

**KENYA NATIONAL EXAMINATIONS COUNCIL**  
**Kenya Certificate of Secondary Education**  
**MATHEMATICS**  
**Paper 2**  
**2<sup>1</sup>/<sub>2</sub> hours**

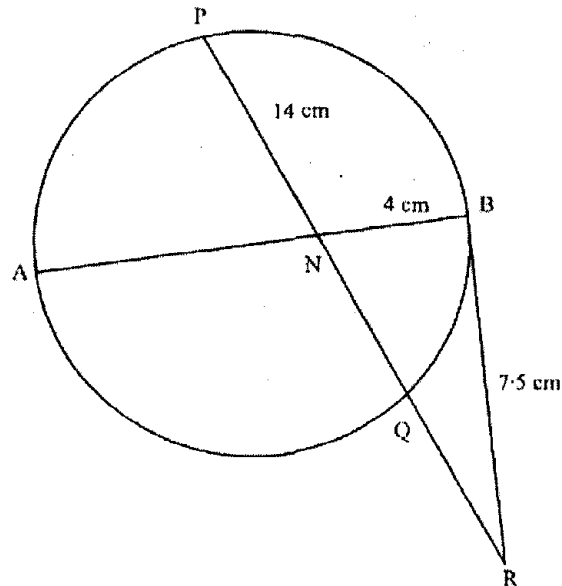
SECTION I (50 marks)

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  $0^\circ \leq x \leq 360^\circ$ . (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  $1 \text{ g/cm}^3$  and that of milk as  $1.2 \text{ g/cm}^3$ , 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)

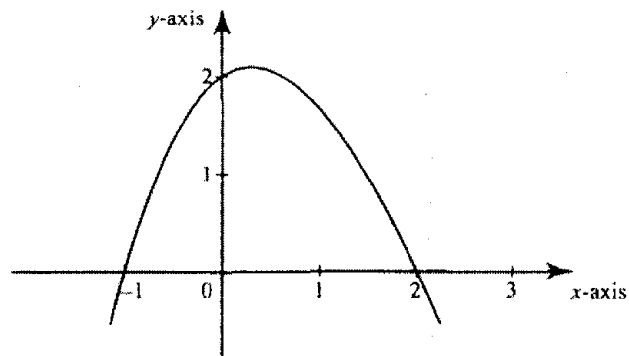


- 11 In the figure below AB is a diameter of the circle. Chord PQ intersects AB at N. A tangent to the circle at B meets PQ produced at R.



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  $\mathbf{q}$  has a magnitude of 7 and is parallel to vector  $\mathbf{p}$ . Given that  $\mathbf{p} = 3\mathbf{i} - \mathbf{j} + 1\frac{1}{2}\mathbf{k}$ , express vector  $\mathbf{q}$  in terms of  $\mathbf{i}$ ,  $\mathbf{j}$  and  $\mathbf{k}$ . (2 marks)
- 13 Two places A and B are on the same circle of latitude north of the equator. The longitude of A is  $118^\circ\text{W}$  and the longitude of B is  $133^\circ\text{E}$ . 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  $4\frac{1}{2}$  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)

