

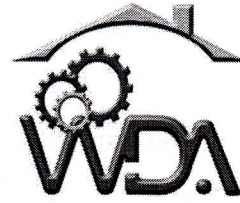
PWO – Topography and Road  
Construction

T131

Monday, 16/11/2015

08:30 – 11:30

WORKFORCE DEVELOPMENT AUTHORITY



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**ADVANCED LEVEL NATIONAL EXAMINATIONS, 2015,  
TECHNICAL AND PROFESSIONAL TRADES**

**EXAM TITLE: Topography and Road Construction**

**OPTION: Public Works**

**DURATION: 3hours**

**INSTRUCTIONS:**

The paper is composed of **three (3) Sections:**

Section **I:** Sixteen (**16**) questions, all **Compulsory**. **55marks**

Section **II:** Five (5) questions, **Choose Three (3) only**. **30marks**

Section **III:** Three (3) questions, **Choose only One (1)**. **15marks**

The use of calculator is admitted

**Every candidate is required to strictly obey the above instructions. Punishment measures will be applied to anyone who ignores these instructions.**

**Section I. Sixteen (16) Compulsory questions. 55marks**

**01.** What are three (3) main factors influencing the geometric design of highways? **3marks**

**02.** What is a design speed? **1mark**

**03.** Classify below terrain according to the given percentage of slope: **3marks**

Percentage slope	Classification
0 - 10	
10 - 25	
25 - 60	

**04.** Define the following:

i) Bearing

**4marks**

ii) Coordinate

**4marks**

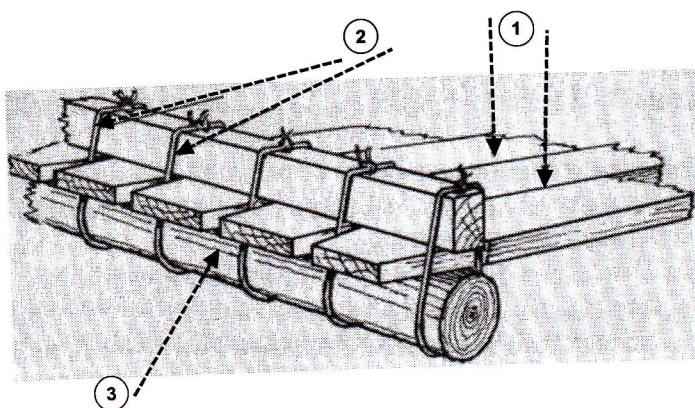
**05.** What is a sight distance? Mention three types of sight distance.

**06.** In Rwanda context, distinguish between national highways and major district roads. **4marks**

**07.** Road setting out consists of horizontal and vertical alignments. What is the difference between them? **4marks**

**08.** Mention three (3) types of loads which a bridge must carry. **3marks**

**09.** Name elements 1, 2 and 3 as shown here below on the bridge flooring sketch



**3marks**

**10.** How many possible alternatives to join the origin and destination of a route location? **1mark**

**11.** Mention three (3) stages of route location surveys. **3marks**

**12.** State four (4) main geometric design elements of a highway. **4marks**

13. What are five (5) groups of variables that should be considered in designing and constructing any road pavement? **5marks**

14. Define the following terms used in road pavement:

- a) Subgrade
- b) Sub base
- c) Road base
- d) Surface course

**4marks**

15. In below table, mention different types of both flexible and rigid prepared in-situ pavements. **5marks**

Flexible pavement	
Rigid pavement	

16. Earth gravel roads usually have three (3) common types of damages, what are they? **3marks**

**Section II. Answer any three (3) questions of your choice**

**(Do not choose more than three questions). 30marks**

17. The geometrical volume of cross section in cut is  $52\text{m}^3$ . If the coefficient of abundance and settling are 21% and 18% respectively, calculate the volume to bring for filling of cross section on which  $66\text{m}^3$  is needed. **10marks**

18. A circular simple horizontal curve has 200m radius and  $65^\circ$  deflection angle ( $\Delta$ ).

Calculate:

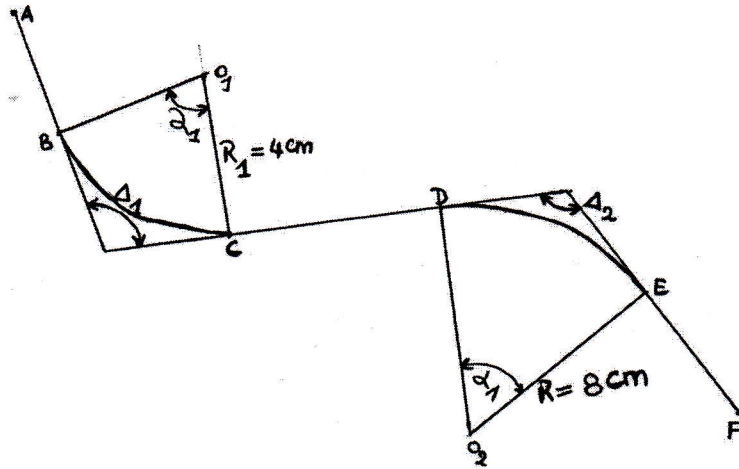
- a) The length of curve (L)
- b) The tangent length (T)
- c) The length of long chord (d)
- d) Mid- ordinate (f)

**10marks**

19. From the following figure, calculate:

(a) the central angles  $\alpha_1$  and  $\alpha_2$ ;

(b) the length of line ABCDEF if  $AB = 3\text{cm}$ ,  $CD = 5\text{cm}$ ,  $EF = 6\text{cm}$ .



If  $\Delta_1 = 120$  grades and  $\Delta_2 = 155$  grades, Scale of detail  $\frac{1}{2000}$

10marks

20. What are the factors on which the selection of base course and the surface course of the road construction depends on?

10marks

21. The distance measured between two points on sloping ground is 450m.

Find the correction to be applied and the horizontal distance if:

a) The angle of slope is  $10^\circ$

b) The slope is 1 in 5.

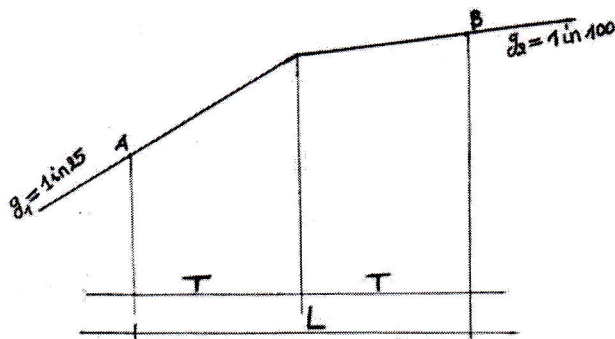
10marks

**Section III. Answer any one (1) question of your choice**

**(Do not choose more than one question).**

15marks

22. It is required to connect 2 upper grades  $g_1$  and  $g_2$  with a parabolic curve whose minimum radius  $R = 2000\text{m}$ .



Calculate:

- the length of the parabolic curve L.
- the coordinates x and y of summit of parabolic curve.
- the ordinates  $y_1$  and  $y_2$  corresponding to intermediate points

$$X_1 = 45\text{m and } X_2 = 70\text{m}$$

**15marks**

- 23.** a) Find the total width of a pavement on a horizontal curve for a new national highway to be aligned along a rolling terrain with a ruling minimum radius.

Assume the following data:

- National highway on rolling terrain, ruling design speed (V) = 80kmph.
- Normal pavement width (w) = 70m
- Number of lanes n = 2
- Wheel base of the truck  $\ell = 0.07$  and skid resistance  $f = 0.15$

- b) What are the functions of curbs?

**15marks**

- 24.** Fill in and name the table below. Construct Lalanne's graphic and comment on the results.

**15marks**

Profile No	Volume of cut	Volume of fill	Cut to use transversally to axis	Excess of cut	Excess of fill
1	34	26	?	?	-
2	28	-	-	?	-
3	26	6	?	-	?
<b>Total</b>	?	?	?	?	?

N.B: Intervals between 1 and 2 = 20 m and 35 m between 2 and 3