KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education
MATHEMATICS
Paper 2
$2^1/2$ hours

SECTION I (50 marks)

*Answer **all** the questions in this section.*

1 Using logarithm tables, evaluate $\left(\frac{0.032 \times 14.26}{0.006}\right)^{\frac{2}{3}}$. (3 marks)

2 Given that $y = \frac{2x - z}{x + 3z}$, express x in terms of y and z. (3 marks)

3 Solve the equation $3 \cos x = 2 \sin^2 x$, where $0° \leq x \leq 360°$. (4 marks)

4 (a) Expand the expression $\left(1 + \frac{1}{2}x\right)^5$ in ascending powers of x, leaving the coefficients as fractions in their simplest form. (2 marks)

(b) Use the first three terms of the expansion in (a) above to estimate the value of $\left(1\frac{1}{20}\right)^5$. (2 marks)

5 A particle moves in a straight line through a point P. Its velocity v m/s is given by $v = 2 - t$, where t is time in seconds, after passing P. The distance s of the particle from P when $t = 2$ is 5 metres.

Find the expression for s in terms of t. (3 marks)

6 The cash price of a T.V. set is Ksh 13 800. A customer opts to buy the set on Hire Purchase terms by paying a deposit of Ksh 2 280.

If Simple Interest of 20% p.a. is charged on the balance and the customer is required to repay by 24 equal monthly instalments, calculate the amount of each instalment. (3 marks)

7 Find the equation of a straight line which is equidistant from the points (2,3) and (6,1), expressing it in the form $ax + by = c$ where a, b and c are constants. (4 marks)

8 A rectangular block has a square base whose side is exactly 8 cm. Its height, measured to the nearest millimetre, is 3.1 cm.

Find in cubic centimetres, the greatest possible error in calculating its volume. (2 marks)

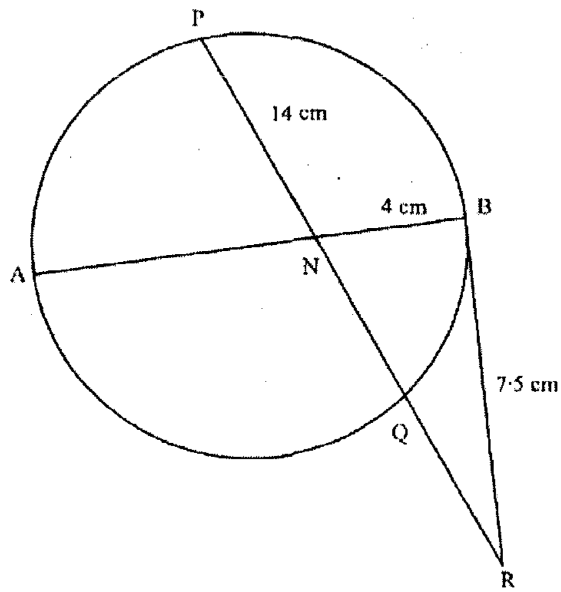
9 Water and milk are mixed such that the ratio of the volume of water to that of milk is 4:1.

Taking the density of water as 1 g/cm^3 and that of milk as 1.2 g/cm^3, find the mass, in grams of 2.5 litres of the mixture. (3 marks)

10 A carpenter wishes to make a ladder with 15 cross-pieces. The cross-pieces are to diminish uniformly in lengths from 67 cm at the bottom to 32 cm at the top.

Calculate the length, in cm, of the seventh cross-piece from the bottom. (3 marks)

11 In the figure below AB is a diameter of the circle. Chord PQ intersects AB at N. A tangent to the circle at B meets PQ produced at R.



Given that PN = 14 cm, NB = 4 cm and BR = 7.5 cm, calculate the length of:

(a) NR (1 mark)

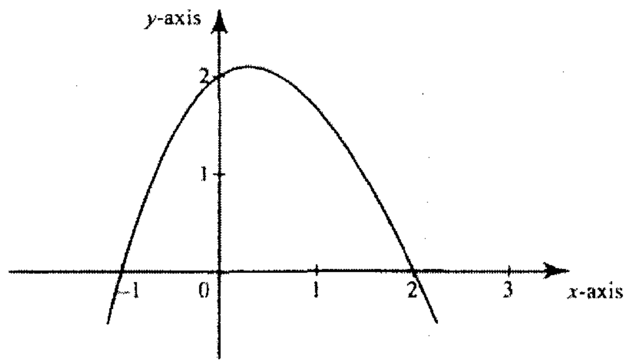
(b) AN. (3 marks)

12 Vector **q** has a magnitude of 7 and is parallel to vector **p**. Given that **p** = 3 **i** – **j** + 1 ½ **k**, express vector **q** in terms of **i**, **j** and **k**. (2 marks)

13 Two places A and B are on the same circle of latitude north of the equator. The longitude of A is 118°W and the longitude of B is 133°E. The shorter distance between A and B measured along the circle of latitude is 5422 nautical miles.

