THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN BUILDING CONSTRUCTION
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN ARCHITECTURE

MODULE III

MATHEMATICS III AND SURVEYING III

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
    Answer booklet;
    Drawing instruments;
    Mathematical table/Scientific calculator.
*This paper consists of **EIGHT** questions in **TWO** sections A and B.*
*Answer **FIVE** questions choosing at least **TWO** questions from **each** section and **one** other question from either sections.*
All questions carry equal marks.
Candidates should answer the questions in English.

This paper consists of 7 printed pages.

Candidates should check the question paper to ascertain that
all the pages are printed as indicated and that no questions are missing.

Turn over

SECTION A: MATHEMATICS III

*Answer at least **TWO** questions from this section.*

1. (a) Given $\begin{vmatrix} 2 & -1 & 3 \\ K & 2 & 4 \\ K-2 & 3 & K+7 \end{vmatrix} = 8$

   Determine the possible value of k. (9 marks)

   (b) Given the matrix

   $$M = \begin{vmatrix} 3 & 2 & 1 \\ 1 & -2 & -1 \\ 1 & 0 & 3 \end{vmatrix},$$

   determine the inverse and hence solve the following simultaneous equations:

   $$3x + 2y + z = 7$$
   $$x - 2y - z = 1$$
   $$x + 3z = 11$$

   (11 marks)

2. (a) A hardware shop sells a particular type of lock. The daily sales of this lock follows a poisson distribution with mean 3. Determine the probability that on a particular day the shop sells:

   (i) exactly 3 locks;
   (ii) at least 4 locks. (7 marks)

   (b) The continuous random variable x has probability density given by:

   $$f(x) = \begin{cases} Kx, & O \le x \le a \\ 0, & otherwise \end{cases}$$

   Where a and k are positive constants.
   Determine the variance. (9 marks)

   (c) The weight of decorating marbles is normally distributed with a mean of 12.5 gm and variance of 8 gm. Determine the probability that one such marble will weigh less than 7.6 gm. (4 marks)

3. (a) The acidity X measured in PH of limestone collected from different areas is assumed to be normally distributed. The PH of 50 random samples produced the following results:
   $\Sigma x = 354, \Sigma x^2 = 2510$
   Test at 10% level of significance, whether the mean PH is 7.12. (8 marks)

(b)   A machine fills cement filler packets whose nominal weight is 1 kg. a random sample of 80 packets were weighed and 6 packets were found to be underweight. Determine a 90% confidence interval the proportion of all the underweight packets.

(7 marks)

(c)   Given the following statistics, determine the Pearson product moment correlation coefficient and comment.

$$\Sigma x = 183 \quad \mathrm{E}x^2 = 4301 \quad \Sigma xy = 7724$$
$$\Sigma y = 336 \quad \mathrm{E}y^2 = 14140 \quad n = 8$$

(5 marks)

4.   (a)   Use Newton's backward difference formulae to estimate value of f(1.45) from the data in **Table 1**.

Table 3: Data

x	1	1.1	1.2	1.3	1.4	1.5
$f(x)$	2	2.1	2.3	2.7	3.5	4.5

(10 marks)

(b)   Given the equation $e^{3x} = x + 20$, show that:

(i)   the equation has a root between 1 and 2;
(ii) $x = \frac{1}{3} In(X_n + 20)$;
(iii) Determine the root of the equation correct to 4 decimal places starting with first approximation as $x_o = 1.5$.

(10 marks)

