2312/306
SURVEY CONTROL AND
ENGINEERING SURVEYING
Oct./Nov. 2022
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;
    Survey computation form (C22)
This paper consists of SIX questions in TWO sections; A and B.
Answer any FOUR questions choosing any TWO questions from each section.
Questions in section A are 30 marks each while those in section B carry 20 marks each.
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.

This paper consists of 6 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

Answer TWO questions from this section.

1. The following are adjusted bearings and reduced distances for three traverses all terminating on a common point N. Using the information and datum coordinates in **table 1** calculate the weighted mean coordinates of point N. (30 marks)

2.

$K - P_1$	$T_2 - T_3$	$B_2 - B_3$
117°59′57″	44°05′04″	312°50′32″
1228.10 m	814.28 m	1112.29 m

$P_1 - P_2$	$T_3 - T_2$	$B_2 - N$
250°17′48″	113°40′15″	281°28′20″
1052.03 m	1123.63 m	926.25 m

$P_2 - N$	$T_4 - N$
164°12′55″	10°18′42″
774.03 m	1123.63 m

$R - T_1$	$A - B_1$
36°36′47″	323°58′57″
786.08 m	1310.52 m

$T_1 - T_2$	$B_1 - B_2$
108°16′33″	298°49′45″
1140.57 m	1298.77 m

16065
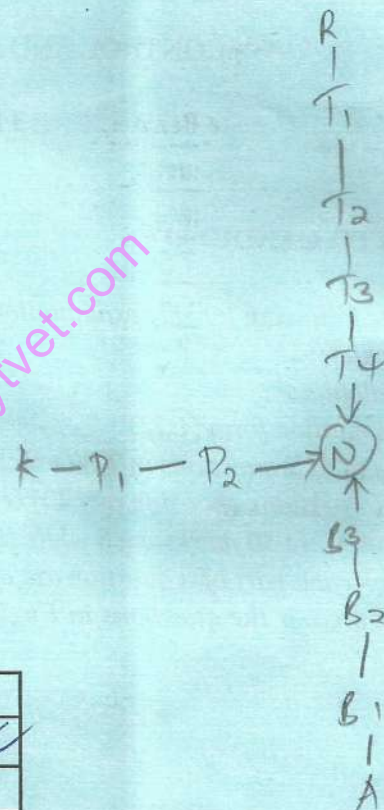
1550.66

Table 1 - Datum coordinates

Point	N (m)	E
K	− 4852.70	+ 3306.30
R	− 8050.90	+ 260.30
A	− 9150.82	+ 7246.91

2. (a) The following are triangulation observations for the purpose of fixing a new station F. Use the data and the datum bearings in **table 2** to prepare a triangulation bearing sheet.   (17 marks)

At N

Z   246°40′31″
L   287 49 45
F   37 40 16
N 326 40 59
G 351 35 57

At N

G   97° 22′ 27″
M   146 41 33
F   150 51 50

At G

M   171° 36′ 51″
F   190 29 30
N   277 22 17

At F

M   217° 40′ 30″
N   330 51 20
G   10 28 57

Table 2: Datum Bearings

Line	Bearing
M - Z	246°40′53″
M - L	287 50 36
N - N	326 41 13
M - G	351 36 14
G - N	277 22 00

(b) Explain the twin station fix method as used in triangulation, outlining the field procedure, computation and graphing.   (9 marks)

(c) State **four** precautions to be observed when carrying out altimetric heighting.   (4 marks)

3. (a) List **six** instruments used in field astronomy.   (3 marks)

(b) State the sine and cosine formulae as used in a spherical triangulation computations.   (6 marks)

(c) State **six** sources of error in Global Positioning System (GPS) observations.   (6 marks)

(d) State **five** field requirements in order to minimize error in ordinary spirit levelling. (5 marks)

(e) **Table 3** shows observations taken at point PK for the purpose of heighting new points KW and MWI. If the height of PK was 1310.701 m above datum, the coefficient of reflection (K) for the area was 0.056 and the radius of the earth was 6378 Km, calculate the heights of kW and MWI.

(10 marks)

Table 3

At pK H+ of instrument = 1.798 m

To	Kw	MWI
V. angle (α)	$+00°10'33''$	$-00°46'35''$
Distance (s)	8302.63 m	9762.74 m
Height of signal	4.084 m	3.688 m

SECTION B: ENGINEERING SURVEYING

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

4. (a) Define the following terms as used in construction surveying:

    (i) setting out;
    (ii) bench mark;
    (iii) gradient;
    (iv) formation level;
    (v) invert level.

    (5 marks)

   (b) **Table 4** shows observations and data used when setting out a sewer line between points P and Q, 120 m apart at a gradient of 1:130 to Q. If the invert level at point P is 112.250 m, compute:

    (i) invert level at point Q;

    (ii) sight rail level at point P and Q if a 3.0 m boring rod is used.

    (iii) Invert level at point R, 30 m from point Q on line PQ produced at the same gradient.

    (ic) The height of sight rails on ground at 30 m, 60 m and 90 m 120 m.

