Name ……..

Student #.....

GLY 264: Introduction to Geophysics
Practical 3. Gravity

Newton's Law of Universal Gravitation $F = G\frac{m_1 m_2}{r_2}$ … (1)

Newton's Second Law $F = m_1 a$ ... (2)

By equating the forces given in (1) and (2), we then have $m_1 a = G m_1 m_2 / r_2$ and thus $a = G$

As applied to gravity on Earth, a is generally written as g. g is the gravitationally-induced acceleration of mass m_1 due to the attractive force between m_1 and m_E (m_E = mass of Earth)

It is interesting that g does not depend upon the mass m_1 but only on m_E and the distance r. $g = G m_2 / r_2 = G m_E / r^2$. … (3)
This explains why objects fall toward Earth at the same rate.

So the value of *g* depends on the distance from the center of the mass of Earth. Assumptions:

Mass is represented by a point at the center of mass; i.e., it is uniformly distributed. Value of G is constant.

1. Calculate the gravity of the Earth, given that r = R = 6371km at the Earth's surface and $m_E = 5.97 \times 10^{24}$kg. [2]

Units: let's note that we're talking about acceleration (time rate of change of velocity) --> (m/s)/s

• Galileo made some of the first recorded measurements of gravitational acceleration, and thus his name is attached to a unit of acceleration.
1 Gal = 1 cm/s^2 = 1×10^{-2} m/s^2

• Typical variations in gravity on Earth are in the milligal range:
1mGal = 1×10^{-5} m/s^2. Most people used mGal so will be us, but other books use gravity units (gu). 1 mGal = 10 gu

2. Gravity varies with distance from the center of the Earth: but how much?
To find out by how much g is varying, find the derivative of equation (3) and use the value of G, m_E and r. [3]

3. What's the difference in the value of gravity on top of Mt. Everest compared to sea level? [3]

4. The Earth is not round (nor spherical)… It is a lumpy oblate spheroid.
(a). Why? Give an explanation [3]
(b). When gravity is measured, several corrections must be made to the raw data in order to find gravity anomalies. Mention at least three of these corrections and discuss them. [7]