

<b>FACULTY</b>	AGRICULTURE, ENGINEERING AND NATURAL SCIENCES		
<b>SCHOOL</b>	ENGINEERING AND THE BUILT ENVIRONMENT		
<b>DEPARTMENT</b>	CIVIL AND MINING ENGINEERING		
<b>SUBJECT</b>	THEORY OF STRUCTURES		
<b>SUBJECT CODE</b>	I3691VS		
<b>DATE</b>	JUNE 2023		
<b>DURATION</b>	3 HOURS	<b>MARKS</b>	100

**FIRST OPPORTUNITY EXAMINATION**

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 Internal Moderator: DR. VALENTINE KATTE  
 External Moderator: PROF. AKPOFURE TAIGBENU (University of the Witwatersrand)

This question paper consists of **5** pages including this front page.

**Instructions**

1. This is a **CLOSED BOOK** examination.
2. Read the questions carefully.
3. The paper contains 4 questions. **Attempt all FOUR (4) questions** for full marks.
4. Answers should be brief and to-the-point and where necessary be supplemented with neat sketches.
5. Marks for each question are indicated.
6. Make reasonable and logical assumptions where necessary.
7. Write your answers, wherever necessary, to three decimal places.

**Question 1**

**(20 Marks)**

The cable in Figure Q1 is loaded as shown. Determine:

- i. The reaction at support A and support E.
- ii. The cable profile (i.e., the sag at point C and point D).
- iii. The length of the cable.

**[13 Marks]**

**[2 Marks]**

**[5 Marks]**

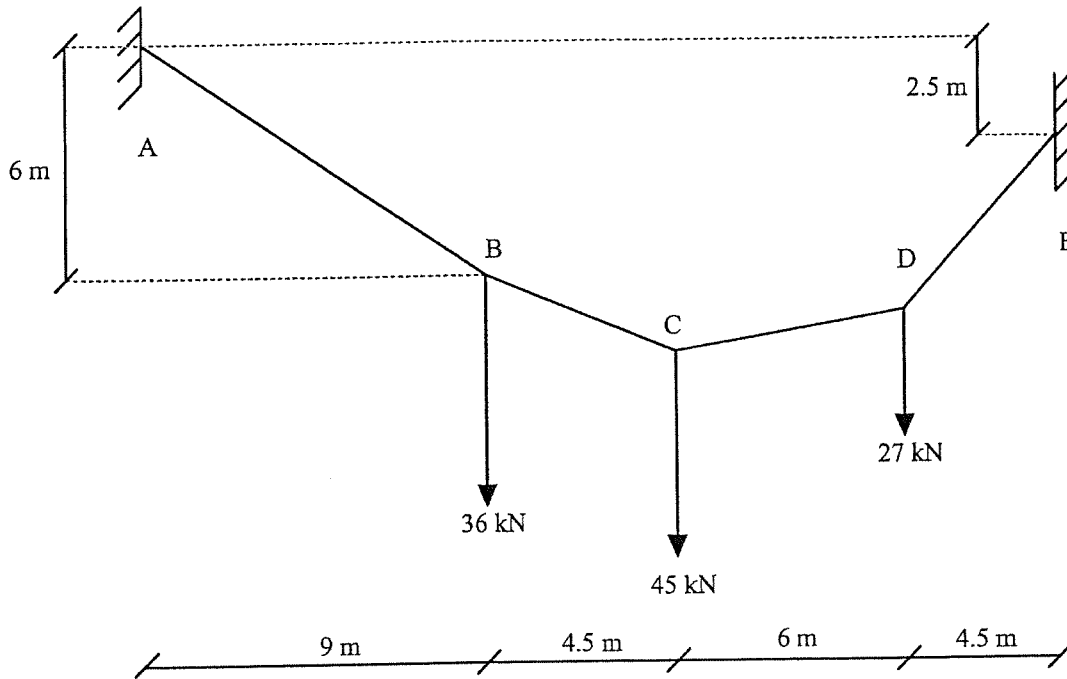


Figure Q1: A loaded cable

**Question 2**

**(20 Marks)**

A three-hinged parabolic arch ACB is loaded as shown in Figure Q2. Assuming that the profile of the parabola can be described by the following equation,  $y = \frac{x^2}{32}$ , where  $x$  and  $y$  are the horizontal and vertical distances from point C respectively. Determine the reactions at support A and support B.

