بسم الله الرحمن الرحيم

King Fahd University of Petroleum & Minerals

DEPARTMENT OF CIVIL ENGINEERING

Second Semester 2008-2009 (082)

CE 203 STRUCTURAL MECHANICS - I

Final Examination

Day and Date: Wednesday, June 24, 2009 **Time:** 7:00 – 10:00 AM **Time allowed:** Three hours

Name		Class Sections (Instructor code)	1 (SHA)	2 (HNG)	3 (AJT)	4 (AHG)	5 (SAG)	6 (AAK)	7 (MMZ)
Number			CIRCLE YOUR SECTION NO.						

SAMPLE exam!

Summary of Scores

Problem	Full Mark	Score
1	14	
2	20	
3	20	
4	20	
5	20	
6	6	
Total	100	
Remarks		

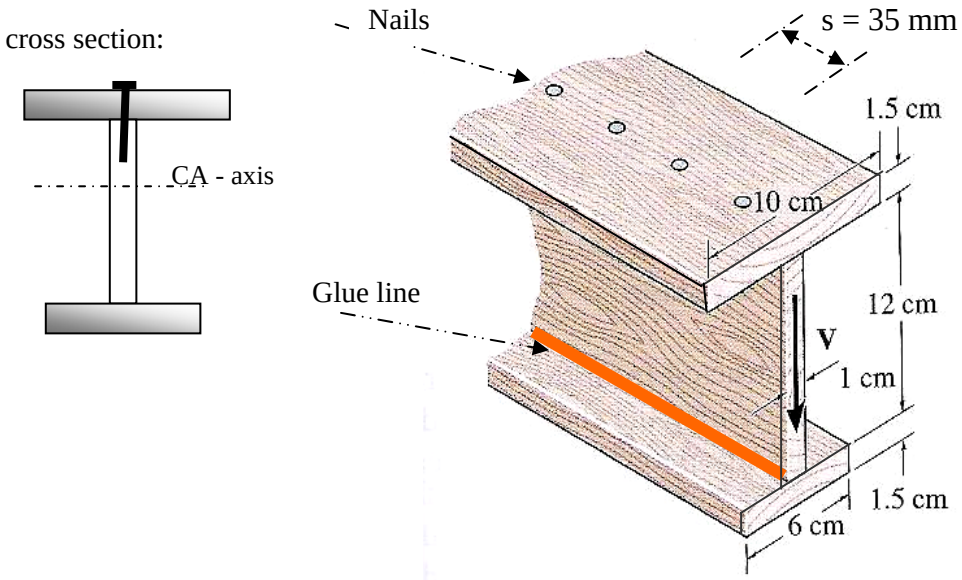
Note: Basic Formulae sheet is provided with this examination.

Problem 1:

The beam shown in Fig. P-1 is constructed from three wooden boards. The *top board* (10 cm x 1.5 cm) is *nailed to the vertical board* (12 cm x 1 cm) by nails spaced at s = *35* mm, while the *bottom board (*6 cm x 1.5 cm*) is glued to the vertical board.* If the beam is subjected to a shear force V = 15 kN, determine:

1. the *shearing force* in each nail holding the top board;
2. the *shear flow* (q: force *per* unit length) in the glue holding the bottom board.

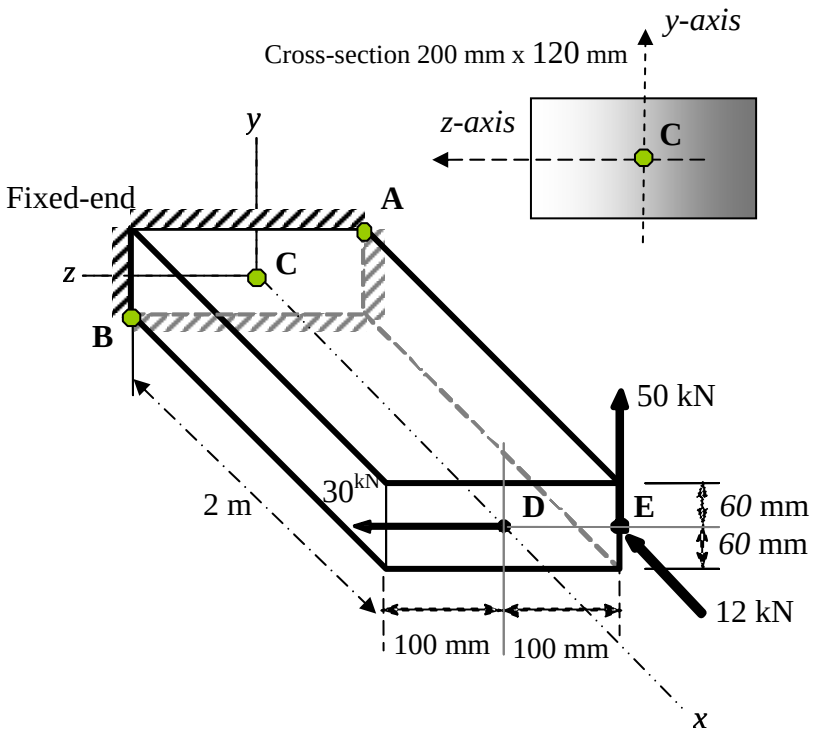
Fig. P-1 Wooden beam composed of three boards held together with nails and glue.



