LULEÅ UNIVERSITY OF TECHNOLOGY
Applied Physics

Course code	**F7006T**
Examination date	2016-03-15
Time	9.00 - 14.00 (5 hours)

Examination in: FASTA TILLSTÅNDETS FYSIK / SOLID STATE PHYSICS
Total number of problems: 5
Teacher on duty: Hans Weber Tel: (49)2088, Room E304
Examiner: Hans Weber Tel: (49)2088, Room E304

Allowed aids: Fysikalia, Physics Handbook, Beta, calculator, COLLECTION OF FORMULAE for Solid state physics and COLLECTION OF FORMULAE for Quantum Physics.

Define notations and motivate assumptions and approximations. Present the solutions so that they are easy to follow. Maximum number of point is 15 p. 7.5 points are required to pass the examination. Grades 3: 7.5, 4: 9.5, 5: 12.0

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1. **Reciprocal lattice**

   Calculate for Copper the shortest distance from the centre (K=0) to the surface of the Brillouinzone and calculate the radius of the Fermi sphere. Compare these two results and give a comment. (3p)

2. **Crystal structure**

   The elements Gold, Molybdenium and Silicon all have a different crystal structure.

   (a) Calculate the number of atoms contained in the primitive unit cell for each of these elements. (1p)

   (b) Calculate the number of atoms contained in the cubic unit cell for Gold, Molybdenium and Silicon. (1p)

   (c) For Silicon calculate (in Ångström) the nearest and next nearest neighbour distance. (1p)

3. **Heat capacity of Sodium**

   Sodium metal displays free–electron–like behaviour. The thermal effective electron mass is equal to the electron mass and the Debye temperature is 160 K. What fraction of the total heat capacity at 300 K is contributed by the electrons. (3p)

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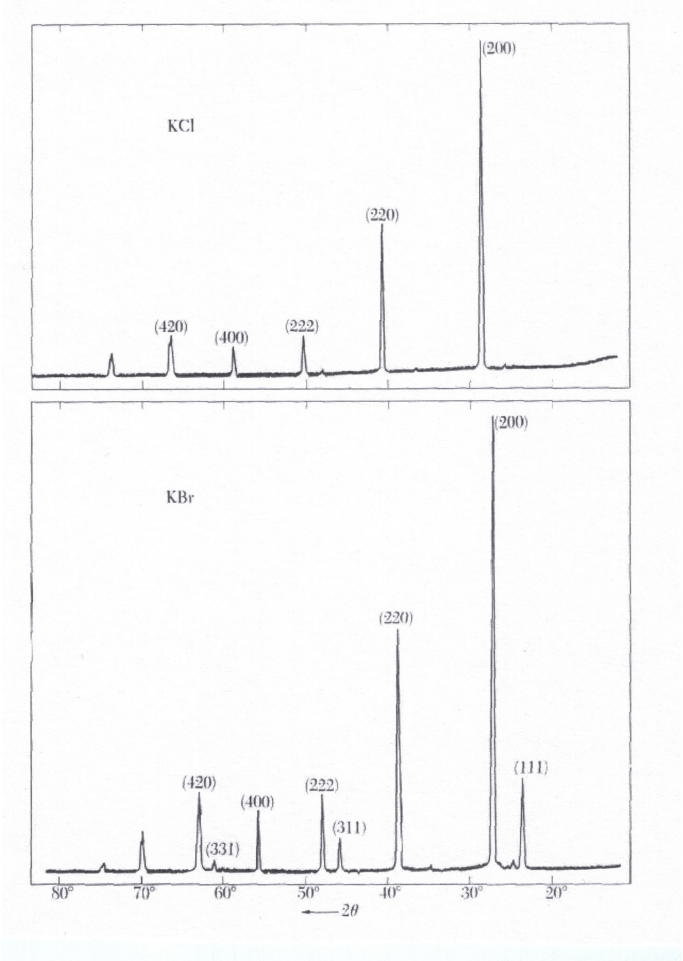

4. **Bragg diffraction**

   In the figure above you see the results from x–ray reflections of KCl and KBr powders. Both salts have an fcc lattice, but as one can see the x–ray reflections do not look the same. Explain this apparent difference. (3p)

5. **Germanium**

   A sample of Ge had the following values of resistance at the given temperatures:

T (K)	310	321	339	360	383	405	434
R (Ω)	13.5	9.10	4.95	2.41	1.22	0.74	0.37

   Evaluate the energy gap. (3p)

Good Luck !