Numerical problems

CE Course, GeoIndia-2022
JECC, Jaipur
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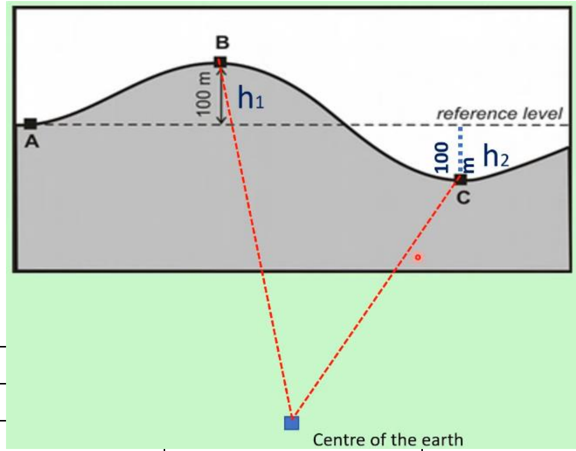
1. Free air correction

   Δg_f = 0.3086 h (mgal)



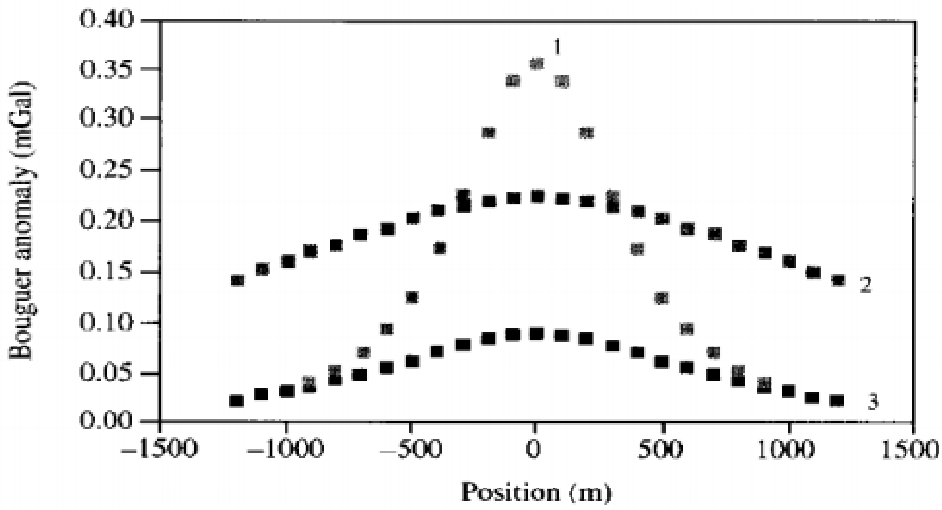
Station	g_observed (mGal)	Elevation (m)		
A	2946.3	100		
B	2941.0	-100		

2. Bouguer correction
   Density ρ = **2.70m/gm^{-3}**
   Δg_B = 0.04192ρh (mGal)

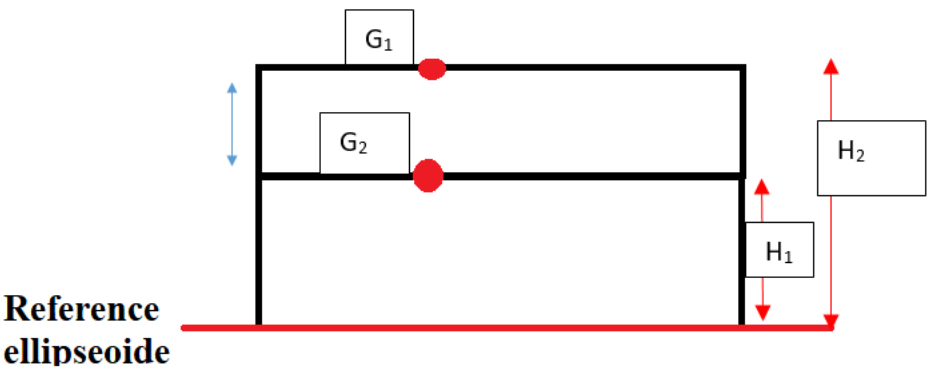
Station	g_observed (mGal)	Elevation (m)	Δg_B	g_ corrected
A	2946.3	100		
B	2941.0	-100		

