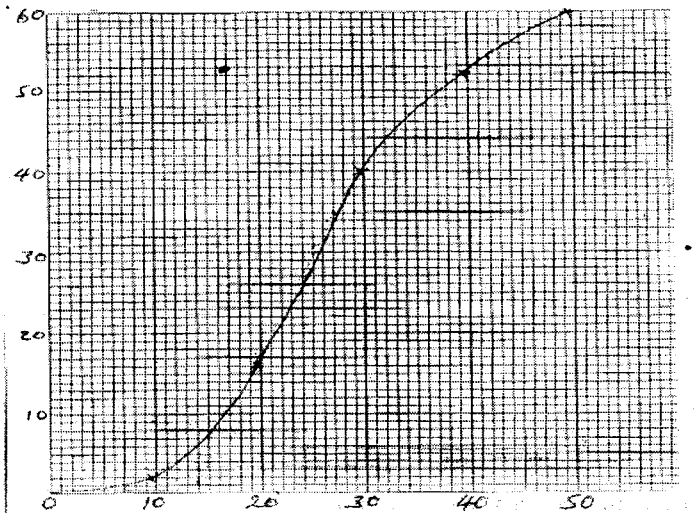
(a) Draw a cumulative frequency curve on the grid provided.

(b) Using the curve drawn in (a) above determine:
(i) the median
(ii) the number of matches in which goals scored were not more than 37.
(iii) the inter-quartile range.

The question tested on drawing an ogive. Candidates were expected to determine the class boundaries then plot the ogive on the grid and use it to answer questions that followed.

Weaknesses
Candidates did not determine the lower limit of the first class. Candidates had difficulty in inter quartile range.

Expected Response



Scale
Plotting
Smooth curve

(b)(i) Median goals 25.5 ± 0.5

(ii) number of matches in which scores were between 0 & 37 49

(iii) $Q_1 = 19 \pm 0.5$
$Q_3 = 33 \pm 0.5$

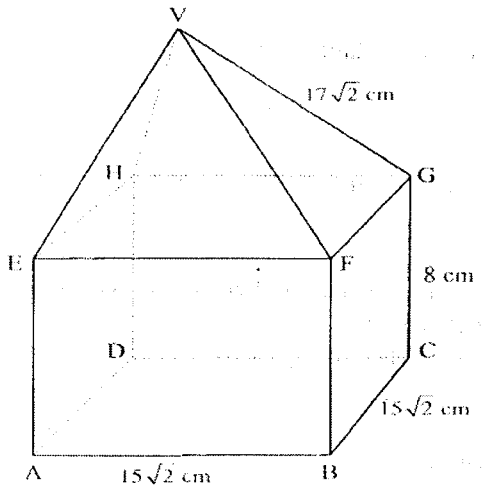
Inter quartile range 33-19 14

Advice to Teachers

Explain the starting point when the first class starts with zero. Teach thoroughly on ogive and interpretation of interquartile range using the ogive.

Question 22

The figure below shows a right pyramid mounted onto a cuboid. AB = BC = $15\sqrt{2}$ cm, CG = 8 cm and VG = $17\sqrt{2}$ cm.



Calculate:

(a) the length of AC;

(b) the angle between the line AG and the plane ABCD;

(c) the vertical height of point V from the plane ABCD;

(d) the angle between the planes EFV and ABCD.

This was a question in 3-Dimension Geometry. It required candidates to use knowledge of Pythagoras theorem and trigonometry to solve the problem.

Weaknesses

Identifying the required angle was a problem.

Expected Responses

(a) $AC = \sqrt{(15\sqrt{2})^2 + (15\sqrt{2})^2} = 30cm$

(b) Identification of θ

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

$\theta = 14.93^0$

(c) Pyramid height $\sqrt{(17\sqrt{2})^3 - 15^2}$

$= 18.79cm$

$VO = 18.79 + 8$

$= 26.79cm$

(d) Identification of α

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

$\alpha = 60.55^0$

Advice to Teachers
Use models to demonstrate angles between planes.

Question 24
Amina carried out an experiment to determine the average volume of a ball bearing. She started by submerging three ball bearings in water contained in a measuring cylinder. She then added one ball at a time into the cylinder until the balls were nine.

The corresponding readings were recorded as shown in the table below:

Number of ball bearings	3	4	5	6	7	8	9
Measuring cylinder reading (F)	98.0	105.0	123.0	130.5	145.6	156.9	170.0

(a) (i) On the grid provided, plot (x, y) where x is the number of ball bearings and y is the corresponding measuring cylinder reading.
(ii) Use the plotted points to draw the line of best fit.

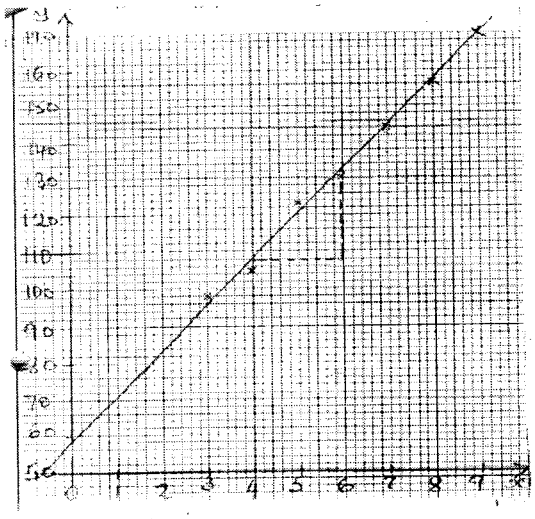
(b) Use the line of best fit to determine:
(i) the average volume of a ball bearing;
(ii) the equation of the line.

(c) Using the equation of the line in b(ii) above, determine the volume of the water in the cylinder.

The question tested on drawing line of best fit.

Weaknesses
Poor choice of scale, candidates used points from table to locate line.

Expected Response



(a) (i) Scale
Plotting

(ii) Line of best fit

(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 volume of y when x = 0

$y = 12.5 \times 0 + 58$

$= 58$

Advice to Teachers

Emphasize on qualities of the line of best fit.

5.3 GENERAL COMMENTS

5.3.1 Teachers are advised to cover the syllabus early enough and have time for comprehensive revision with the students.

5.3.2 Candidates should read and adhere to the instructions given in the examination e.g. if told to use ruler and pair of compasses only do not use a protractor or set square.

5.3.3 Emphasis on application of the concept learnt in class to real life situations should be done.

5.3.4 Teachers should encourage candidates to attempt only the required questions, they should avoid leaving blanks especially in section I.