## Problem 1.1 *(10 points)*

ABCD represents a frame attached to the wall at A, with the free end (D) subjected to two forces: 1) W acting in the negative Z direction and 2) P acting in the positive X direction.

(a) Calculate the internal resultants, i.e, forces and moments developed at the centroid of the cross sections-

- A, and
- B

(b) Does the internal resultant force vary as you move along the line segment AB? What about along line segment BC?

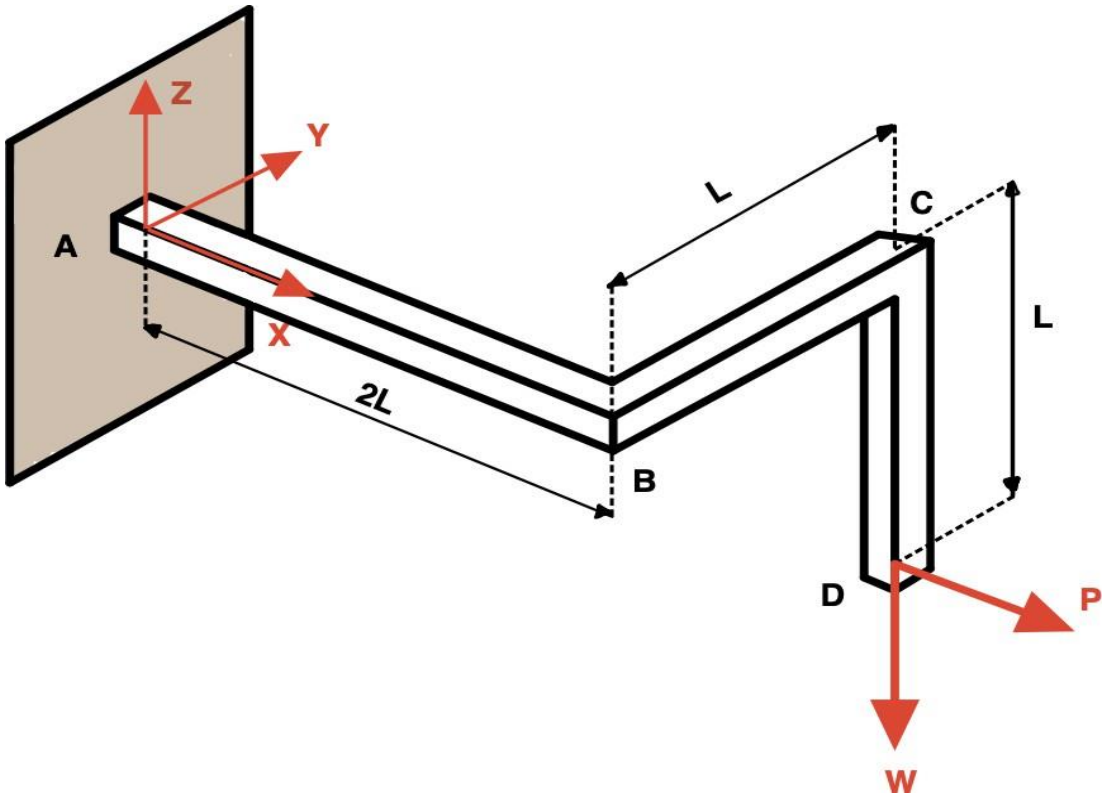



Fig 1.

## Problem 1.2*(10 points)*

Two wooden blocks of identical square cross section (10 mm x 10 mm ) are glued together along the plane AC as shown in the figure below. The dimension of the entire setup is 10 mm x 10 mm x 100 mm.

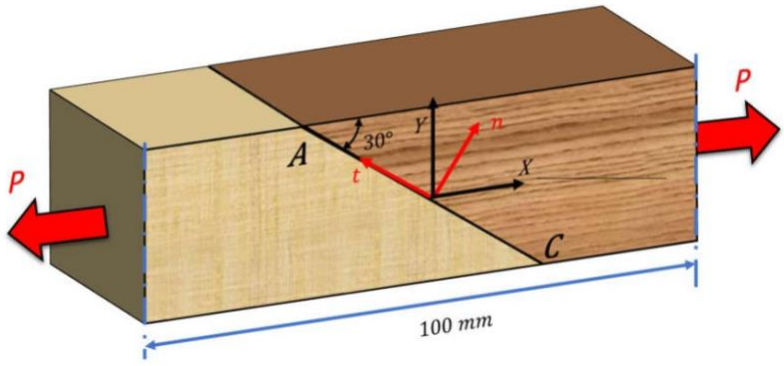



Fig 2

(a) Assuming that the glue can withstand a maximum shear stress of 10,000 Pa, calculate the maximum force P that can be applied at the end of the wooden blocks.
(b) A new glue was tested which can withstand a maximum normal stress of 5,000 Pa and shear stress of 3500 Pa. What is the maximum load that can be applied?

**Problem 1.3 (10 points)**

Frame assembly is subject to the loading as shown in Fig 3. The bars ABC and BD are rigid and the connections at A, B, and D are pin joints.

**a)** Determine the magnitude of the internal shear forces in the pin joints and identify the pin that carries the maximum magnitude load.

**b)** If the area and the shear strength of each pin is $A$ and $\tau$, respectively, then express the maximum value of P possible without failure in terms of $\tau$ and $A$. Assume that pins B and D are double-sided and the pin A is single-sided in your calculations.

