1308/314
LAND SURVEYING THEORY
June/July 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN LAND SURVEYING

LAND SURVEYING THEORY

3 hours

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INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Scientific calculator;
Survey computation forms (C/22).
*This paper consists of **EIGHT** questions.*
*Answer **FIVE** questions.*
All questions carry equal marks.
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.

1. (a) State **five** characteristics of contour lines. (5 marks)

(b) Describe the following methods of contouring:

(i) direct method;
(ii) indirect method (grid method). (15 marks)

2. (a) State **five** permanent adjustments of a theodolite. (5 marks)

(b) The following angular observations were taken from station R to station P, Q and S. Reduce the readings for station adjustment. (6 marks)

@R

P			Q			S		
128°	22′	12″	308°	10′	34″	280°	58′	00″
200°	46′	22″	20°	34′	56″	353°	22′	24″

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(c) **Figure 1** shows three survey stations E, F and G. Outline the field procedure for measuring angle EFG using a T_2 theodolite. (9 marks)

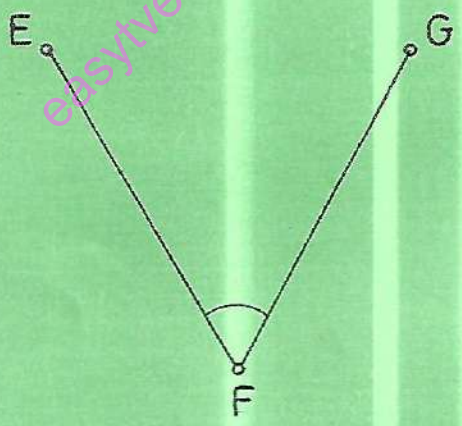

Fig. 1

3. (a) State **five** accessories used in plane tabling. (5 marks)

(b) Outline the "radiation" method of plane tabling. (9 marks)

(c) An obstacle was chained around and the data obtained is as shown in **figure 2**. Calculate the lengths of line CD and CF. (6 marks)

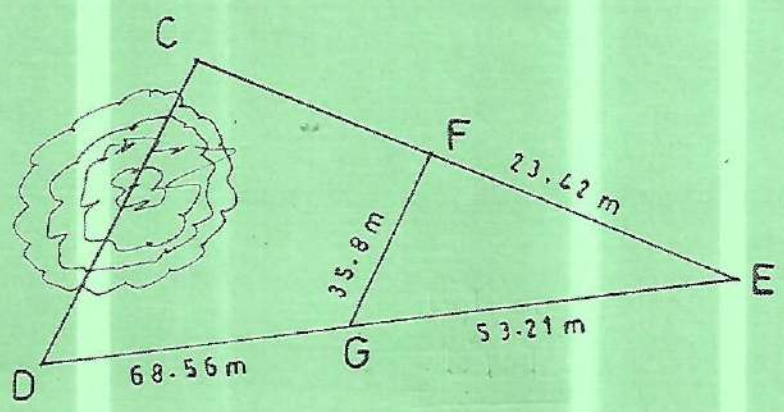

Fig. 2

Figure 3 shows a traverse run from P to T. Using datum bearing in **table 1**, prepare a traverse bearing sheet. (20 marks)