Problem 2:

For the 2-m long beam CD shown in Fig. P-2 (with one end fixed and the other end free) the beam is loaded with three concentrated loads. Determine the normal stresses, at **corner points A, B**, and at the **centroidal point C** of the fixed-end (*namely*: σ_A, σ_B, and σ_C) and specify the stress as tensile (T) or compressive (C).

Fig. P-2 : Cantilever beam in 3D with three concentrated loads all applied at points D and E at the free-end



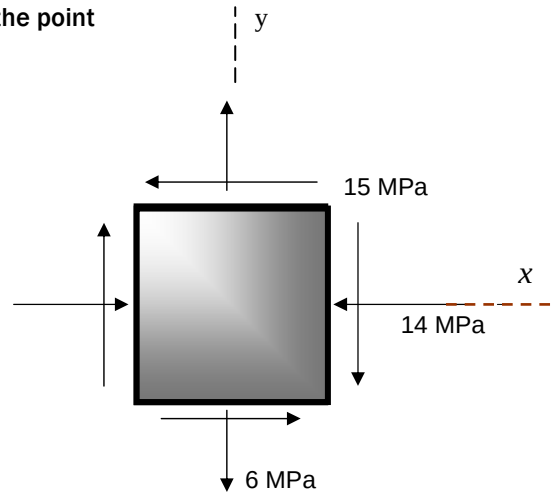
Problem 3:

For the plane state of stress shown on the element given in Fig. P-3:

1- Construct Mohr's circle.
2- **Use the circle** to determine the principal normal stresses and the orientation of the element on which they act. Show the results on a *properly oriented* element.
3- **Use the circle** to obtain the state of stress on an element oriented 15° counter-clockwise from the given element. Show the results on a properly oriented element.
4- **Use the stress transformation equations** to determine the maximum shear stresses and the orientation of the element on which they act. Show the results on an element.

Note: All calculations and necessary steps should be shown.

