2312/306
SURVEY CONTROL AND
ENGINEERING SURVEYING
Oct./Nov. 2018
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN LAND SURVEYING

SURVEY CONTROL AND ENGINEERING SURVEYING

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Scientific calculator.
*This paper consists of **SIX** questions in **TWO** sections; **A** and **B**.*
*Answer any **FOUR** questions choosing at least **TWO** questions from each section.*
*Each question in section **A** carries 30 marks, while each question in section **B** carries 20 marks.*
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.

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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.

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SECTION A: SURVEY CONTROL

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

1. (a) State **six** sources of error when measuring angles in traversing. (6 marks)

(b) **Figure 1** shows point F which is the starting point of a traverse but is inaccessible. A distant triangulation point P can be seen from point M that is near F. A point E is established and the following linear and angular observations made:

Reduced distance ME	=	212.53 m
Angle FEM	=	82° 39' 00"
Angle FME	=	52° 34' 01"
Angle FMP	=	76° 06' 31"

The datum coordinates of P and F are:

STN	N (m)	E (m)
P	+558.62	+889.12
F	+104.18	+1196.16

Calculate:

(i) the bearing of line PM;
(ii) the coordinates of M.

(15 marks)

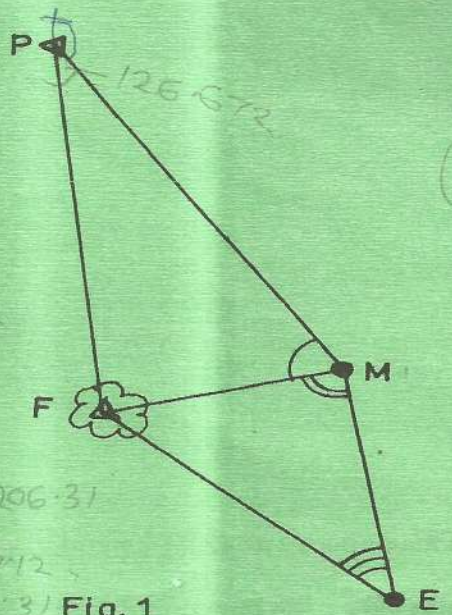

Fig. 1

(c) Outline the sources of error encountered in fixing a point by Global Positioning System (GPS). (9 marks)

2. (a) Use the following information to determine the coordinates a new point P by the intersection method. (15 marks)

Coordinates		
Point	**N (m)**	**E (m)**
A	+1668.40	+12600.36
B	+3949.19	+9577.46

Bearings:

A - P = 259° 38' 20"
B - P = 197° 18' 32"

(b) **Table 1** shows horizontal angles observed from a triangulation station X. Reduce the observations and obtain the final adjusted bearings. (9 marks)

Table 1

A	B	C	D	E	A
242° 37' 39"	261° 39' 18"	265° 08' 18"	263° 08' 47"	328° 37' 40"	242° 37' 39"
62° 37' 38"	81° 39' 23"	85° 08' 13"	83° 08' 44"	1481° 37' 46"	62° 36' 46"
287° 36' 59"	306° 39' 51"	310° 08' 10"	308° 09' 07"	13° 37' 41"	287° 37' 46"
107° 37' 40"	126° 39' 48"	130° 08' 18"	128° 08' 29"	193° 37' 42"	107° 37' 46"

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(c) Describe the field procedure for determining the difference in level between two points A and B by ordinary spirit levelling. (6 marks)

3. (a) State:

(i) the **two** assumptions made in all methods of altimetric heighting;

(ii) the **three** distinct causes of the difference in pressure between two points on the surface of the earth.

(6 marks)

(b) **Table 2** shows altimetric readings for three altimeters carried out in the morning and evening for the purpose of indexing. Taking altimeter A as the standard, determine the mean index corrections to be applied on altimeter B and C. (6 marks)

Table 2

Time	A	B	C	Time	A	B	C
08:00	283.77	285.29	282.55	4:00	299.92	302.26	298.09
08:05	283.46	285.29	282.24	4:05	299.92	302.06	297.79
08:10	283.46	284.99	282.24	4:10	299.62	302.06	298.40
08:15	283.16	284.99	282.94	4:15	299.14	301.45	298.09

(c) Draw a field note page and demonstrate how the following are carried out in precise levelling:

(i) order of booking staff readings;
(ii) type of readings per staff;
(iii) checking of staff readings.

(8 marks)

(d) With the aid of a diagram, explain the Declination (Dec) and Right Ascension (RA) coordinate system of star "S" as used in field astronomy.

(7 marks)

(e) **Figure 2** shows an Astronomical triangle ZPS. Label the triangle and show that:

$$Cos\ Z = \frac{Sin\delta - Sinh\ Sin\phi}{Cosh\ Cos\phi}$$

(3 marks)

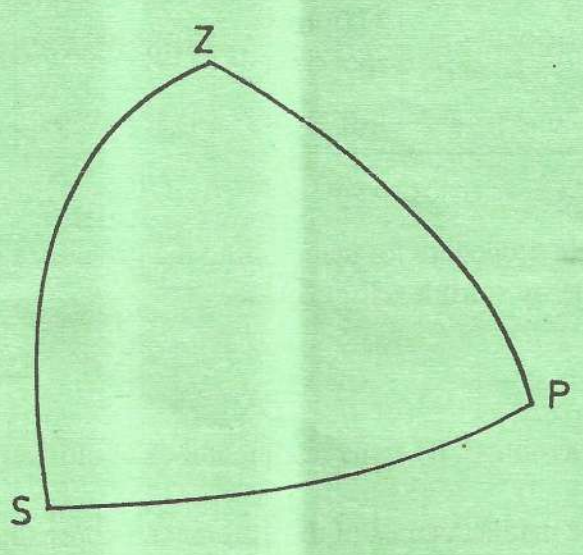

Fig. 2

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SECTION B: ENGINEERING SURVEYING

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

4. (a) With the aid of a diagram, state the elements of a simple circular curve giving the formula for determining each. (9 marks)

(b) A simple circular curve of radius 740 m has been set out connecting two straights with a deflection angle of 46°. It is decided that for construction reasons, the mid-point of the curve must be moved 6 m towards the centre from the intersection point. The alignment of the straights is to remain unaltered.

