ECE 713 - Spring Quarter 2006

Final Exam

June 5th, 2006

Write your name below and sign the honor pledge “No aid given, received, or observed” if it applies.

There are 3 problems on this exam. Exam is open book and notes.

Please box or underline your final answers, and remember to include units.

Be sure to show all work clearly if you wish to obtain any partial credit.

Try to keep your work within the provided space. Use the back of a previous sheet if necessary.

Name: _____

No aid given, received, or observed.

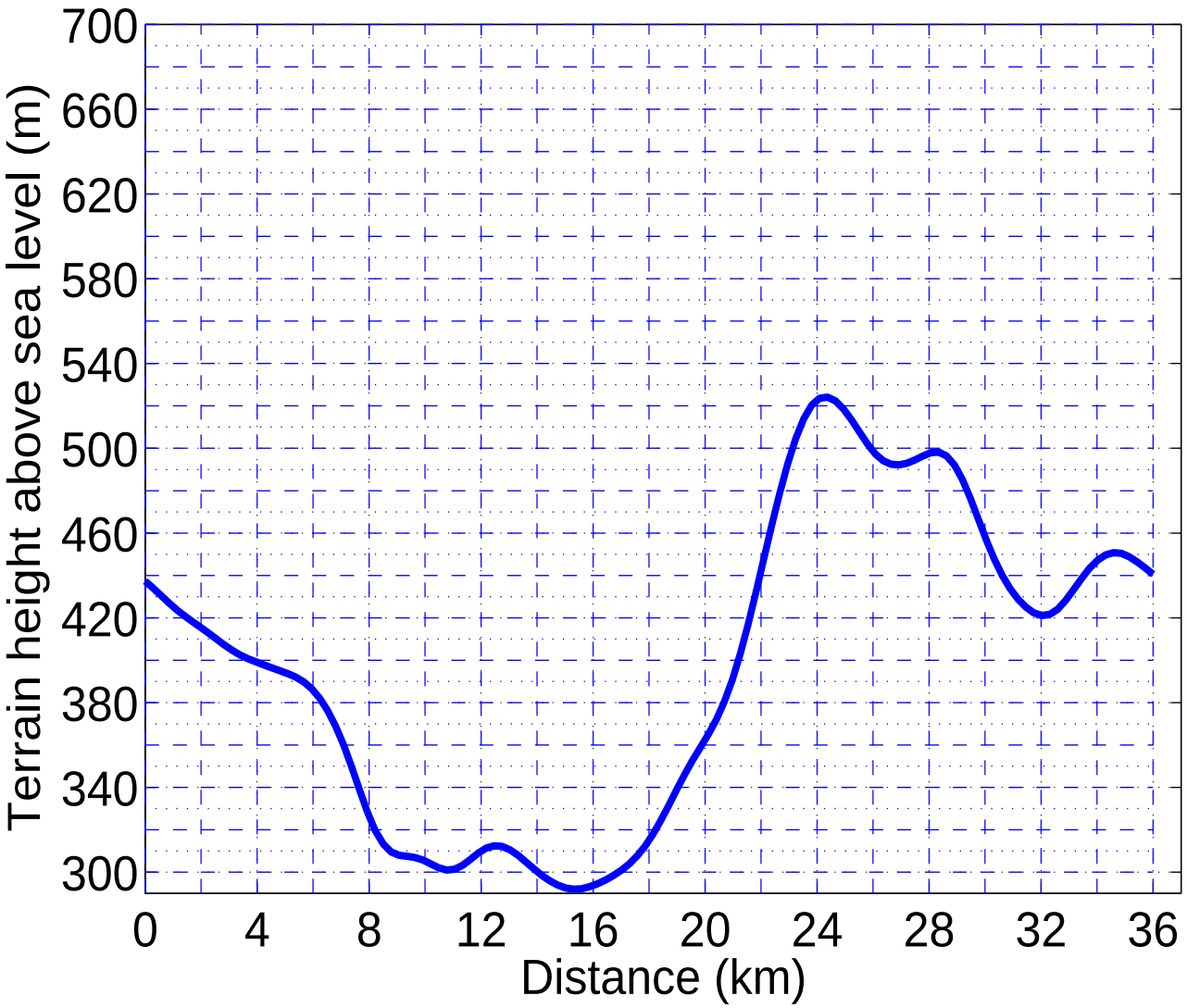
“The Pledge”: _____

Problem 1 (3 parts, 40 points)

A 600 MHz transmitter is located 22 m above the leftmost point on the terrain profile shown on the next page. A like-polarized receiver is located at the rightmost point on the profile (36 km away), and the propagation loss relative to free space is measured as the receiver height is increased from ground level.