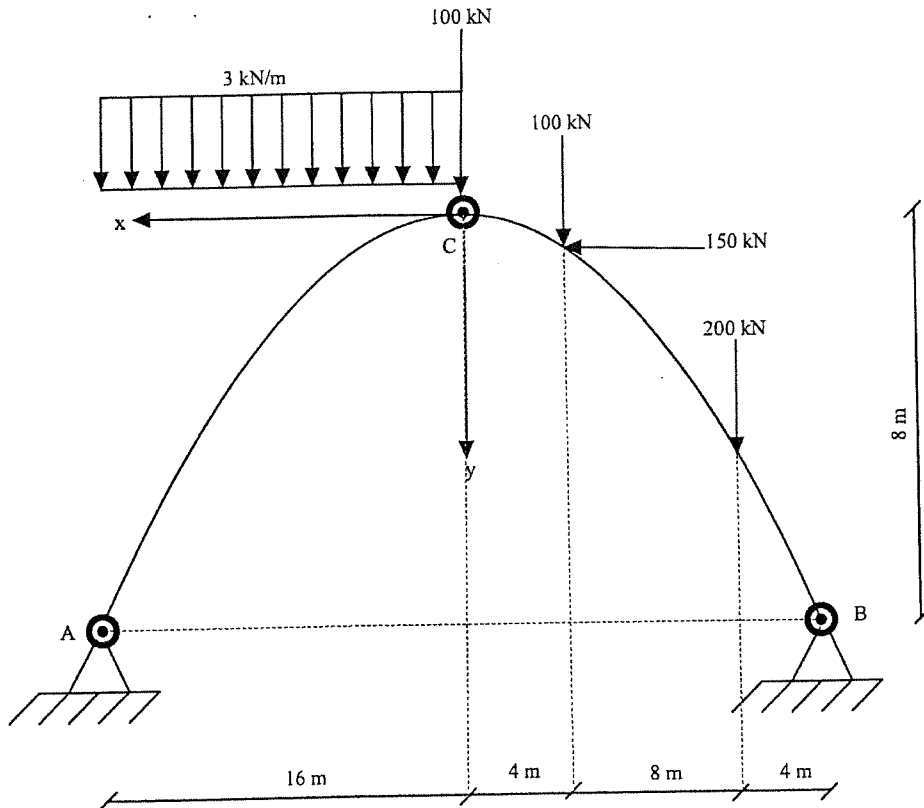


Figure Q2: A parabolic arch

**Question 3**

**(25 Marks)**

A simply supported beam with two cantilever overhangs is loaded as shown in Figure Q3.

- i. Determine the reactions at support B and support C. *[5 Marks]*
- ii. Draw the shear force and bending moment diagrams for the beam. *[15 Marks]*
- iii. Determine the magnitude and location of the maximum sagging and hogging moments as a result of the given loading. *[5 Marks]*

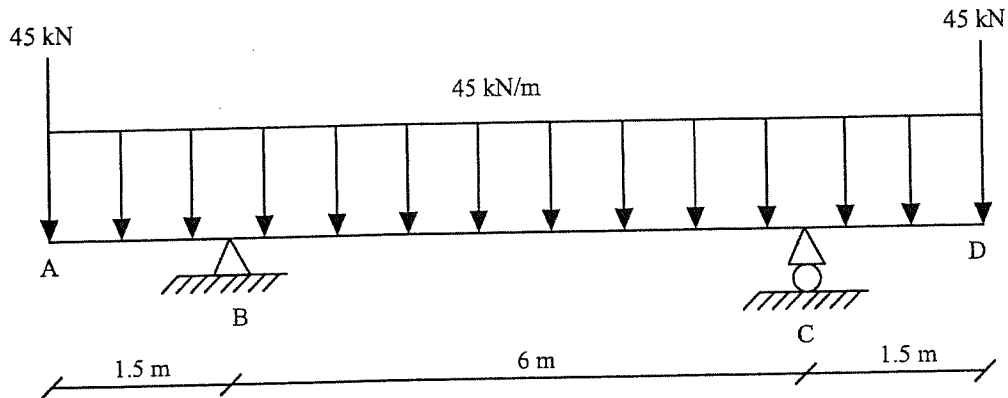


Figure Q3: A simply supported beam with cantilever overhangs

**Question 4**

**(35 Marks)**

A simply supported beam is loaded as shown in Figure Q4. Use the unit load method to determine:

- i. The rotation at support A and support B. *[24 Marks]*
- ii. The vertical displacement at point C. *[11 Marks]*

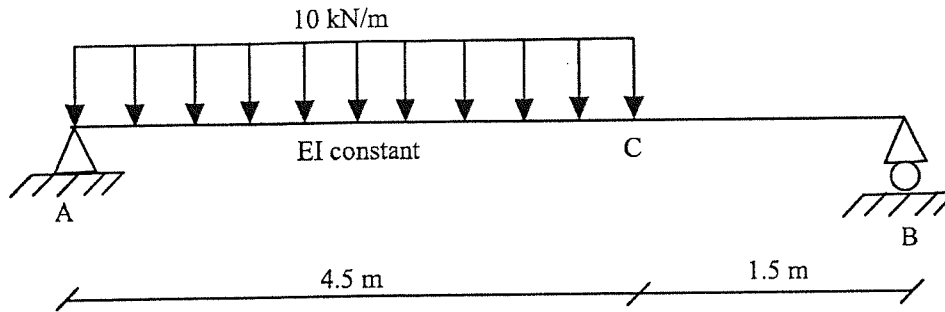


Figure Q4: A loaded simply supported beam