

National Exams May 2004

98-Geol-B2-2, Site Investigation

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
 2. Candidates may use one of two calculators, the Casio or Sharp approved models. This is a Closed Book exam.
 3. Any FIVE QUESTIONS constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
 4. All questions are of equal value.
-

20 marks QUESTION 1:

- (12) Quality control of samples collected for analyses of trace chemistry is a key element of many site investigations. Define each of the following quality control sample terms and describe the purpose of each sample type as part of a quality assurance program.

Field Blank
Equipment Blank
Trip Blank
Duplicate Sample
Spiked Sample
Replicate Analysis

- (8) Propose a quality assurance program (ie. Describe the types and numbers of quality control samples) for a site investigation where 20 groundwater monitors will be sampled for trace chemistry to identify the presence/absence of a suspected groundwater contamination problem.

20 marks QUESTION 2:

In-situ field tests are commonly used in soils investigations to determine the physical/mechanical properties of soils. List five in-situ tests which might be used for determining soils characteristics during a site investigation.

Set up a table which identifies for each test:

- (5) (a) the type of test (the common test name);
(5) (b) the soil type to which the test is best suited;
(5) (c) the types of soils for which the test is not suitable (and why);
(5) (d) properties that can be determined from the test.
-

20 marks QUESTION 3:

Identify four different types of water sampling devices that could be used to collect water samples suitable for chemical analyses from existing small diameter (50mm) monitoring wells. Answer the following questions for each type of device.

- (8) a. Briefly describe the principle of operation. Use a sketch if this will assist your description.
- (4) b. What are the advantages of using this device? Describe an "ideal" application.
- (4) c. What are the limitations/disadvantages of using this device?
- (4) d. Would you propose using this device to collect separate phase liquids (LNAPLs/DNAPLs)? Explain why or why not.

20 marks QUESTION 4:

- (2) Identify four different drilling methods used in site investigations and monitoring well installation. Answer the following three questions for each method.
 - (8) a. Briefly describe the drilling method. Use a simple sketch if this will assist your description.
 - (2) b. Which geologic materials is this drilling method best suited to?
 - (4) c. What is the general capability of this method for retrieving:
 - i. representative soil samples?
 - ii. representative bedrock samples?
 - iii. representative groundwater samples?
 - (4) For any drilling program, what activities should you undertake before drilling to minimize hazards and risks of accident/injury?
-

20 marks QUESTION 5:

- (5) Most site investigations begin with the collection of existing data from public sources. List five types of document available in the public domain that could be used to gain specific knowledge of site conditions prior to initiating field work.
- (10) For each example: describe the information from the document that would benefit an engineering site investigation; describe the likely source of the document (where you would attempt to obtain copies of this document).
- (5) Discuss the relevance of each document type when used to support a regional scale investigation, and a site specific investigation.

20 marks QUESTION 6:

Consider the following four construction projects:

- (a) residential subdivision development
 - (b) railway alignment
 - (c) hazardous waste processing facility
 - (d) major urban commercial development
- (8) Rank the following five types of map in their order of usefulness to a site investigation for each of these projects.
- i. Bedrock geology
 - ii. Surficial geology (Pleistocene & Recent deposits)
 - iii. Topography
 - iv. Agricultural soils
 - v. Groundwater (showing water table contours)
- (12) Explain the reason for your first map choice for each of the projects, and describe the types of information you would expect to draw from this map.
-

20 marks QUESTION 7:

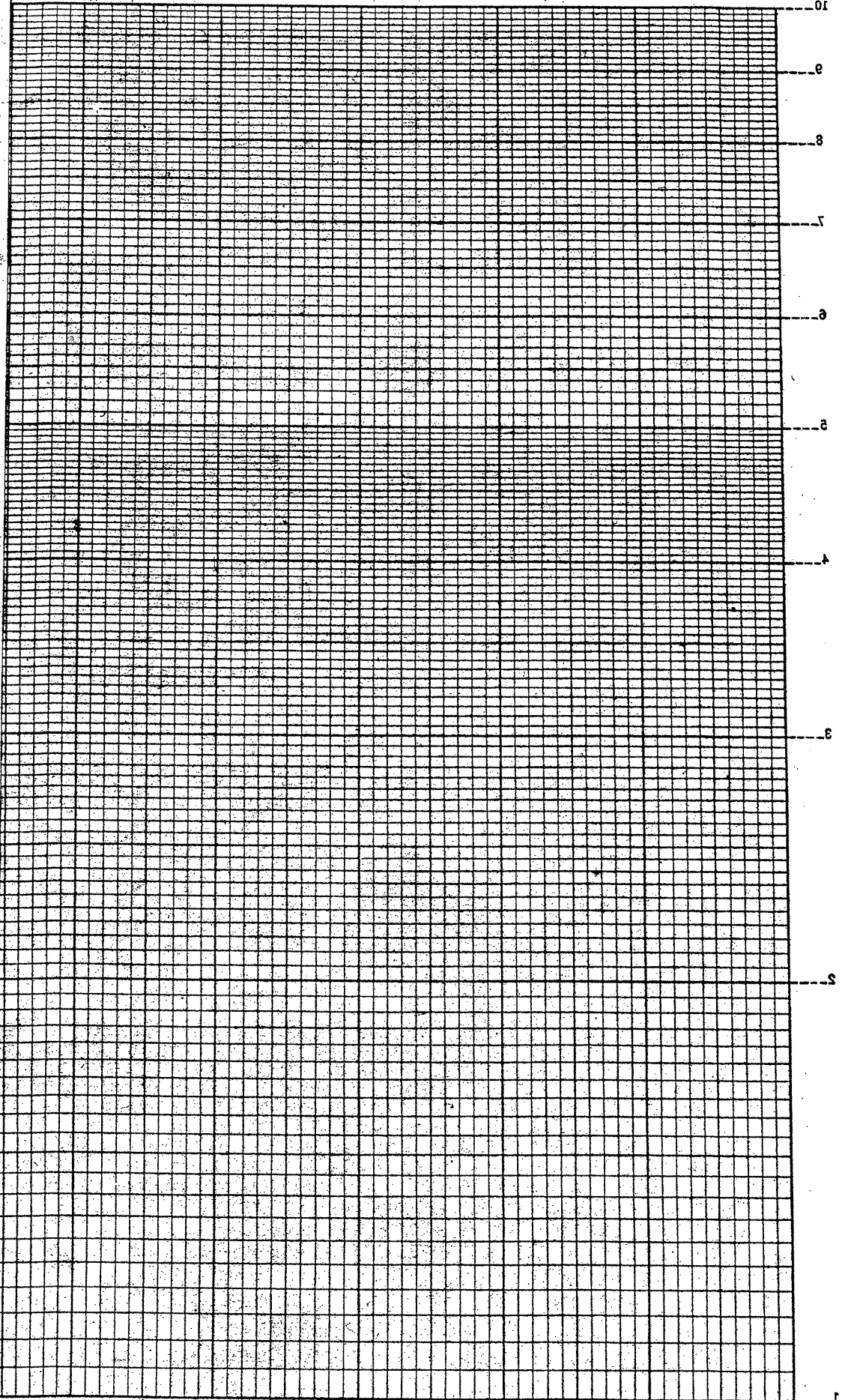
Answer the following questions with regard to the Hvorslev “slug” test method for determining hydraulic conductivity of an aquifer intersected by a piezometer.

- (4) a. List the assumptions which are implicit in the Hvorslev “slug” test.
- (12) b. Calculate hydraulic conductivity using the following two data sets. Clearly show your calculation using the graphical intercept method on the graph paper provided. Assume that the water level remains in the riser pipe.

