Structure of the exam

10 minutes you choose from The Questions what to answer

10 minutes, talk about hydrologic responses from The Challenges – my choice 😊

Flow across a constant head boundary

Impacts of heterogeneity on head and flow

Zone of influence of a well

Capture zone of a well

Well capture

Effects of confined vs unconfined conditions

‘Real’ vs MODFLOW treatment of ET

10 minutes – you identify one of The Questions that you feel LEAST comfortable answering and we will dig into it.

The Questions

1. What is a model?  What is a ground water model?  How are ground water models used?
2. What is a conceptual model?  How does this term describe the process of representing the real world as a ground water model?
3. What is meant by the ‘dimensionality’ of a model?  How is it possible to represent reality, with three spatial dimensions, as a 1D model?  Give an example.  Repeat the question for a 2D model.
4. What are model parameters?  How can they be defined?  How can their values be determined for ground water applications?  For example, what is hydraulic conductivity at the scale of a ‘hand sample’?  How does this relate to hydraulic conductivity in a model cell?  How does this relate to ‘zones’ of K in a model?  What do these have to do with the concepts of homo/heterogeneity and (an)isotropy?
5. Compare and contrast analytical and numerical models - both how they are formulated and solved and their advantages/disadvantages.
6. What are equipotentials?  What are flowlines?  Contrast a combined map of equipotentials and flowlines with a flow net.
7. What is a finite difference model?  Explain this in terms that someone who is only familiar with Excel could understand.  Be sure to include the concept of iterative solution and a convergence criterion.
8. What is a ‘solver’ and (generally) how does it work?
9. What is a model node?  A model cell?  Use a simple diagram to show the relationship between heads defined at nodes and properties defined in cells.
10. What are boundary conditions at a conceptual level?  Use your definition to describe how you can decide where to draw the boundaries of a groundwater model and when it is and is not acceptable to use watershed boundaries.
11. What is a Type I boundary condition.  Include both a mathematical definition and an explanation of how they are used to develop a ground water model that represents the real world.  What is the flow condition for which this BC type is most physically accurate?  Give two examples where this boundary condition is used commonly, even though it is a relatively poor (or difficult to quantify) boundary.  What is NOT defined where a Type I boundary is defined?  Repeat this question for a Type II boundary condition.
12. Can the value of a boundary condition change with time?  Can a boundary change type (e.g. Type I to Type II) with time?  Give an example of a system that might require each of these temporal changes.
13. What is a steady state model and when can you use one in practice?  GIve one example that represents the true system and one that is just the ‘best that we can do’.
14. What is MODFLOW?  What are three key differences between MODFLOW and MODFLOW6?
15. What is a MODFLOW package?  Give at least two examples and describe how the packages work together to make a MODFLOW model.
16. How does water flow to a fully penetrating well in a confined homogeneous aquifer?  How is this represented in MODFLOW?  Revise your answer for a fully penetrating well in an unconfined homogeneous aquifer.  For a partially penetrating well in a confined homogeneous aquifer.  For a fully penetrating well in a confined layered aquifer.
17. What is meant by well interference?  Explain this conceptually for a confined aquifer and for an unconfined aquifer.  Explain how MODFLOW represents well interference.
18. How is the response of a well affected by a Type I boundary.  Explain this conceptually for a confined aquifer and for an unconfined aquifer.  Explain how MODFLOW represents the effects.  Repeat this question for a Type II (no flow) boundary.