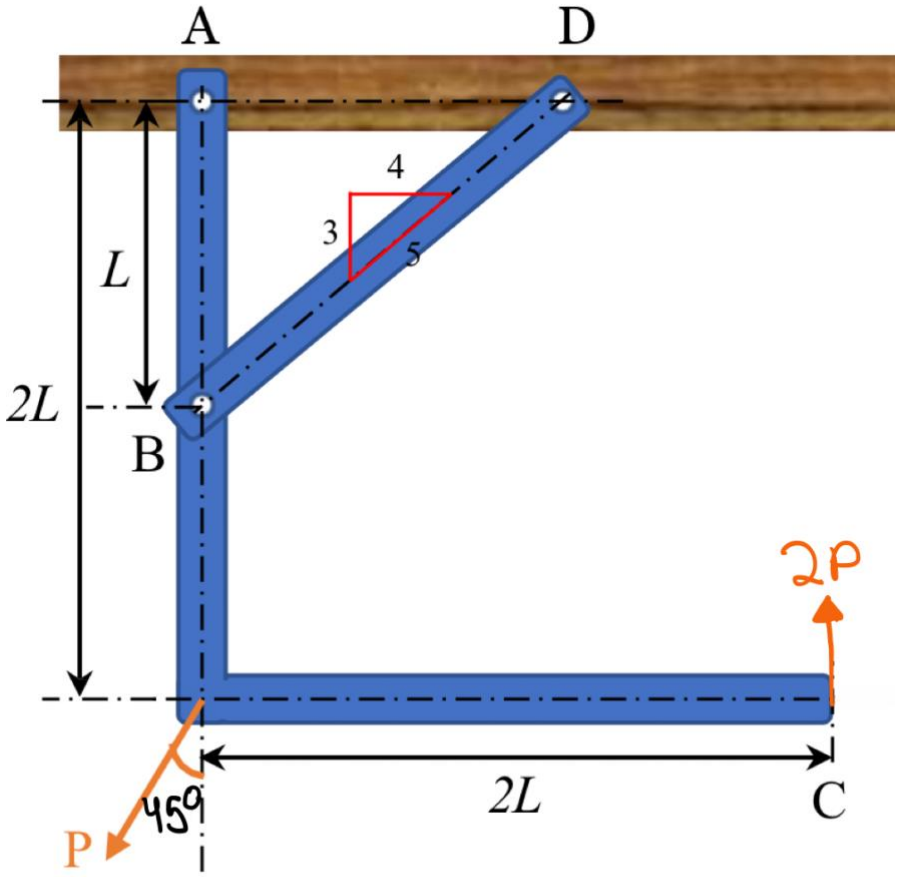
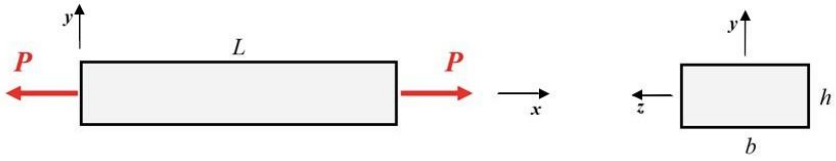



**Fig 3**

## Problem 1.4 Conceptual *(2.5+2.5 points)*

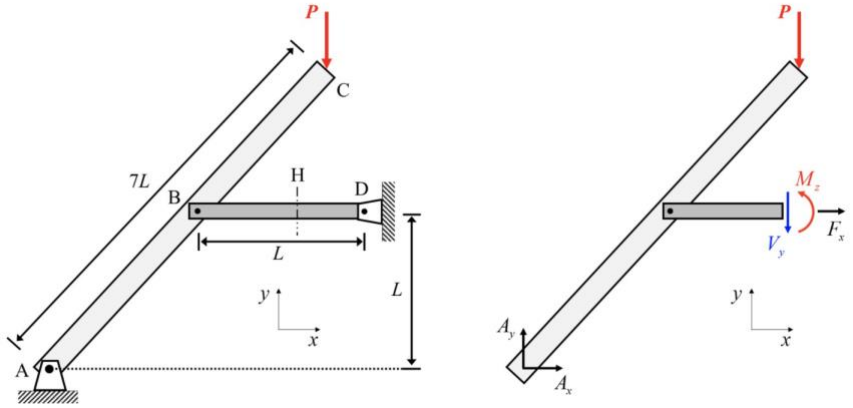
(a) The rod shown below has a rectangular cross section and is made of a material with Young's modulus $E$ and positive Poisson's ratio $\nu$. It has dimensions $L > b > h$ and it is subjected to a tensile load P in the x direction, as shown.




Select the correct statement. And justify your stance.

(a) $|\Delta h| > |\Delta b|$
(b) $|\Delta h| < |\Delta b|$
(c) $|\Delta h| = |\Delta b|$
(d) Insufficient information. Depends on the value of Poisson's ratio.

(b) Bar ABC is supported by a pin joint at point A and loaded by a vertical force P at point C. Bar ABC is also connected to bar BD via a pin joint at B which in turn is supported by a pin joint at D. Bar BD is oriented along the x axis.




Select the zero internal resultant(s). And justify your stance.

(a) Normal force $F_x$
(b) Shear force $V_y$
(c) Bending moment $M_z$
(d) All internal resultants are non zero