    (15 marks)

Table 4

B3	I3	F3	H.C	Rl	Remarks
0.744			117.064	116.320	BM.
	3.036			114.028	P
	2.808			114.256	⦰ 30
	2.671			114.393	30 60
	3.026			114.038	60 90
	3.131			113.933	90 120 ⦰.
		0.744		116.320	B.M.

5. (a) State **four** characteristics of mass haul diagrams. (8 marks)

(b) **Figure 1** shows 20 m square grid with depths of cut marked at each grid intersection. Assuming that the surface slope is constant between grid intersections, compute the volume of material excavated. (12 marks)

Fig.1
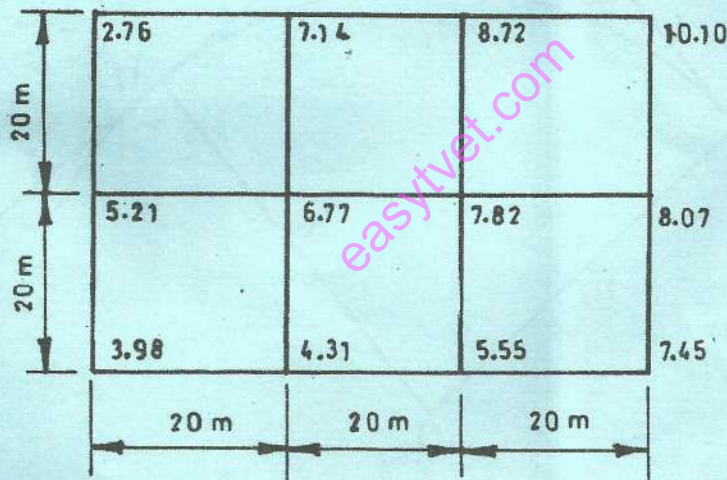
6. (a) (i) Define the term sounding as used in hydrographic surveying.

(ii) State **three** methods of determining planimetric positions of soundings. (4 marks)

(b) Explain how the factors affecting the verticality of wires in underground surveying can be reduced. (3 marks)

(c)   **Figure 2** shows a proposed circular curve in which the intersection point (I) of the straights PI and QI is not accessible. Measurements were carried out in the field as follows:

Distance BD   = 1485 m
PQ = QD   = 1200 m
Angle $P\hat{B}D$ = 123°48′00″
Angle $Q\hat{D}B$ = 126°12′00″

If the radius if the curve is 1600 m, use the information given above to compute the distances PT_1 and QT_2 respectively.
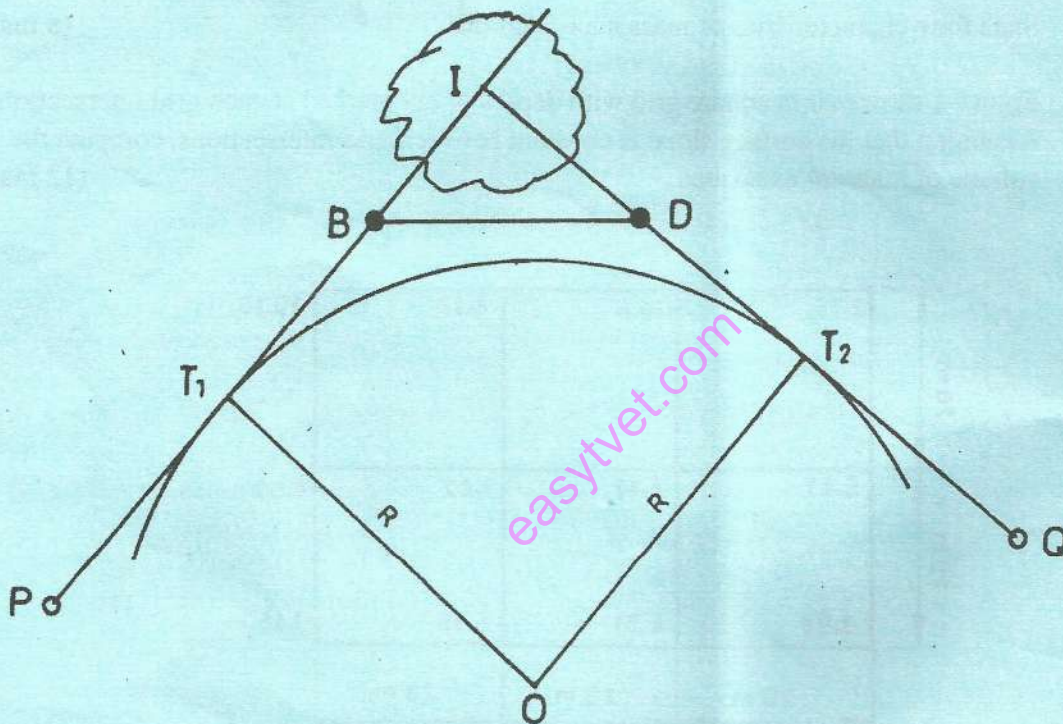
(13 marks)

Fig. 2

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