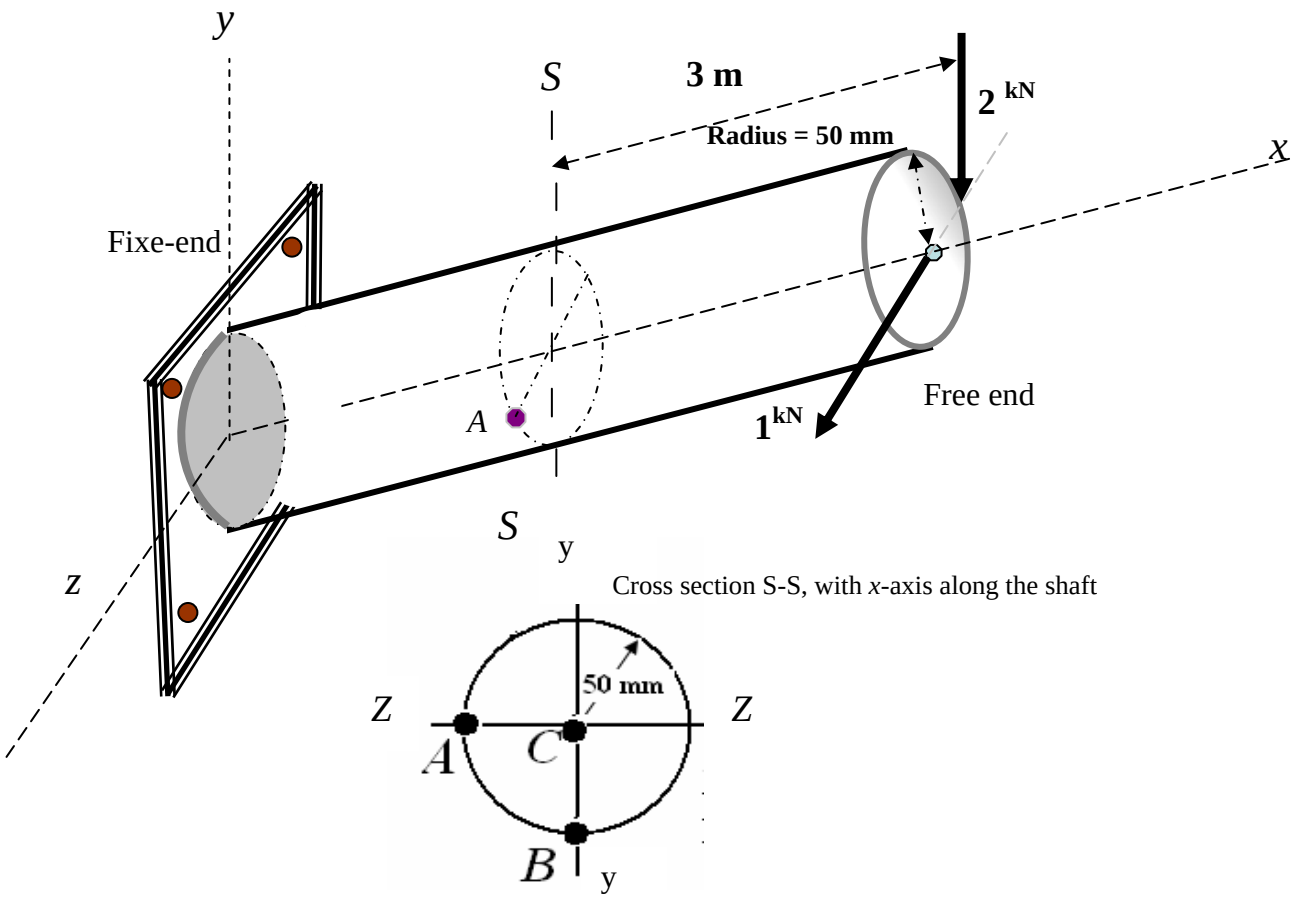
Fig. P-3: A plane state of stress at the point



Problem 4:

Determine the state of shear stress τ at points A, B, and C (*namely*: τ_A, τ_B τ_C) on the section of a solid circular shaft at location *S-S located 3m from the free-end* as shown in Fig. P-4.

Fig. P-4: Beam with two concentrated loads P_y = 2 kN and P_z = 1 kN.

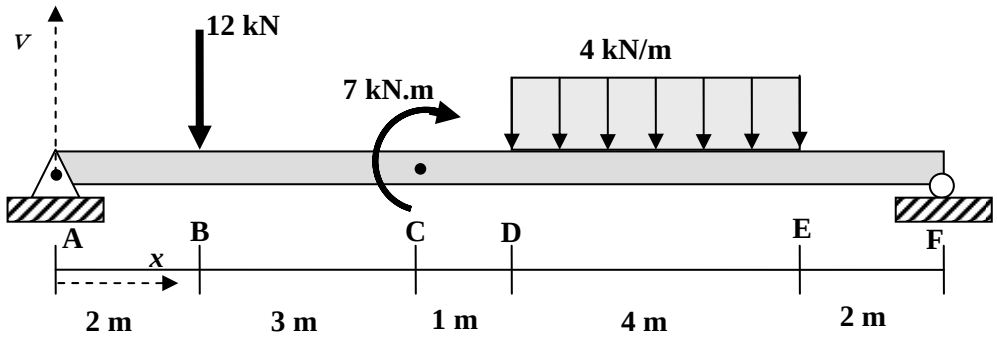


Problem 5

The 12-m long beam AF is subjected to the loads shown in Fig. P-5. Using **discontinuity (singularity)** functions, determine:

1. the equation of the elastic curve $v(x)$;
2. the *magnitude* and *direction* of the deflection of the beam at point **D**;
3. the *magnitude* and *direction* of the slopes at the beam two ends at **A** and **F**.

Fig. P-5: Beam ABCDEF with given EI = Constant.



Problem 6:

For the beam ABC shown in Fig. P-6 use the ***singularity*** (discontinuity) function to **derive an expression** (equation) for the **deflection** (elastic curve) for the beam shown. EI = constant

Write all necessary **boundary conditions**, but ***do not solve for the unknowns in the equation***.

Fig. P—6: Beam with free end A at x = 0, roller-support at B, and fixed-end at C