系所組別： 土木工程學系甲、丙、丁組
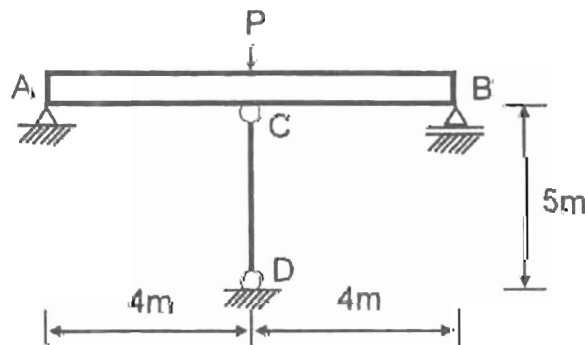考試科目： 材料力學 考試日期：0219，節次：1

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1. (1) Define the following terms: principal stress, principal strain. (5%)

   (2) Find the principal stresses of plane stress (x-y plane). (10%)

   (3) If the elastic modulus is E, Poisson's ratio is v, find the in plane principal strains of plane stress (x-y plane). (10%)

2. A rigid beam is pinned supported at its left end and at mid-span and the right end by two springs, each of stiffness k (force/displacement). The beam supports a weight P at mid-span.

   (1) Find the forces of reaction at the three support points. (15%)

   (2) Sketch the shear force and bending moment diagram. (10%)
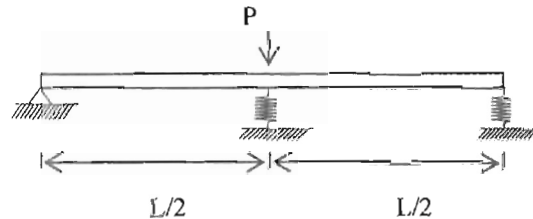
3. A simple beam AB of span length $L = 8$ m supports a concentrated load P at the midpoint C. The beam also supported by a circular rod CD at midpoint C, and both ends of CD are hinges. The beam AB has a cross section of width $b = 20$ mm and height $h = 60$ mm. The rod CD has a length 5 m, and diameter $d = 10$ mm. Assume all the members are made with the same material. The elastic modulus $E = 200$ GPa, allowable normal stress $\sigma_{allow} = 600$ MPa, and factor of safety $n = 3$.

   (1) Find the allowable load P_{allow}. (20%)

   (2) Find the vertical displacement of point C induced by P_{allow}. (5%)

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4. A stress field is shown in the figure.

(1) Calculate the maximum normal stress and the maximum shear stress. (15%)

(2) If the elastic modulus $E = 200$ GPa, Poisson's ratio $\upsilon = 0.3$, find the principal strains. (10%)