

UNIVERSITY OF BOLTON
**SCHOOL OF THE BUILT ENVIRONMENT &
ENGINEERING**

BENG (HONS) AUTO ENGINEERING

SEMESTER 1 EXAMINATIONS 2009/2010

VEHICLE STRUCTURES

MODULE NO: ATT3010

GERMAN STUDENTS

Date: Wednesday, 20 January 2010

Time: 10.00 a.m. – 1.00 p.m.

INSTRUCTIONS TO CANDIDATES:

There are **FOUR** questions on this paper.

Answer **1** question from Section A and 2 questions from Section B.

Marks for parts of questions are shown in brackets.

School of the Built Environment & Engineering
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SECTION A - ALL STUDENTS MUST ANSWER QUESTION 1

Q1. An engine support bracket is fully fixed or encastre at the support as shown in Figure 1. The bracket lie in the XY plane, where a vertical force P is applied 90° out of the plane at point A, in direction Z.

- a) Draw free body diagrams for appropriate parts of the bracket and then derive expressions for shear force, bending moment and torque in appropriate parts of the bracket. Show all your working clearly.

(20 marks)

- b) Determine the vertical deflection at point A using Castigliano method.

(30 marks)

Total 50 marks

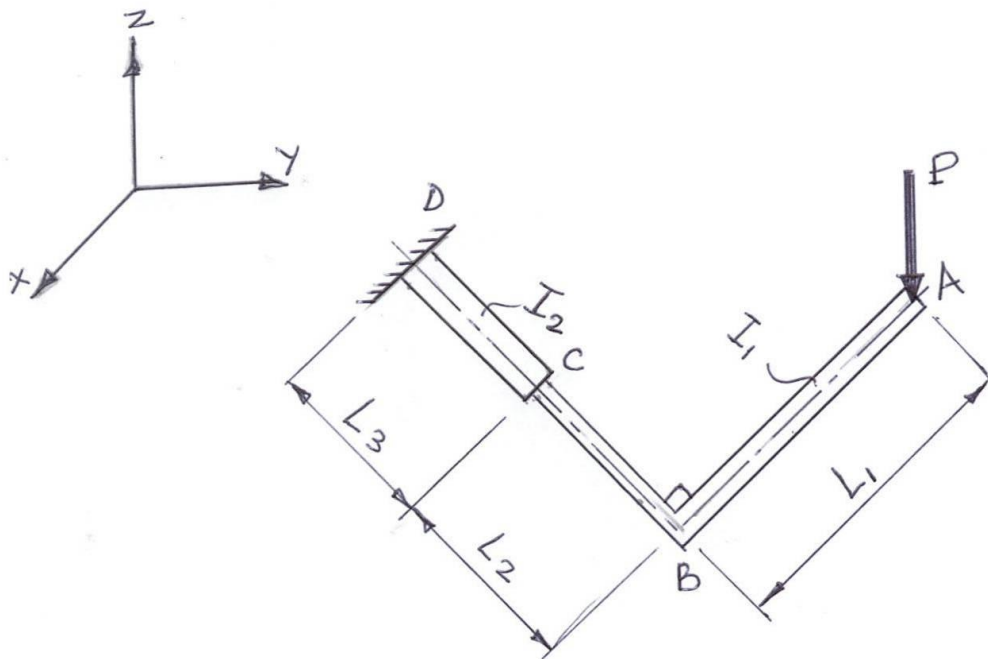


Figure Q1

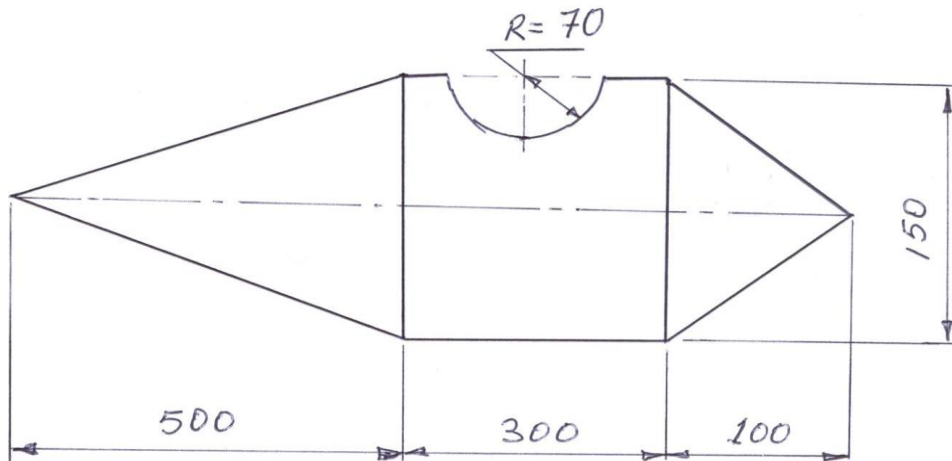
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SECTION B : ANSWER TWO QUESTIONS ONLY

2. The supersonic wedge shape has a maximum moment of 750 Nm applied. Assume $G = 30 \text{ GPa}$.
- a) Draw the shear flow diagram around the shape. (22 marks)
- b) If the shape is 3.5m long, what is the angle of twist. (3 marks)

Total 25 marks



All dimensions are in mm

Figure Q2

3. A 50mm diameter strut with rounded ends is made to transfer load from the roof top to the waist rail in a bus. The material has : $\alpha = 1/7500$ and the yield stress for the strut is 320 MPa, while the Young's Modulus is 210 GPa.
- a) Find the length for which the Euler and Rankine formulae will be equal. (15 marks)
- b) Draw the stress characteristics of Euler and Rankine against slenderness ratio and graphically determine the validity limit for Euler from the graph. (10 marks)

(10 marks)

Total 25 marks

Please turn the page

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4. A straight uniform strut has one end position- and direction-fixed, while the other end is hinged in position-fixed only.
- a) Derive a formula for the buckling load under ideal axial loading assuming $\alpha = nL = 4.5$. (21 marks)
- b) Calculate the percentage error in finding the buckling load if the equivalent length for a freely hinged strut is assumed as $2/3L$, where L is the actual strut length. (4 marks)

Total 25 marks

END OF QUESTIONS