ADVANCED LEVEL NATIONAL EXAMINATIONS, 2015, 
TECHNICAL AND PROFESSIONAL TRADES

EXAM TITLE:  Topography and Road Construction

OPTION: Public Works

DURATION: 3 hours

INSTRUCTIONS:

The paper is composed of three (3) Sections:

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

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

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

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

<table>
<thead>
<tr>
<th>Percentage slope</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10</td>
<td></td>
</tr>
<tr>
<td>10 - 25</td>
<td></td>
</tr>
<tr>
<td>25 - 60</td>
<td></td>
</tr>
</tbody>
</table>

04. Define the following:
   i) Bearing
   ii) Coordinate 4marks

05. What is a sight distance? Mention three types of sight distance. 4marks

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

<table>
<thead>
<tr>
<th>Flexible pavement</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rigid pavement</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 52m³. If the coefficient of abundance and settling are 21% and 18% respectively, calculate the volume to bring for filling of cross section on which 66m³ is needed.  
10marks

18. A circular simple horizontal curve has 200m radius and 65° deflection angle (Δ).  
   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,

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

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.

Section III. Answer any one (1) question of your choice
(Do not choose more than one question).

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

---

WDA/TVET / PWO – Topography and Road Construction – Academic Year 2015

Page 4 of 8
Calculate:

a) the length of the parabolic curve L.
b) the coordinates x and y of summit of parabolic curve.
c) the ordinates y₁ and y₂ corresponding to intermediate points

X₁ = 45m and X₂ = 70m

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 trick ℓ = 0.07 and skid resistance f = 0.15

b) What are the functions of curbs?

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

<table>
<thead>
<tr>
<th>Profile No</th>
<th>Volume of cut</th>
<th>Volume of fill</th>
<th>Cut to use transversally to axis</th>
<th>Excess of cut</th>
<th>Excess of fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>34</td>
<td>26</td>
<td>?</td>
<td>?</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>28</td>
<td>-</td>
<td>-</td>
<td>?</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
<td>6</td>
<td>?</td>
<td>-</td>
<td>?</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

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