(a) What is the lowest receiver height for which a free space propagation level should be obtained if $k_{eff} = \frac{4}{3}$? (15 points)

(b) What is the lowest receiver height for which a maximum in the height gain pattern would be obtained if $k_{eff} = \frac{4}{3}$ assuming the point at distance 24 km is the only reflection point? (10 points)

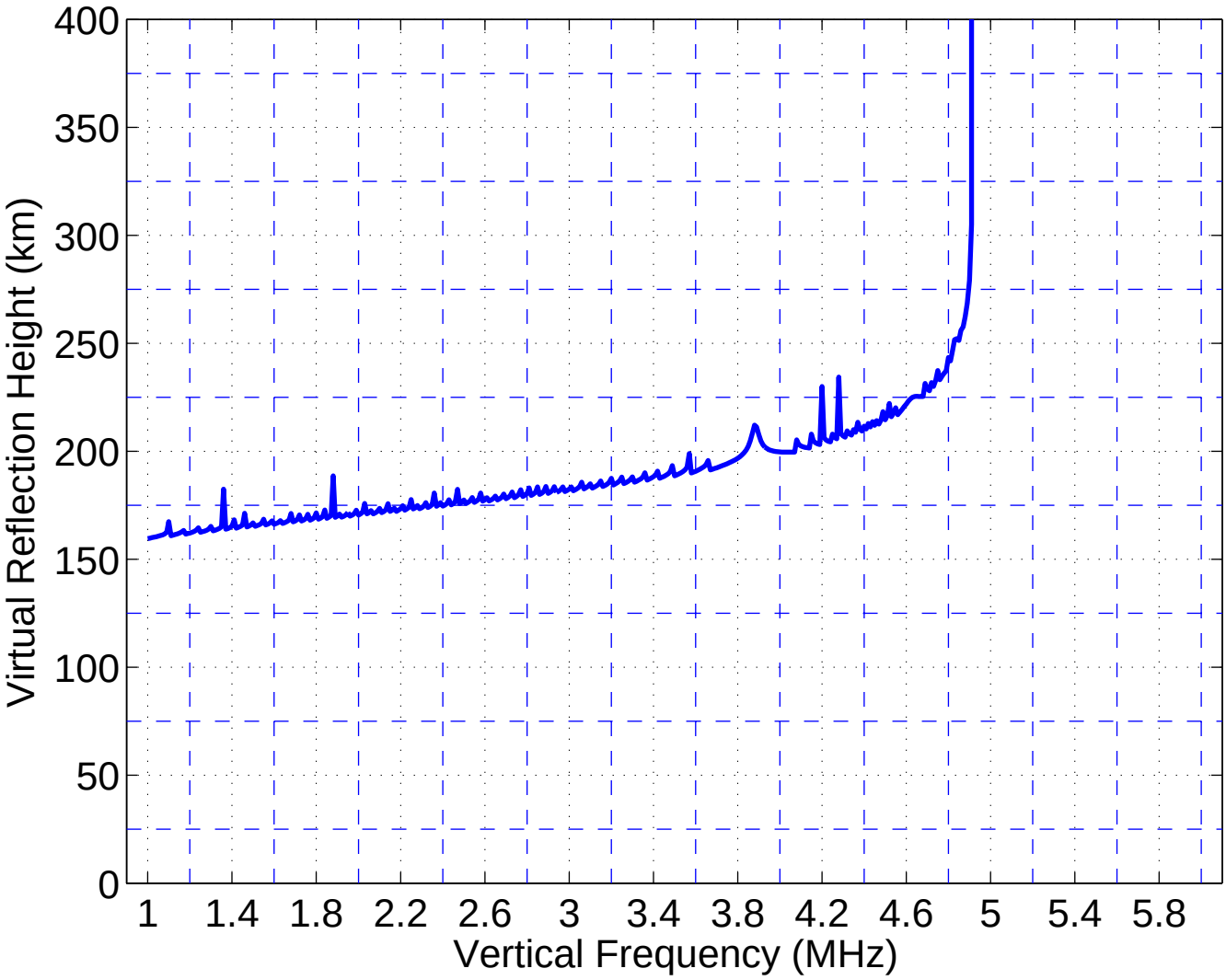

Terrain height above sea level (m)
700
660
620
580
540
500
460
420
380
340
300
0
4
8
12
16
20
24
28
32
36
Distance (km)

Problem 1 (cont'd)

(c) It is known that the power received with the receiver at height 250 m above the local terrain is -90 dB,w if slow fading effects are neglected. It is also known that slow fading is present with a standard deviation of 5 dB. Find the received power that will be exceeded 95% of the time. (15 points)

Problem 2 (3 parts, 30 points)

A night-time ionogram for the ordinary wave (containing reflection only from a single F layer) is illustrated below. Neglect ionospheric loss in this problem, and assume a planar Earth.



(a) Find the critical frequency of the ordinary wave for the F-layer. (5 points).

(b) For the ionospheric sounder that generated the above ionogram, find the total amount of time required for 2.4 MHz pulses to propagate up from the ground, reflect from the ionosphere, and return to the ground (10 points).

(c) Estimate the MUF in this ionosphere for a 1500 km path. (15 points)

Problem 3 (2 parts, 30 points)

An AM radio station operates at 1 MHz and broadcasts 1 kW of power from a short vertical dipole antenna on the ground. These properties result in $2E_0 = 300$ millivolts/m for distances specified in km. Dielectric properties of the ground are such that the planar Earth numerical distance $\underline{p}$ is given by $(0.5 - j0.5)d_{km}$, where d_{km} is the actual distance in km. It is also known that the applicable spherical Earth ground-wave parameters are $x = (5.26 \times 10^{-3})d_{km}$ and $\underline{\tau} = 10e^{-j\pi/3}$. Neglect any elevated antenna effects in your solution.

(a) Estimate the groundwave electric field amplitude (in millivolts/m) at distance 50 km. Feel free to use any figures or approximations from the notes, but please explain which figures or approximations you are using. (15 points)

(b) Estimate the groundwave electric field amplitude (in millivolts/m) at distance 250 km. Feel free to use any figures or approximations from the notes, but please explain which figures or approximations you are using. (15 points)