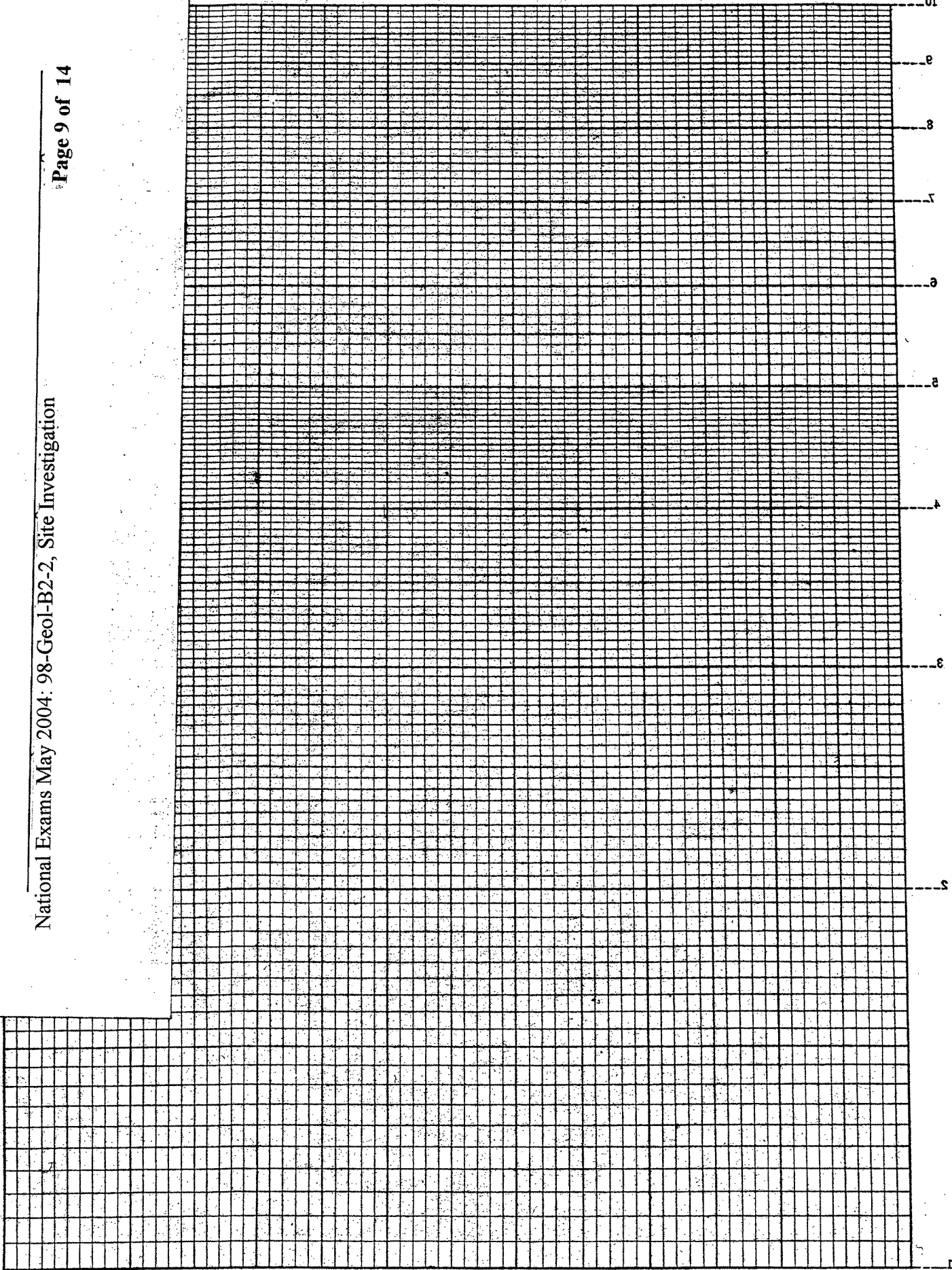
$$\text{Recall: } K = \frac{r^2 \ln(L/R)}{2 L T_0} \quad \text{for } L/R > 8$$

- (4) c. Describe the difference in appearance between the graphs of these two data sets. Provide a likely explanation for this variation.

Data Set 1 (Piezometer 1)		Data Set 2 (Piezometer 2)	
- piezometer completed in clayey silty sand		- piezometer completed in clayey till	
- no sand pack installed		- sand pack length	1.5 m
- screen diameter	10 cm	- sand pack radius	0.075 m
- screen length	1 m	- screen radius	0.0175 m
- riser pipe diameter	5 cm	- riser pipe radius	0.0175 m
- static water level ($t < 0$)		97.5 m	
time (min)	water elevation (m)	time (sec)	$\frac{(H - h)}{(H - H_0)}$
0	97.00		
200	97.15	900	0.929
400	97.22	17,400	0.709
600	97.29	98,460	0.257
1000	97.38	104,220	0.244



10
9
8
7
6
5
4
3
2
1



10
9
8
7
6
5
4
3
2

20 marks QUESTION 8:

Answer the following questions with regard to the use of geophysical seismic methods for investigating the nature of subsurface materials.

- (2) (a) Briefly describe the physical principles on which seismic methods work.
- (2) (b) List and define the types of elastic waves measured in seismic methods. Which wave type is most commonly used for calculating travel times?
- (2) (c) Why are refraction methods used for shallow investigations rather than reflection methods?
- (2) (d) List three limitations of seismic refraction methods.
- (12) (e) Using the shallow seismic survey data presented below, and the graph paper provided, determine the following features for a site known to be composed of planar, flat-lying strata.
- How many layers are identified by the data?
 - What is the wave velocity in each layer?
 - What is the depth to the top of each identified layer?

$$\text{Recall: } d_2 = 0.8 d_1 + \frac{X_{c2}}{2} \cdot \frac{v_3 - v_2}{v_3 + v_2}$$

Geophone Distance (m)	Travel Time (ms)
3	9
6	18
9	21
12	24
15	27
18	28
21	29
24	30

HAND IN WITH QUESTION 8

Candidate Name: _____

