

**Final Examination Topics for  
Hydrogeologist Engineer Master Students**

**Hydrogeology and Water Mining**

1. What is the definition of the aquifer? What are the principal aquifer rock types? Please give examples for the values of hydraulic conductivity in case of different rock types. What is the definition of the storage coefficient?
2. What is hydrogeology? Please describe the Darcy-equation and its components. What are the elements of hydrologic cycle? Please describe the global hydrological (water budget) equation.
3. What is the definition of groundwater basin? Please describe the Hubert's model and the Toth's flow model. Please describe the local, medium and regional flows in a basin. Please describe the Ghyben-Herzberg equation in case of sea water intrusion. How can this phenomenon jeopardize drinking water supply in coastal regions?
4. Please describe the main steps of the Theis pumping test evaluation. Please give the main equations with the well function. What is the meaning of recovery data in well hydraulics? Why can experts prefer field data to laboratory data concerning the hydraulic conductivity?
5. Please describe the evolution of the safe yield concept. What are the most important groundwater management tools? What kinds of aspects have the term of sustainability?
6. How does artificial recharge work in reality? Which regions can be suitable for this method? What are the main technical solutions for implementing the artificial recharge? What is the advantage of conjunctive water use?
7. What is the importance of transboundary aquifers? Which is the more preferable position in case of water management? Downstream side or upstream side? What is the situation in Hungary concerning the internationally shared aquifers? How can groundwater flow simulations help the decision makers?
8. Drinking, mineral, medicinal and thermal water resources and their utilization from aquifers. Please give the basic definitions. How can geothermal gradient and heat flow be defined? What is the relationship between hydrogeology and geothermal energy utilization?

9. Please describe the main properties, features and aspects of karst aquifers? What kinds of methods are existing in karst investigations? Please give information about hydrograph analysis. What are the main processes of karstification? What kind of distributive methods can be used in karst modeling?
10. What are the main steps of the comprehensive water management focusing on water status? Please describe the concepts of the Water Framework Directive. Why is the Danube watershed so special?
11. Please describe the isotope hydrology techniques in groundwater investigation. Please give the most important radioactive and stable isotopes in hydrogeology. What are the methods for groundwater age dating?
12. How can you estimate the groundwater recharge with environmental isotopes in the unsaturated and the saturated zone? What kind of interaction can exist between groundwater and surface water?
13. Water utilization possibilities in general. Definitions, types, application, advantages - disadvantages.
14. Springs and galleries. Definitions, types, application, advantages - disadvantages.
15. Boreholes and wells. Definitions, types, advantages - disadvantages.
16. Well design - necessary basic information, determination of the expected geology cross section, principles, and the main parts of the well.
17. Well design - construction order of the well, the role and the construction of the main elements (packed joint, gravel pack, steel shoes, bottom plate, grouting)
18. Well design - Necessary calculations, drilling- and pipe sizing, pipe materials
19. Classification of drilling techniques (basis for classification, benefits, limitations)
20. Introduce one selected drilling technique (principle of operation, applicability, equipment, pros and cons, etc.)
21. Types/classification of well screens
22. Physical and chemical stressors on well screens, basic principles for screen design
23. Rotary mud drilling (introduction, types, benefits, equipments, accessories)
24. Physical and chemical properties of the rotary drilling mud (functions of the mud, benefits, limitations, on site lab tools)

## **Groundwater Prospecting, Water Management and Geotechnical Engineering**

1. Elements of the hydrologic cycle (evapotranspiration, precipitation, surface runoff, infiltration process, recharge, seasonal and other impacts for shallow groundwater)
2. Basics of GW flow (hydraulic gradient, Darcy's flow velocity, potential energy, pressure head, total head, hydrostatic pressure, pressure-depth relationship)
3. Theory of hydrogeological unit basin (Tóth J.) (flow and equipotential lines, recharge and discharge area, scale of groundwater systems)
4. Sustainable yield concept in GW management (static and dynamic yield in case of surface - and groundwater, exchange rate, types of water uses, groundwater recharge, GW dependent ecosystem, Surface water-gw interaction, storage and specific yield, GW abstraction from unconfined and confined aquifers, water budget)
5. The problems in GW resource management (changes in recharge, aquifer depletion, the origins of groundwater salinization, land subsidence, pollution)
6. Groundwater protection (basic ideas of protection, problems in protection, protection zones, watersheds, travel times etc)
7. Step by step site investigation (gaining geological and hydrogeological information, hydrogeological cross-sections, gw level measurements, potential maps, flow direction and gradient, upward-downward flow, monitoring)
8. Aquifer properties (hydraulic conductivity, transmissivity, specific yield and storage, porosity, determination of hydraulic conductivity)
9. Application of surface geophysical methods in GW exploration (resistivity methods, DC, IP, GPR, MT, seismic m., gravity m., advantages, disadvantages, which method for which type of exploration, needed tools, the results)
10. Application of borehole logging in GW exploration (methods in borehole, resistivity logs radiation logs, penetration depths, interpretation, aquifer identification)
11. Application of well logging (which type of methods can be used in a cased well, well inspection logging, flow meter, cement bond logs, interpretation of results)
12. Subsurface exploration (types of drilling, soil sampling, investigation methods, well construction, well types, well testing and its results)

13. Tracers in GW exploration
14. Remote sensing in GW exploration
15. Basic characteristics of soils
16. In-situ testing of soil
17. Philosophy of EC7
18. Earth pressures – Active Earth Pressure
19. Earth pressures – Passive Earth Pressure
20. Shallow foundations
21. Deep foundations
22. Stability of self-supporting soil masses
23. Retaining structures
24. Geosynthetic materials
25. Geotechnical soil improvements
26. Geotechnical aspects of landfill sites