Calculate:

(i) the radius of the new curve;

(ii) the distances from the intersection point to the new tangent points;

(iii) the deflection angles required for setting out 30 m chords of the new curve;

(iv) the length of the final sub-chord.

(9 marks)

(c) State **two** purposes of a transition curve. (2 marks)

5. (a) **Table 3** shows staff readings taken for setting out pegs A and B and a trench from TBM of R.L. 100.00 m above datum. Pegs A and B are to be set out at R.L. 100.792 m and 100.719 m respectively. If the R.L. of trench is 100.448 m and a 2 m boring rod is used:

(i) Fill the missing readings marked x_1, x_2, x_3 and x_4 to complete the booking.

(ii) Reduce the readings by the rise and fall method applying the arithmetic checks.

Table 3

BS	IS	FS	Remarks
1.754			T.B.M. R.L. 100.00 m
	x_1		Peg A R.L. 100.792 m
1.947		x_2	Peg B R.L. 100.719 (C.P.)
	x_3		Profile R.L. 102.448 m
1.847		2.103	Plate level (R.L. x_4) C.P.
		2.410	T.B.M. R.L. 10000 m

(14 marks)

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(b) Explain the use of sight rails and boning rods in levelling for construction. (6 marks)

6. (a) **Figure 3** shows a triangular piece of land ABC with corner coordinates. Use the information to show that the area of the parcel in square units is given by:

$$\text{Area} = \frac{1}{2}[x_2y_1 + x_3y_2 + x_1y_3 - x_1y_2 - x_2y_3 - x_3y_1]$$ (9 marks)

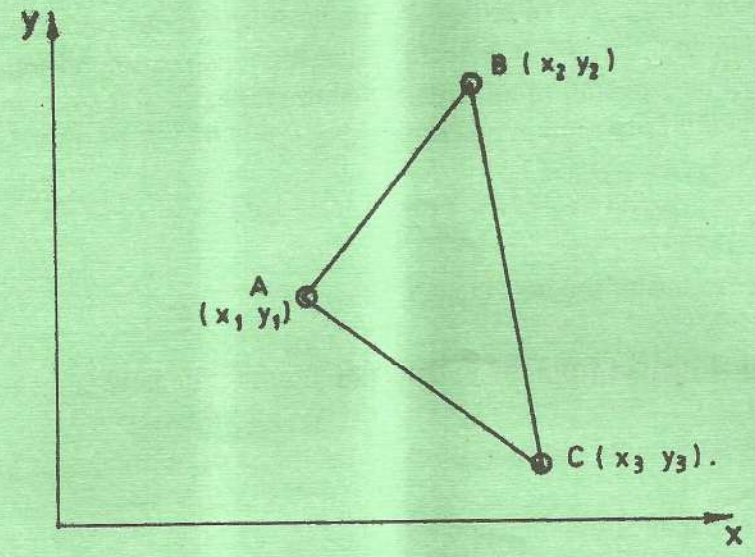

Fig. 3

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(b) State:

(i) **four** methods of controlling verticality in multi-storeyed structures;

(ii) **three** methods of determining planimetric positions of soundings.

(5 marks)

(c) **Figure 4** shows two vertical wires P and Q hang in a shaft, the bearing PQ being 55° 10' 30". A theodolite at R to the right of PQ produced measured angle PRQ as 00° 20' 25". The distances PR and QR were 7.4782 m and 4.2998 m respectively.

Calculate:

(i) the perpendicular distance from R to PQ produced;

(ii) the bearing of line RP;

(iii) the angle to be set off from QR to establish RT parallel to PQ produced.

(6 marks)

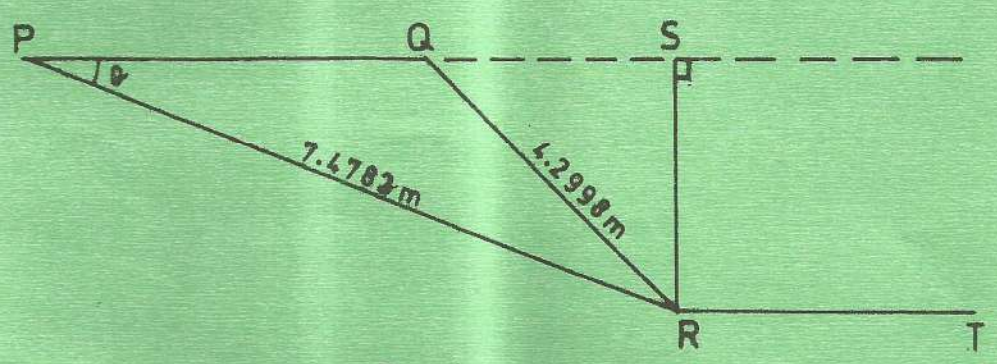

Fig. 4

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