3. The Bouguer anomaly at a site, A, is the sum of the free-air, Bouguer and latitude corrections. Use the following information to calculate the value of this anomaly:
   Free-air correction: 3.086 g.u. per metre elevation
   Bouguer correction: 2πGph
   Latitude correction: 9780318.46(1 + 0.005278895sin$^2\varphi$ + 0.000023462 sin^4 φ) g.u.,
   where the gravitational constant, G = 6,67x10 m^{3}kg^{-1}s^{-2}, the upper crust density, ρ = 2300 kg m-^{3}, the elevation above sea level, h = 123 m, the latitude of the station, φ = 53° 54' 11" N, (53.9030) and the observed gravity is 9813621.1 g.u. (1 g.u. = 10^{-6} ms^{-2}). What assumption has been made in calculating this Bouguer anomaly? If the density contrast for a sedimentary basin is, typically, 200 kgm^{-3}. What is the sedimentary thickness at the observation site?

4. Determine the depth of the centre of the sphere represented by the anomaly curve 1, shown below



5. Find (Δg), in the fig. below, the difference between the corrected values of g1 and g2 after reduction to the level H_2 (reference level)



6. Find out the ratio between total intensity of magnetic field at equator to poles?

7. Total magnetic intensity B_t, it's a resultant radial component Br and tangential component B_θ of dipolar field.
   where,

$$B_r = \frac{\mu_0}{4\pi}\frac{2m\cos\theta}{r^3}$$
$$B_\theta = \frac{\mu_0}{4\pi}\frac{m\sin\theta}{r^3}$$
$$B_t = \sqrt{B_r + B_\theta} = \frac{\mu_0 m}{4\pi}\frac{\sqrt{1+3cos^2\theta}}{r^3}$$

The vertical gradient is obtained by differentiating the B_t with respect to r, is given by

$$\frac{\partial B_t}{\partial r} = -3\frac{\mu_0 m}{4\pi}\frac{\sqrt{1+3cos^2\theta}}{r^4} = -\frac{3}{r}B_t$$

The latitude correction is obtained by differentiating the B_θ with respect to θ, is given by

$$-\frac{1}{r}\frac{\partial B_t}{\partial\theta} = \frac{\mu_0 m}{4\pi}\frac{1}{r^4}\frac{\partial\sqrt{1+3cos^2\theta}}{\partial\theta} = -\frac{3}{r}\frac{B_t\sin\theta\cos\theta}{(1+3cos^2\theta)}$$

a. Compute the altitude correction at magnetic equator and magnetic pole.
b. Latitude correction at magnetic pole and magnetic equator
c. Latitude correction at 45°

8. Calculate the ocean depths at which a 1μV/m E-field will be obtained for an E field at the surface of 1 V/m for the following frequencies (a) 10kHz, (b) 10 MHz Assume $\sigma = 4\,\Omega^{-1}m^{-1}, \mu = \mu_0$
9. The plane wave electromagnetic field travelling vertically downward in a homogeneous half-space of resistivity 500 Ω-m varies with depth z as
$$H_y(z) = H_0 e^{-0.5z}\{\cos(wt - 0.5z) + i\sin(wt - 0.5z)\}$$

10. In electromagnetic study, the primary field can be written as $H_P = A\sin(\varphi)$, secondary filed can be written as $H_S = B\cos(wt - \varphi)$, where $\varphi = \tan^{-1}\left(\frac{wL_S}{r_s}\right)$
    a) Derive the equation of elliptic polarization from this primary and secondary filed
    b) Shape of the elliptically polarized equation in case of good conductor
    c) Shape of the elliptically polarized equation in case of bad conductor