Find, to the nearest degree, the latitude on which A and B lie. (3 marks)

14 The figure below is a sketch of the graph of the quadratic function $y = k(x + 1)(x - 2)$.



Find the value of k. (2 marks)

15 Simplify $\frac{3}{\sqrt{5}-2} + \frac{1}{\sqrt{5}}$ leaving the answer in the form $a + b\sqrt{c}$, where a, b and c are rational numbers.

(3 marks)

16 Find the radius and the coordinates of the centre of the circle whose equation is $2x^2 + 2y^2 - 3x + 2y + \frac{1}{2} = 0$. (4 marks)

SECTION II (50 marks)

*Answer **any five** questions in this section.*

17 A tank has two inlet taps P and Q and an outlet tap R. When empty, the tank can be filled by tap P alone in 4½ hours or by tap Q alone in 3 hours. When full, the tank can be emptied in 2 hours by tap R.

(a) The tank is initially empty. Find how long it would take to fill up the tank:

(i) if tap R is closed and taps P and Q are opened at the same time (2 marks)

(ii) if all the three taps are opened at the same time. (2 marks)

(b) The tank is initially empty and the three taps are opened as follows:

P at 8.00 a.m.
Q at 8.45 a.m.
R at 9.00 a.m.

(i) Find the fraction of the tank that would be filled by 9.00 a.m. (3 marks)

(ii) Find the time the tank would be fully filled up. (3 marks)

18 Given that y is inversely proportional to x^n and k as the constant of proportionality;

(a) (i) Write down a formula connecting y, x, n and k. (1 mark)

(ii) If $x = 2$ when $y = 12$ and $x = 4$ when $y = 3$, write down two expressions for k in terms of n.

Hence, find the value of n and k. (7 marks)

(b) Using the value of n obtained in (a) (ii) above, find y when $x = 5\frac{1}{3}$. (2 marks)

19 (a) Given that $y = 8 \sin 2x - 6 \cos x$, complete the table below for the missing values of y, correct to 1 decimal place. (2 marks)

x	0°	15°	30°	45°	60°	75°	90°	105°	120°
$y = 8 \sin 2x - 6 \cos x$	−6	−1.8		3.8	3.9	2.4	0		−3.9

(b) On the grid provided below, draw the graph of $y = 8 \sin 2x - 6 \cos x$ for $0° \leq x \leq 120°$.

Take the scale: 2 cm for 15° on the x-axis
2 cm for 2 units on the y-axis. (4 marks)

(c) Use the graph to estimate:

(i) the maximum value of y, (1 mark)

(ii) the value of x for which $4 \sin 2x - 3\cos x = 1$. (3 marks)

20 The gradient function of a curve is given by the expression $2x + 1$. If the curve passes through the point $(-4, 6)$;

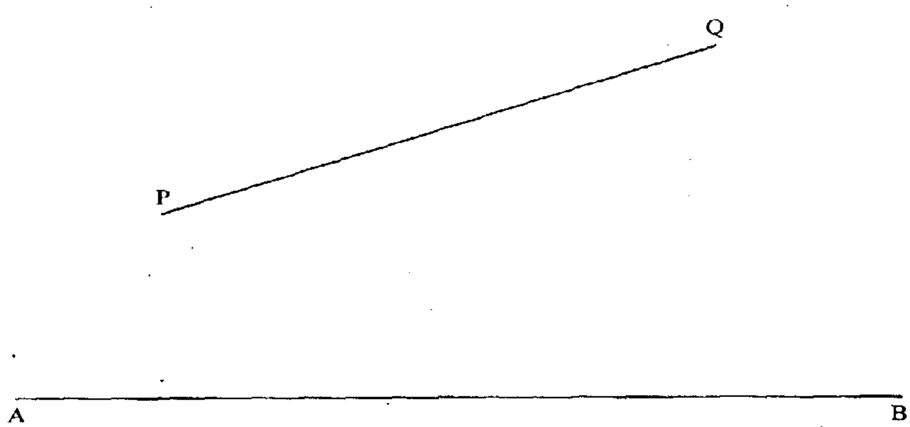
(a) Find:

(i) the equation of the curve, (3 marks)

(ii) the values of x at which the curve cuts the x-axis. (3 marks)

(b) Determine the area enclosed by the curve and the x-axis. (4 marks)

21 *In this question use a ruler and a pair of compasses only.*
In the figure below, AB and PQ are straight lines.



