KUNGL
TEKNISKA
HÖGSKOLAN

VETENSKAP
OCH
KONST

Department of Mechanics
Lars Söderholm, 7152
e-mail lhs@mech.kth.se

Continuum Mechanics, fall 2008
Important topics for the oral examination in continuum mechanics

A number of questions for preparation for the oral exam. The questions marked by

a * are the most basic ones.

1*. How to handle the operator notation, matrix notation and index notation with the summation convention.

2*. Symmetric tensors. Eigenvectors and eigenvalues. The deviator.

2a. The three principal invariants.

3*. Orthogonal tensors

4. Cauhy's polar decomposition together with a picture of its meaning.

5*. How are basis vectors and vector and tensor components transformed under a change of basis?

6. Mohr's circle.

7*. The permutation symbol.

7a. The relation between antisymmetric tensors and vectors.

8*. Isotropic tensors

9. Gradient, divergence and curl of a vector field.

9a*.Gauss' theorem.

10*. The description of small deformations. The linear rotation and the linear strain. Changes of lengths, volume and angles.

11. When the linear strain is identically zero the mapping is rigid.

12. Linear strain for spherical symmetry. (skip cylindrical symmetry)

13*. Using $\mathbf{X}, t$ or $\mathbf{x}, t$ as independent variables. Expressing the acceleration in both ways.

14. The time derivative of an integral over a material volume

15*. Conservation of mass leads to the equation of continuity.

16*. Momentum balance. The stress vector hypothesis. The proof that the stress vector is given by a tensor. The momentum equation.

17. Maximum shear stress.

18. Angular momentum and the symmetry of the stress tensor

19. Force on a bent tube.

20*. Elastic energy for a linearly elastic solid. Consequences for the number of possible elastic constants.

21*. Isotropic linearly elastic solid.

22*. Simple shear and the shear modulus

23*. Isotropic expansion and the bulk modulus

24*. Uniaxial tension and Young's modulus and Poisson's ration.

25. Stability and the restrictions on the elastic moduli

26. Uniqueness

27*. Torsion of circular cylinder

28. Torsion of noncircular cylinder and the warping function

29. The compatibility relations and their meaning

30. Plane strain. Stress normal to the plane necessary. Airy's stress function. Compatibility and the biharmonic equation. The example

31. Bending of a beam.

32. The dynamic Navier's equations and longitudinal and transverse elastic waves.

33. Minimizing the elastic energy gives the equations of equilibrium for an elastic body. The corresponding thing for Laplace's equation. Conditions on the normal derivative on the boundary gives an extra surface term to the integral to be varied.

34*. Euler's equation for an ideal fluid.

35. Sound waves and the wave equation.

36*. Newtonian fluids. The stress tensor and the Navier-Stokes equations.

36a. The signs of the viscosities.

37*. Plane Couette flow

38*. Poiseuille flow, in a channel and in a circular pipe.

39. Flow generated by an oscillating plane

40. Bulk viscosity as a change of the pressure.

There can also be questions on the home assignments.