OPTI 421/521 – Introductory Opto-Mechanical Engineering

Homework 5:

Part 1: Static Equilibrium Problems

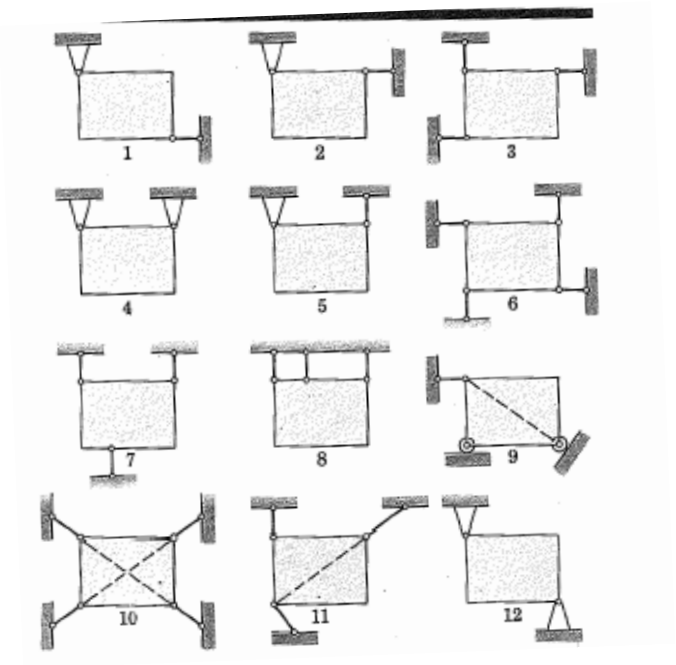
(Neat work is expected, but no report is required).

1)

These diagrams show a rectangular plate held by joints defined by pins and links.

Which ones have:

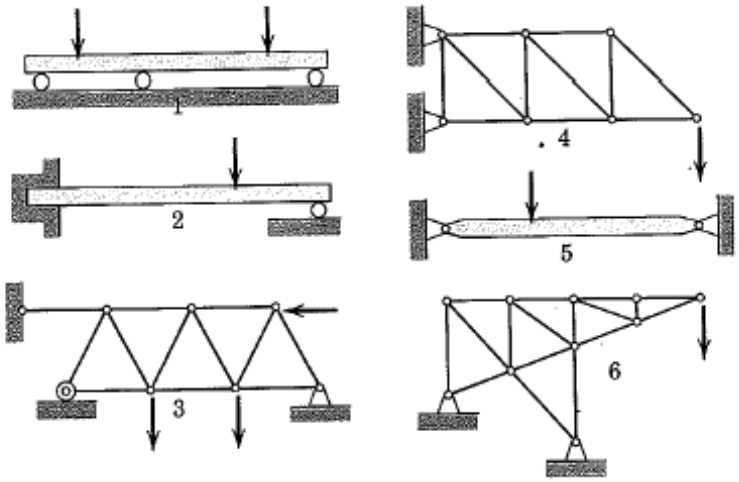
A) Static determinancy
B) Overconstraint
C) Underconstraint
D) Overconstraint in some DoF, Underconstraint in others



2)

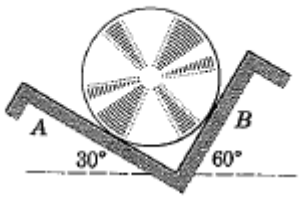
Each of these structures is staticly indeterminate : overconstrained.

Show at least one modification in the supports which would correct this.



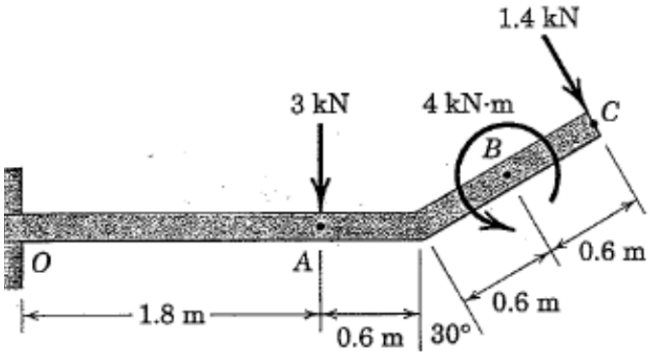
3)

The homogeneous cylinder has a mass of 40 kg and rests on smooth surfaces A and B which are inclined 30° and 60°, respectively, from the horizontal. Determine the contact forces at A and B.