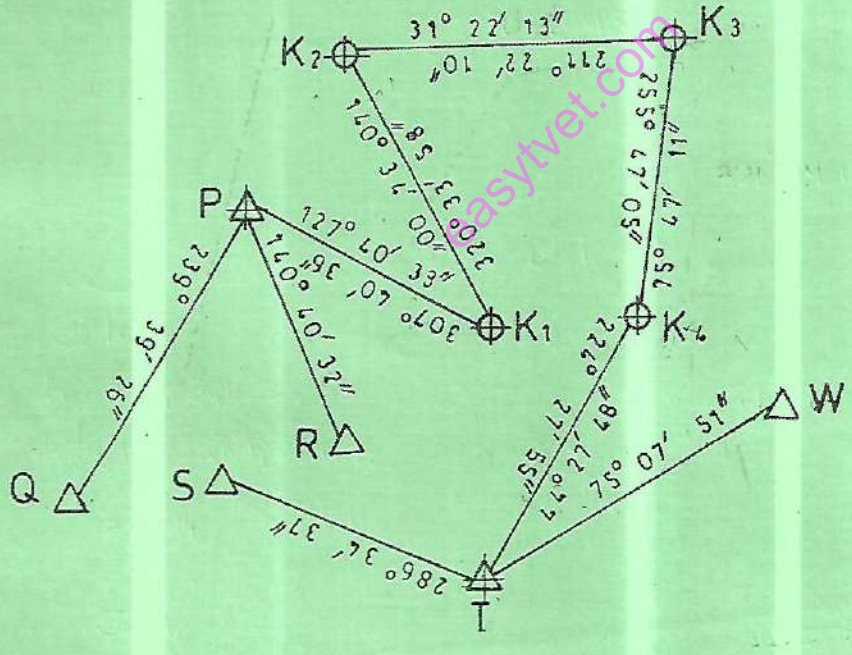

Fig. 3

Table 1

Line		Bearing
P - Q		239° 39′ 56″
R - P		320° 40′ 25″
S - T		106° 34′ 59″
T - W		75° 07′ 44″

5. A sewer line is to be constructed to run 180 m at a falling gradient of 1:250 from a manhole X to a manhole Y. The ground level at X and Y are 142.833 m and 142.928 m respectively. If the invert level at Y is 41.150 m, height of sight rail above the ground at Y is 1.500 m and the reduced level of benchmark is 145.220 m; determine:

(i) length of the boning rod;

(ii) height of fixing the sight rail at X;

(iii) staff reading of intermediate sights at X and Y if a backsight taken on bench mark is 1.987 m.

(20 marks)

6. **Figure 4** shows a parcel of land with straight boundaries as BA, BC and CY and a curvilinear boundary AD. The offsets taken from the line are given in **table 2** and the co-ordinates of B, C, X and Y in **table 3**. Using trapezoidal rule, calculate the area in hectares. (20 marks)

Table 2

Distance from X - Y	0	5	10	15	20	30	40	60
Offset	1.50	2.80	3.50	4.10	4.95	4.80	2.90	1.20

Table 3

Point	**Northing**	**Easting**
X	2235.01	1058.47
Y	2178.06	1114.66
B	2201.45	1022.46
C	2142.52	1078.65

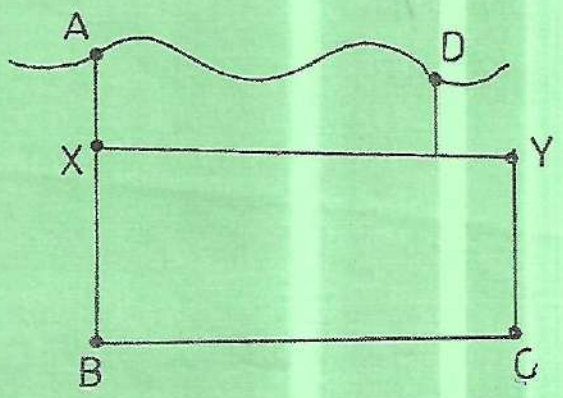

Fig. 4

7. The observations shown in **table 4** were taken with a theodolite fitted with an anallactic lens to vertically held staff. The theodolite had a multiplying constant of 100. If the height of the instrument was 1.45 m, the reduced level of R is 2085.840 m and points R, K and S are collinear, calculate the gradient of RS. (20 marks)

Table 4

Instrument station	Staff station	Vertical Circle reading	Stadia readings	
			Mid	Bottom
K	R	86° 30′ 45″	2.595	1.800
	S	93° 45′ 15″	3.285	2.745

8. (a) Reciprocal observations while levelling across a wide river gave the following readings on to stave held vertically at M and N from instruments stationed at X and Y.

Reading of staff at M from X = 2.534 m;
Reading of staff at N from X = 2.218 m;
Reading of staff at M from Y = 2.816 m;
Reading of staff at N from Y = 2.480 m.

M and N were close to each other on one bank with N and Y similarly situated on the other bank. If the reduced level of N is 150.50 m above mean sea level what is the level of M?

(6 marks)

(b) The data in **table 5** was obtained during a traversing exercise. Given the following datum coordinates:

Station	Northing	Easting
P	+20006.875	–34122.190
Q	+19836.839	–34156.283

(i) Compute and adjust the traverse to Q by the Bowditch's method.

(ii) Determine the bearing and distance from P to K2.

(iii) Evaluate the relative traverse accuracy.

(14 marks)

Table 5

Line	Distance (m)	Bearing
P - K1	184.826	128° 50′ 21″
K1 - K2	132.402	201° 11′ 10″
K2 - Q	147.087	298° 08′ 24″

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