



Høgskolen i Telemark

EXAM

4324 Georesources and groundwater

30. april 2014

Tid/Time: 4 hours

Målform/Language: English

Sidetall/Pages: 3

Hjelpemiddel/
Helping tools: None

Merknad/Notes: None

Vedlegg/Appendix: None

The results from the exam will be published on Internet via Studentweb

Problem 1

Describe the two geophysical methods Ground Penetrating Radar and 2D-Resistivity:

- In what situations will we use these methods?
- What are the principles behind the two methods?
- How are the main components arranged in field?
- How is the field work performed?
- Give examples of the results.

Problem 2

The heat in groundwater can be exploited by heat pumps for heating of buildings.

- In what ways is heat entering an infiltration aquifer?
- How is the groundwater temperature developing through a year in such an aquifer? Illustrate with drawings.
- A certain heat well can permit a lowering of the water table in the well for 2 meters. The ground water temperature is 6°C. Use Thiem's well formula and the heat pump effect formula to calculate the effect by lowering the water temperature to 2°C.

Thiems well formula: $S_w = \frac{Q}{2\pi T} \ln \frac{R}{r} + \epsilon$ (m)

where S_w = lowering (m)
 Q = pump capacity (m^3/s)
 T = transmissivity (m^2/s)
 R = extension of depression cone(m)
 r = well radius (m)
 ϵ = screen losses

$T = 0.02 m^2/s$

$R = 1000 m$

$r = 0.075 m$

$\ln \frac{R}{r} = 9.5$

$\epsilon = 0$

Heat pump effect formula: $E = C_p * Q * \Delta t$ (kW)

where C_p = specific heat capacity of water
 $= 1.16 kWh/m^3 \text{ } ^\circ C$

Q = pumping rate (m^3/h)

$\Delta t = t_{in} - t_{out}$

= temperature difference between input and output of the heat pump

- Give an evaluation of the aquifer and the T-value and the heat potential compared to pump capacity.

Problem 3

- Make a drawing of the cross section of an end moraine with the ice front.
- What kinds of grain sizes and sorting do we find in an end moraine?
- What processes form an end moraine?

- d. Often eskers are connected to the same glacial environment as end moraines. What is an esker?
- e. Make a drawing where the eskers are running in the terrain. Place the ice front.

Problem 4

Describe two Norwegian landforms by their:

- a. Characteristic landforms
- b. Bedrock geology; rocks and geological history.
- c. Location in Norway