



**Telemark University
College**

Faculty of arts and science

Exam

4324 Georesources and groundwater

April 30 2013

Duration: 09.00 AM – 01.00 PM (4 hours)

Language: English

Pages: 4

Helping tools: None

Remarks: All problems have equal weight

Attachments: 1

The results are to be found on internet via Studweb

Problem 1

At the end of the last ice age in Norway the glacier melted down and the glacier front retreated. At several places the glacier front retreat stopped for a while and front deposits were made. You should know about examples of such front deposits from class and field school. Below the marine limit the ice front was either floating in the sea or resting on the grounding line. In this case the glacier is resting on the grounding line.

- Make drawings which show the drainage beneath the glacier and the formation of moraines and waterlain sediments (sediments settled in water). Tell about the processes that have been working.
- Make a map of the different deposits you will expect to find from this an ice front area. Set name of the different deposits and connect them to situations from question 1 a.

Problem 2

The photo in Attachment 1 shows a cross section of layered sedimentary rocks. The photo is presented both in colours and gray scale.

- Extend the layers by drawing and describe and explain the structures you see here.
- Make a geological map (horizontal) of this bedrock outcrop and put on signatures for strike and dip.

Problem 3

- Describe different Norwegian aquifers and in what way the new groundwater in them is made.
- What kind of aquifers is used for large water supply and what aquifers can be used for small ground water supplies only? Argue for the answers.

Problem 4

Ground water modelling.

- Make a map where you put on the different boundaries for a modelled aquifer.
- Describe the finite difference method
 - How is a finite difference grid built?
 - Below is the flow differential equation. Explain the variables and parameters.
 - What parameters should you put into your model?
 - What is the output variable?
 - How will you use GIS (Geographic Information Systems) to present the output?

$$\frac{\partial}{\partial x} \left(K_x \frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left(K_y \frac{\partial h}{\partial y} \right) + \frac{\partial}{\partial z} \left(K_z \frac{\partial h}{\partial z} \right) = S_s \left(\frac{\partial h}{\partial t} \right) - R^*$$

Attachment 1



Attachment 1

