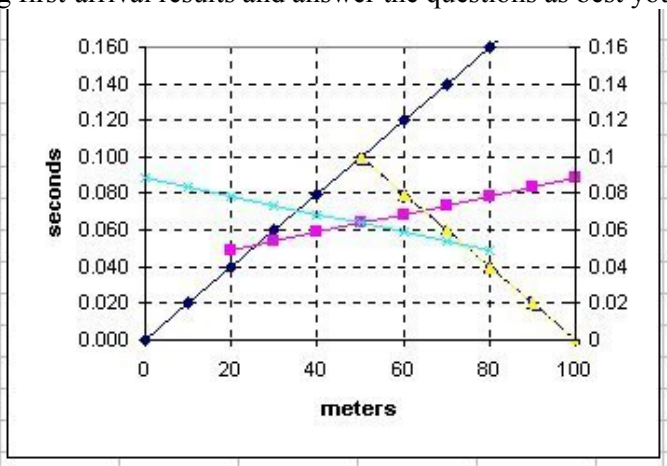
Geology 437 – Final exam, Fall 2000 Who?_____

1. Consider the following first-arrival results and answer the questions as best you can:

	Forward Line	
x	direct	refracted
0	0.000	
10	0.020	
20	0.040	0.049
30	0.060	0.054
40	0.080	0.059
50	0.100	0.064
60	0.120	0.069
70	0.140	0.074
80	0.160	0.079
90	0.180	0.084
100	0.200	0.089



	Reversed Line	
x	T direct	T refracted
100	0.000	
90	0.020	
80	0.040	0.049
70	0.060	0.054
60	0.080	0.059
50	0.100	0.064
40		0.069
30		0.074
20		0.079
10		0.084
0		0.089

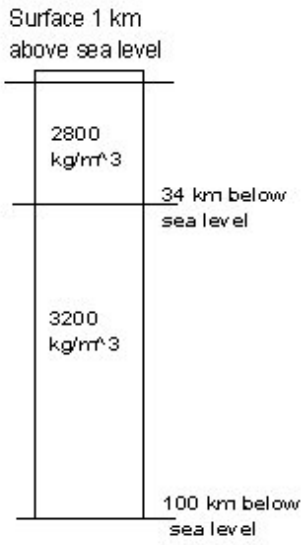
a. How many layers are indicated by the results? How do you know?

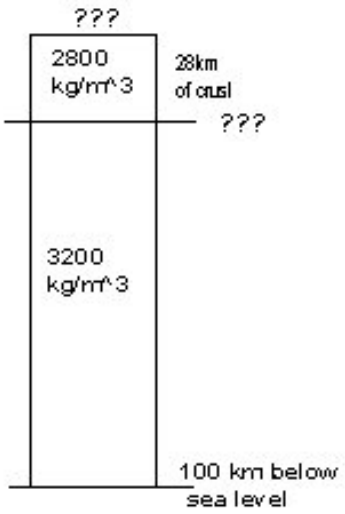
b. Interpret the results as best you can – provide as much information about the subsurface as possible. Show your work on the back of one of these pages.

c. Imagine you are giving a short report to a client. What caveats or potential pitfalls of your interpretation can you provide and what are your assumptions?

2. Start with some continental crust in isostatic equilibrium. It is 35 km thick, the surface 1.00 km above sea level, has density of 2800 kg/m^3, and floats in 3200 kg/m^3 mantle above a compensation depth of 100 km below sea level. Suppose an impacting bolide erodes 20% (7 km) of the crust. Assume constant temperature and isostatic equilibrium:

a. Here are the before and after sketches, what is the new elevation of the surface?





b. Suppose 3 km of basalt (3000 kg/m^3) floods into the hole - what is the new elevation of the surface? Start with your own "after sketch" .

c. Suppose that basalt floods the hole until it is "isostatically full" in other words the accommodation space is filled and you've flooded in as much basalt as possible– how thick will the section of basalt be?

3. Fill in the blanks with the most geophysically relevant word or phrase for this letter:
Dear Aunt Schlumberger:

I finally took that geophysics course you keep harping about; you owe me. During the final few weeks, the course was about mass, moment, gravity and isostacy. Two isostacy models were figured out in the late 1800's by two codgers named _____ and _____ . The first important gravity anomaly we learned about was the _____ anomaly which equals $= g_{th} - g_{obs} +$ _____ . This correction accounts for the _____. If this first anomaly is near zero for _____ wavelengths, then the underlying terrain is most likely _____. What the latter phrase means is that for any two columns above the _____ depth, the _____ of the columns is equal. For high elevations, Earth does this by creating crustal _____ under mountain ranges; their amplitude is about _____ times the height of the terrain! The next important anomaly is the _____ anomaly which is just the previous anomaly corrected for _____ _____. We use this second anomaly to prospect for lateral changes in _____ in the subsurface and a positive anomaly means a mass _____ in the subsurface. Thus sedimentary basins usually have a _____ anomaly due to their relative mass _____. This latter gravity anomaly changes as the depth to the causative source gets deeper; when the source gets deeper, the anomaly gets _____ and _____. And when the causative source gets shallower the anomaly gets _____ and _____ with _____ gradients. For any of these cases, the area under the anomaly curve is constant so the anomalous mass is unique; this was first pointed out by _____ in a theorem. Oh yea, the first correction, g_{th} I mentioned above, accounts for the _____ and _____ of Earth.

So, your aunt calls after she gets the Christmas letter and has a couple of questions:

a. I thought everything causes some gravity, deep stuff, shallow stuff, the moon and the like. If you are exploring for a particular structure, how do you separate the effects of regional and local sources?

b. Clare thinks your uncle Ed is denser than dirt – can you use gravity to figure out how dense the dirt hills on our ranch are? how?

4. The worldwide paleomagnetic database has high quality apparent pole positions for all the continents. North America, Africa, South America and Australia have really good records back into the Precambrian. Explain, as if you were doing so for a journalist, how you would use these data to show that Precambrian plate tectonics worked about like Cenozoic tectonics.

5. Again the journalist… Explain how a couple of pertinent T-delta curves (which ones?) and the known mass, moment, and radius of Earth provide very strong constraints for the internal structure.