Final Exam, Geology 437, Fall 1995. Write your name here:___________________________________

1. For each of the following equations, define the variables and explain the use of the equation:

A. $B = \frac{\mu o}{4 \cdot \pi} \cdot \left(\frac{2 \cdot M \cdot \cos(\theta)}{r^3} \cdot \vec{r} + \frac{M \cdot \sin(\theta)}{r^3} \cdot \vec{\theta} \right)$

B. $Td = \frac{x}{v1}$ $Tr = \frac{x}{v2} + 2 \cdot z \cdot \frac{\sqrt{v2^2 - v1^2}}{v1 \cdot v2}$

C. $FAA = g_{obs} - g_{th} + FAC$ $BA = FAA - BC + TC$

D. $\int_{-x}^{x} \int_{-y}^{y} g_z \, dy \, dx = 2 \cdot \pi \cdot G \cdot M$

2. What does a positive Bouguer anomaly indicate? How about a negative Bouguer anomaly?

3. Suppose Earth's temperature rises by a few degrees and the arctic, Greenland, and antarctic ice packs melt.

A. Explain what effect this would have on the length of the day. Why?

B. Explain what effect this would have on a local gravity survey at the same points before and after the great melting. Why?

C. Explain what effect this would have on the direction of gravity in Missoula. Why?

4. Consider a uniform tectonic province, that is, a large area with similar crust and plate characteristics.

A. Assuming 100% Airy compensation, how would you calculate an isostatic anomaly for a mountain range in the area and what result would you expect?

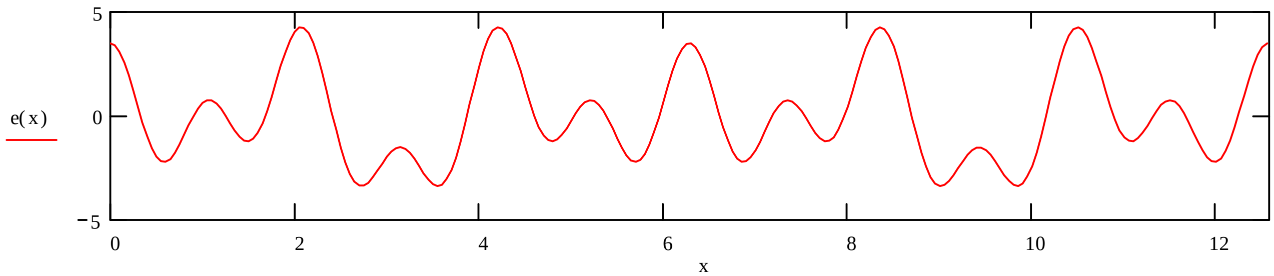
B. Now, how would you determine the effective elastic thickness of the area?

C. Once you know the area's effective elastic thickness, how would that change the way you calculate an isostatic anomaly

5. Shallow, marine sedimentary rocks (average density 2400 kg/m^3) are deposited in one kilometer of water (1000 kg/m^3) over a thinning continental crust (32 km thick, density 2670 kg/m^3) above mantle rocks (density 3200 km/m^3) with a compensation depth of 125 km. If the original situation, before the sedimentary rocks, is in isostatic equilibrium what is the thickness of the crust by the time there are 17 kilometers of sedimentary rocks, replacing the water, in isostatic equilibrium? The surface remains at sea level.

6. Consider the four functions: $a(x) := 2 \cdot \cos(3 \cdot x)$ $b(x) := 0.5 \cdot \cos(x)$ $c(x) := -1 \cdot \cos(2 \cdot x)$ $d(x) := 2 \cdot \cos(6 \cdot x)$

Let x vary from 0 to 4*pi. $x := 0, .05 .. 4 \cdot \pi$ Their sum, e(x), looks like this: $e(x) := a(x) + b(x) + c(x) + d(x)$

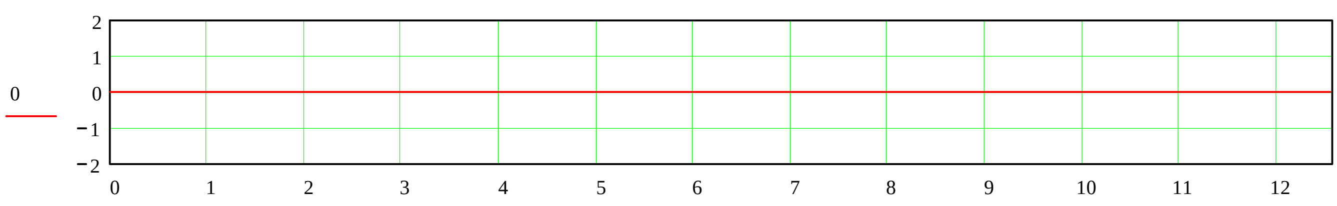


A. Explain the difference between the frequency domain and space domain representations of a function.

B. In the space below, plot a(x), b(x), c(x), and d(x) in the frequency domain. Be sure to label your axes and explain your thinking.

C. Now sketch, in the frequency domain, a function that, when multiplied with the result from B, would save all frequencies less than 2 and eliminate the rest. This is a low pass filter which preserves low frequencies (long wavelengths).

D. Assume your filter from C works correctly and graph the filtered function in the space domain below. That is, graph e(x) after you remove frequencies of two and greater. Label the axes.



7. Below are cross sections of two mountain ranges. Their topography is identical. The range on the left is 100% Airy compensated; the one to the right is 100% supported by the elastic strength of the plate. On the graphs provided, for each range sketch the expected observed gravity, free air anomaly, Bouguer anomaly, and isostatic anomaly. Explain your reasoning and use the same scale for the right hand graphs as for the left hand graphs.

8.) Consider the equations: $T(z) = \frac{A}{k} \cdot \left(H \cdot z - \frac{z^2}{2} \right) + \frac{qb}{k} \cdot z + T(0)$ $\qquad \frac{dT}{dz} = \frac{A(H - z)}{k} + \frac{qb}{k}$

$$T(z) = T(0) + \frac{Ao \cdot D}{k} \cdot \left(D - D \cdot e^{-\frac{z}{D}} - z \cdot e^{-\frac{H}{D}} \right) + \frac{qb}{k} \cdot z \qquad \frac{dT}{dZ} = \frac{Ao \cdot D}{k} \cdot \left(e^{-\frac{z}{D}} - e^{-\frac{H}{D}} \right) + \frac{qb}{k}$$

A) Explain: A, Ao, H, D, qb, and k.

b) From a geological viewpoint, how are the equations different?

C. What effect results from placing heat sources deep in the crust compared to shallow?

c) What is the linear heat-flow versus heat generation relationship and why is it significant?

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