Electrical survey exercises (from the book of Musset and Khan)

(a) Distinguish the geological situations for which the following forms of surveying are most appropriate: VES, profiling, imaging.

(b) In modelling VES results, what assumptions are normally made about the subsurface?

(c) Plot the data given below for the 5 VES surveys and deduce the minimum number of layers that exist in the subsurface. Why is it the minimum number?

Spacing (m)	Readings (ohms)				
	(a)	(b)	(c)	(d)	(e)
0.5	76	88	36	25	261
1	51	39	15	13	150
2	34	21	5.9	7.2	74
4	21	12.9	2.7	4.35	37
8	10.4	6.3	1.27	2.1	21
16	2.95	2.0	0.59	0.70	10.2
32	0.46	0.32	0.26	0.23	2.8
64	0.15	0.12	0.11	0.10	0.40

(d) A VES survey using a Wenner array is carried out where beds, successively downwards, have the following thicknesses and resistivities: 1 m, 20 ohm-m; 5 m, 400 ohm-m; 30 m, 100 ohm-m. Sketch roughly how the results would plot; you should label and number the axes and give rough values.

(e) You are to carry out a survey whose purpose is to find out whether a 4 m-wide galena ore vein, seen in a known outcrop to strike roughly east-west, continues westwards beneath overburden 2 to 3 m thick, and if so, to locate its position. Describe how you would set about it, using a Wenner array. Why might you prefer to use another array, and what might it be?

(f) A reading is taken at a particular place using a Wenner array and yields an apparent resistivity value of 100 ohm-m when using an '*a*' spacing of 5 m.
- What is the simplest electrical structure that would give that reading?
- If the same value was also obtained for spacings of 0.2, 2 and 20 m, what can you say about the subsurface?

(g) Classify the following as likely to have resistivities greater or less than 100 ohm-m: clay, massive galena ore, disseminated pyrites, coastal sand below sea level, clean gravel beneath the water table, shale, dry sand, sphalerite ore, granite.

(h) Consider if a resistivity survey would be appropriate to help solve the following problems. For each case where it would be appropriate, what form should the survey take?
- To locate a disseminated ore of galena.
- To locate a massive ore of sphalerite.
- To measure the depth to the water table in sands.
- To determine if there is saline water in the lower part of an aquifer that extends roughly from 10 to 70 m.

- To measure the thickness of clay overlying sand saturated with fresh water.
- To locate a strike-slip fault in crystalline bedrock, beneath dry sand.
- To locate saline water ‘pools’ beneath a few meters of dry sand.
- To detect if the thin soil covering a limestone area covers sinkholes.

(i) Why is a pseudosection so called?

(j) Sketch how current flows between two electrodes 5 m apart inserted into a very thick uniform sands.
How would it be modified if the sand below 5 m were replaced by rock with lower resistivity?

(k) Why are four electrodes used in electrical surveying?

(l) Describe the electrode arrangements for the following arrays: Wenner, Schlumberger, gradient and dipole–dipole. What are their relative advantages and disadvantages?