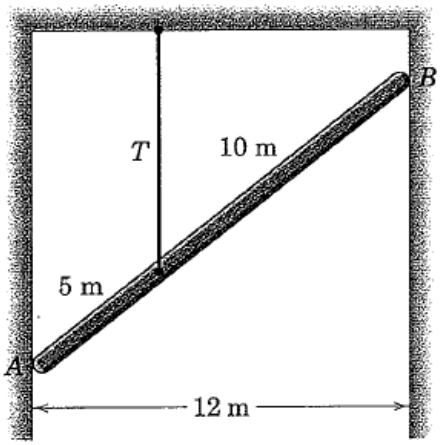
4)

The uniform beam has a mass of 50 kg per meter of length. Compute the reactions at the support O. The force loads shown lie in a vertical plane.



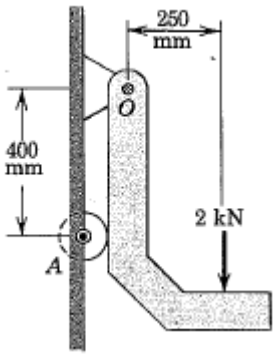
5)

The uniform 15-m pole has a mass of 150 kg and is supported by its smooth ends against the vertical walls and by the tension T in the vertical cable. Compute the reactions at A and B.



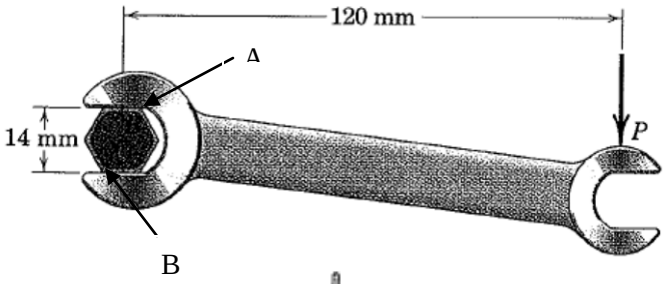
6)

The resistance of the bracket to bending is tested under the 2-kN load. Compute the force on the roller at A and the total force supported by the pin at O.



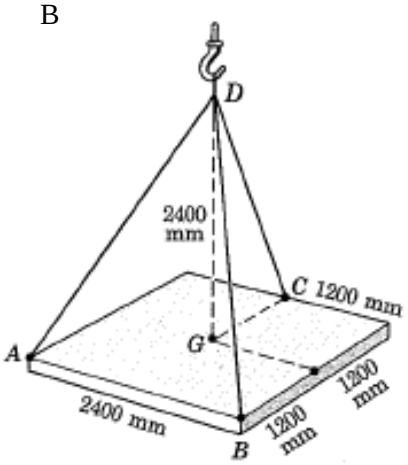
7)

A torque (moment) of 24 N · m is required to turn the bolt about its axis. Determine P and the forces between the smooth hardened jaws of the wrench and the corners A and B of the hexagonal head. Assume that the wrench fits easily on the bolt so that contact is made at corners A and B only.



8)

The square steel plate has a mass of 1800 kg with mass center at its center G. Calculate the tension in each of the three cables with which the plate is lifted while remaining horizontal.



Part 2: Manufacturing summary

Write a summary on manufacturing of metal components. Specifically, what types of parts can be made on the mill or lathe. What surface finish and surface accuracy is typical for each? What type of parts would be made on the NC machines? Do some research to find out a more specialized manufacturing process, (EDM, molding, additive manufacturing, …). What are the advantages and disadvantages of these methods?

The purpose of this exercise is for you to think through the basics. Do research on your own as necessary. You need only to write a few paragraphs, which should be submitted along with Parts 1 and 3.

Part 3 Rules of thumb

Provide three rules of thumb using the format provided.