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

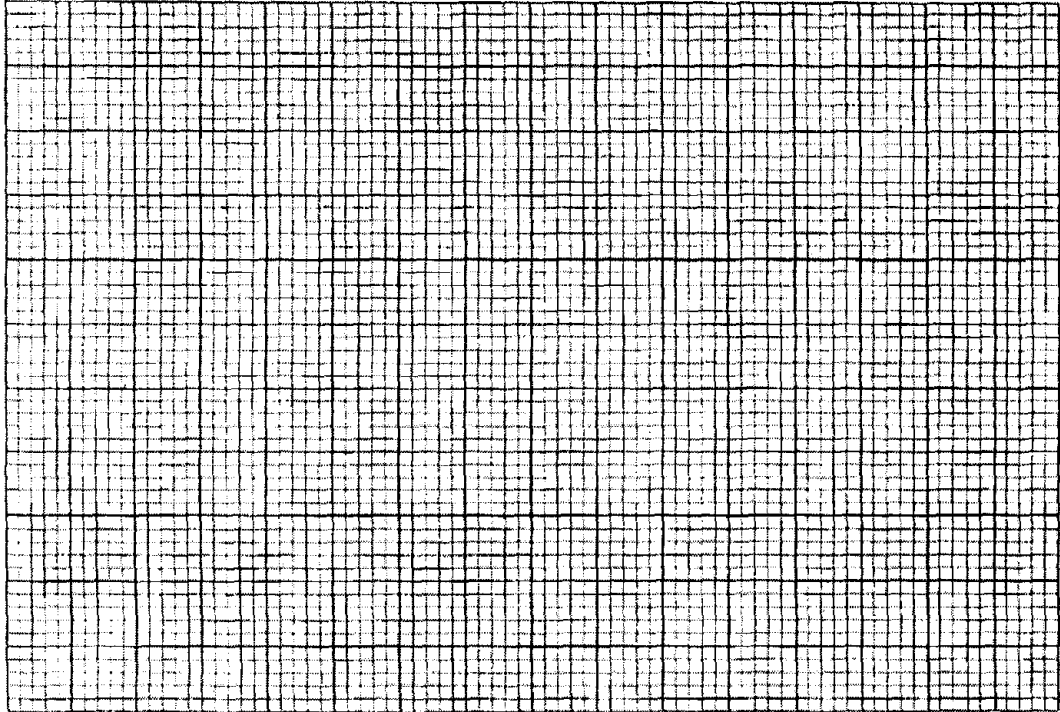
- (b) On the grid provided below, draw the graph of  $y = 8 \sin 2x - 6 \cos x$  for  $0^\circ \leq x \leq 120^\circ$ .

Take the scale: 2 cm for  $15^\circ$  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)

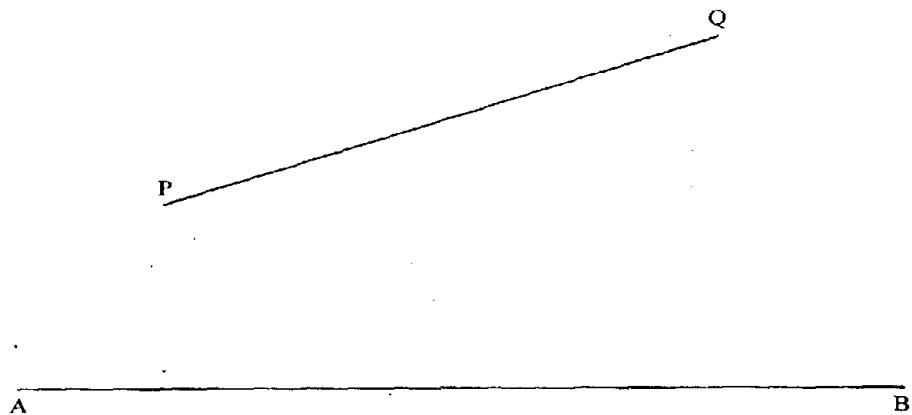
(ii) the values of  $x$  at which the curve cuts the  $x$ -axis.

(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:

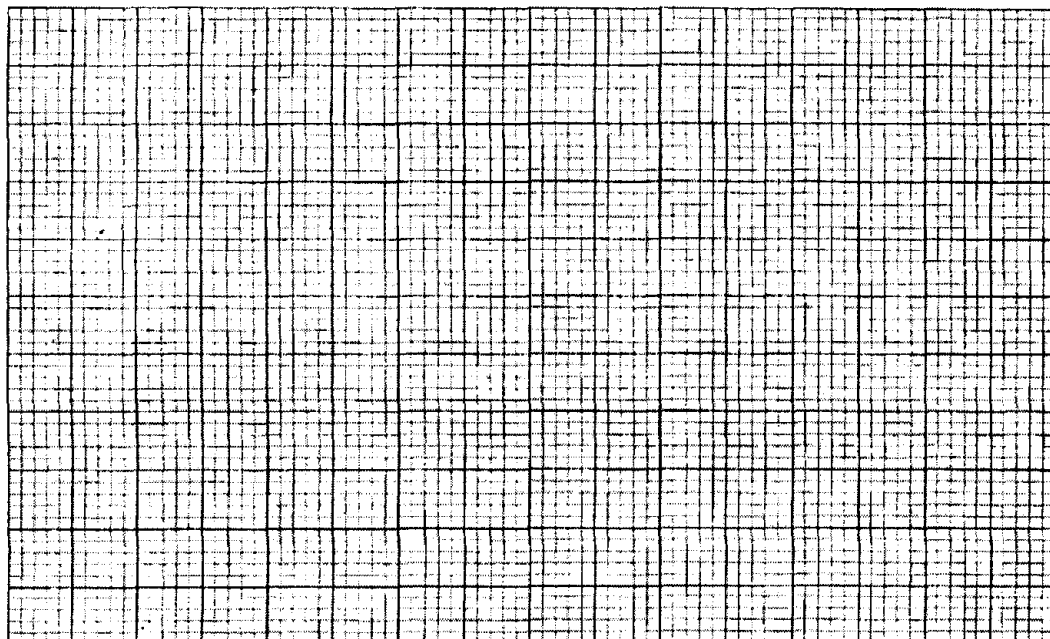
- I: X is nearer to PT than to PQ
- II: RX is not more than 4.5 cm
- III:  $\angle PXT > 90^\circ$  (4 marks)

- 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 <sup>2</sup>	Ksh 1 500
B	5	8m <sup>2</sup>	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<sup>2</sup>
  - 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)

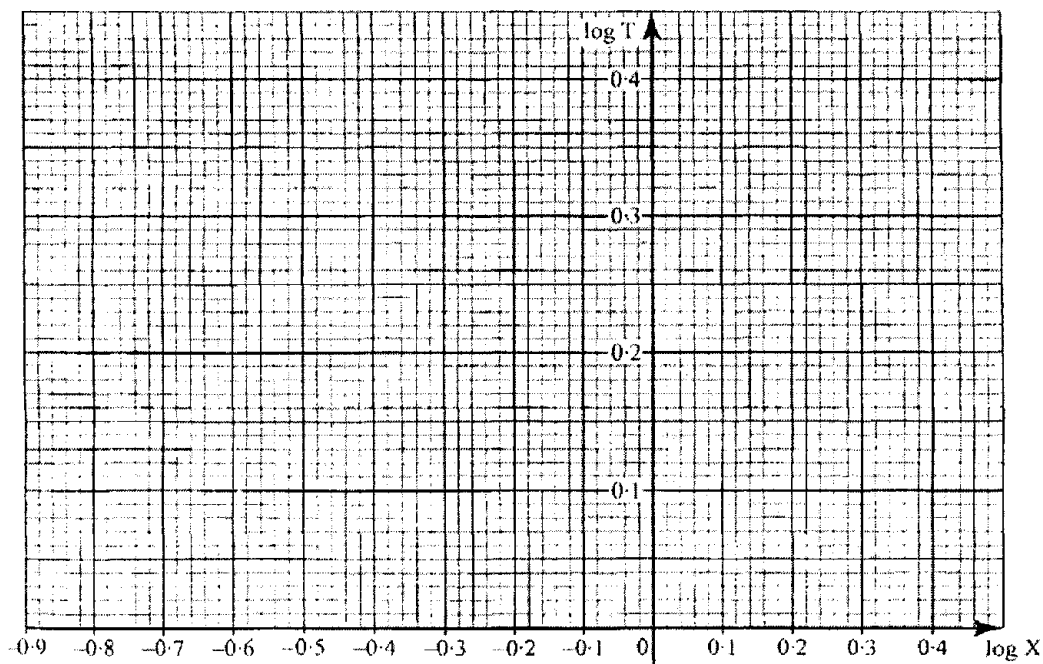


- (c) Draw a search line and use it to determine the number of machines of each type that should be installed to maximize the daily profit. (2 marks)

- 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)

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