*Answer at least **TWO** questions from this section.*

5.   (a)   **Figure 1** shows the optical principle of measuring horizontal distance (D) in stadia tacheometry. Derive the formula for determining the horizontal distance.   (6 marks)
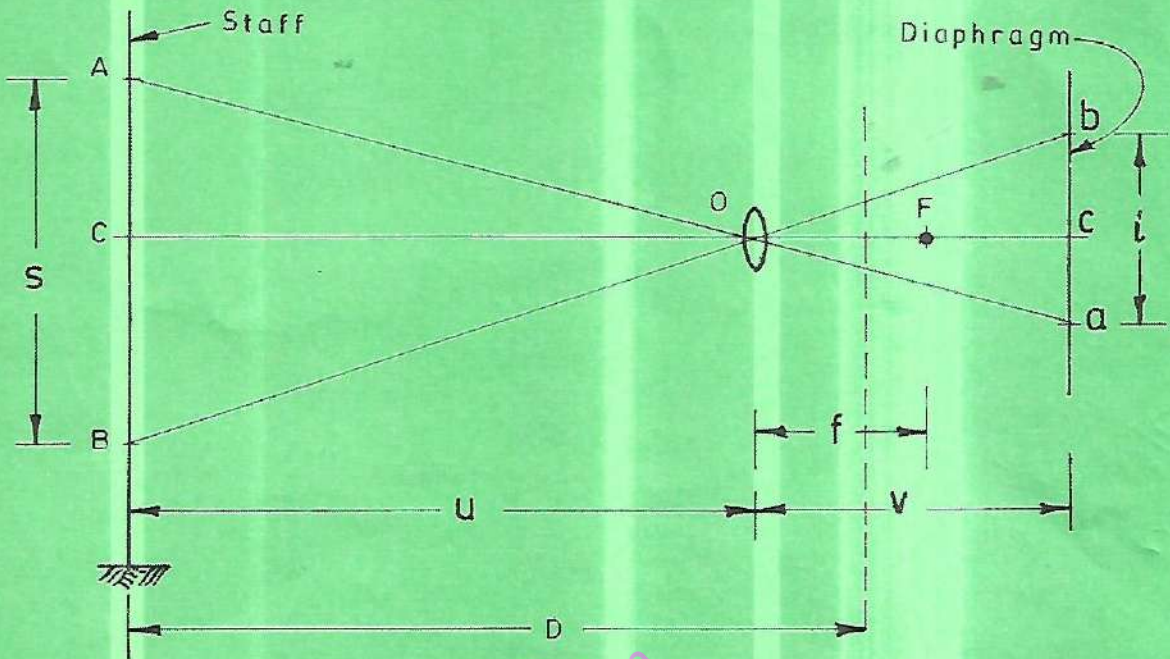

Fig. 1

(b)   **Table 2** shows tacheometric observations taken from station P and Q to a staff station R. The tacheometer was fitted with an anallactic lens, determine:

(i)   horizontal distance PR and RQ;
(ii)   reduced level of point R and Q.

Table 2

Instrument Station	Height of Instrument	Staff Station	Vertical angle	Stadia reading			R.C of Station
P	1.65	R	+3°15'	2.43	1.69	0.89	2506.025
Q	1.65	R	−5°20'	2.53	1.60	0.45	—

(14 marks)

6. (a) The reduced ground level and formation level of an embarkment at 0 m, 30 m and 60 m chainages are shown in **table 3**.

Table 3

Chainages (m)	0	30	60
Reduced ground level (m)	35.10	36.20	35.80
Formation level (m)	38.20	38.40	38.60

Given that the formation widths of the top of the embarkment is 6.0 m, traverse slope in horizontal and the embarkment sides slope at 1 in 2. Calculate the:

(i)   Width of embarkment;

(ii) Volume using trapezoidal and prismoidal rule.   (12 marks)

(b) State **three** uses of mass haul diagram.   (3 marks)

(c) Outline the procedure of using a planimeter.   (5 marks)

7. (a) In preparing the fixing of sight rails, the following consecutive staff readings were taken from one setting of level.

Staff position	Staff readings(m)
BM (R.L = 50.49 m)	0.83
Ground level at A	1.80
Invert of sewer at A	3.24
Ground level at B	1.30
Ground level at C	1.08

If the server is to rise at 1 in 300 and the distance AB = 105 m and BC = 153 m

(i)   Invert level at B and C:

(ii) height of sight rail at A, B and C with use of 3.05 m boning rod.

(14 marks)

(b) Explain the following terms as applied in setting out:

(i)   survey grid;

(ii)   site grid;

(iii) structural grid.

(6 marks)

8. (a) Define "photogrammetry: (2 marks)

   (b) Describe the following methods of making mosaic using:

      (i) paper prints;
      (ii) negatives;
      (iii) digital imagery. (9 marks)

   (c) State **four** uses which necessitate overlaps in aerial photographs. (4 marks)

   (d) A photograph of a building was taken from aerial view and the following information was obtained:

      Height of camera = 1200m
      measurement in photo from top of building = 88.40 mm
      measurement in photo from bottom of building = 90.50 m.

      Calculate the height of the building. (5 marks)