(a) Use the figure to:

(i) find a point R on AB such that R is equidistant from P and Q (1 mark)

(ii) complete a polygon PQRST with AB as its line of symmetry and hence measure the distance of R from TS. (5 marks)

(b) Shade the region within the polygon in which a variable point X must lie given that X satisfies the following conditions:

I: X is nearer to PT than to PQ

II: RX is not more than 4.5 cm

III: $\angle PXT > 90°$ (4 marks)

22 A company is considering installing two types of machines, A and B. The information about each type of machine is given in the table below.

Machine type	Number of operators	Floor space	Daily profit
A	2	$5m^2$	Ksh 1 500
B	5	$8m^2$	Ksh 2 500

The company decided to install x machines of type A and y machines of type B.

(a) Write down the inequalities that express the following conditions:

I: the number of operators available is 40

II: the floor space available is $80m^2$

III: the company is to install not less than 3 of type A machines

IV: the number of type B machines must be more than one third the number of type A machines. (4 marks)

(b) On the grid provided, draw the inequalities in part (a) above and shade the unwanted region. (4 marks)

(c) Draw a search line and use it to determine the number of machines of each type that should be installed to maximize the daily profit. (2 marks)

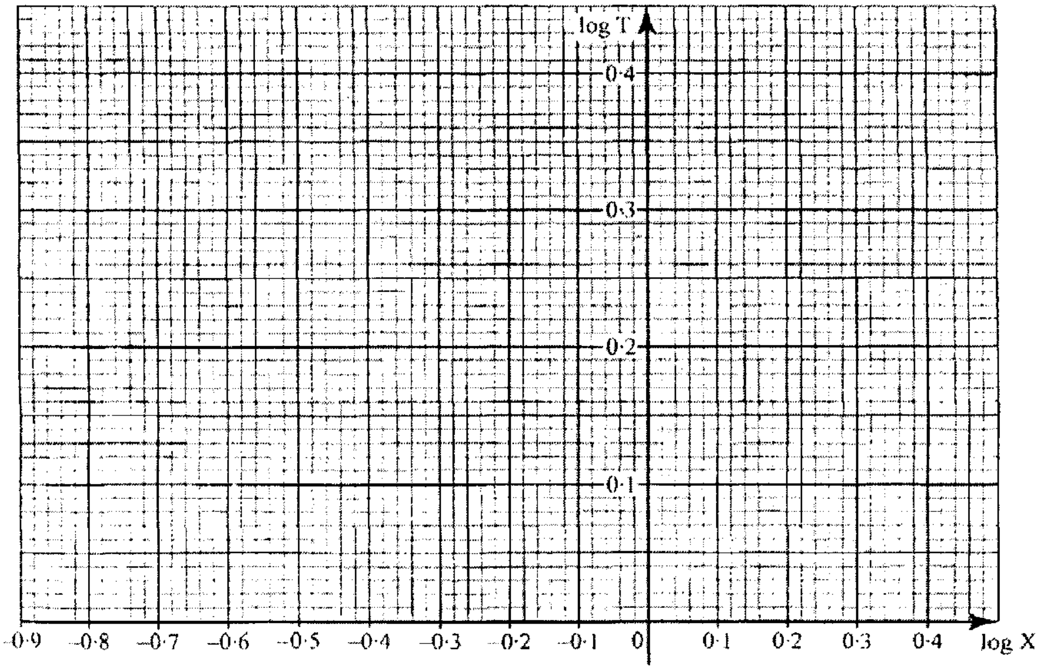
23 The table below shows the values of the length X (in metres) of a pendulum and the corresponding values of the period T (in seconds) of its oscillations obtained in an experiment.

X (metres)	0.4	1.0	1.2	1.4	1.6
T (seconds)	1.25	2.01	2.19	2.37	2.53

(a) Construct a table of values of log X and corresponding values of log T, correcting each value to 2 decimal places. (2 marks)

(b) Given that the relation between the values of log X and log T approximate to a linear law of the form $m \log T = b \log X + \log a$ where a and b are constants;

(i) Use the axes on the grid provided to draw the line of best fit for the graph of log T against log X. (2 marks)



(ii) Use the graph to estimate the values of a and b. (3 marks)

(c) Find, to 2 decimal places, the length of the pendulum whose period is 1 second. (3 marks)

24 Two bags A and B contain identical balls except for the colours. Bag A contains 4 red balls and 2 yellow balls. Bag B contains 2 red balls and 3 yellow balls.

(a) If a ball is drawn at random from each bag, find the probability that both balls are of the same colour. (4 marks)

(b) If two balls are drawn at random from each bag, one ball at a time without replacement, find the probability that;

(i) the two balls drawn from bag A or bag B are red, (4 marks)

(ii) all the four balls drawn are red. (2 marks)