**King Saud University Science College Student Name : Geology Department University Number:**

**Question1:** How to approved the gravity theory?

Gravity theory:

Newtonian gravitation

Newton’s Law of Gravitationstates that if two point masses are a distance *r* apart, they will attract each other with a force *Fg*:



Fg= Gm1m2/r2

The parameter G is the **universal gravitational constant** (or “big G” or the Newtonian constant).

G = 6.67 x 10-11 m3 kg-1 s-2

Units are:

F Newtons (N)

m kilograms (kg)

r metres (m)

This equation shows that Fg obeys an **inverse square law** – as the distance between the two masses increases, Fg decreases by 1/r2.

Now consider that one of the masses is the Earth (call this ME). For a spherical, non-rotating, homogeneous Earth, it can be shown that the force of gravity due to the mass of the Earth will be the same as if all the mass were at the centre of the Earth.

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If you were to drop a small object (with mass m), the force of gravity will cause it to accelerate according to Newton’s third law of motion:

Fg=ma

The acceleration (a) is therefore: a =Fg/m

Combine this with Fg from the gravitation equation on page 1:

a=GMgm1/r2\*1/m=GMg/r2=g

In this equation, g is the **gravitational acceleration** (units are m/s2). Note that:

1. ***g* decreases with distance from ME** - decreases by 1/r2 (inverse square law).
2. **g does not depend on the mass of the small object**. A small mass and a large mass will fall with the same acceleration.

**Question2:** What is the average gravitational acceleration at the surface of the Earth?

Mass of the Earth (ME) = 5.974 × 1024 kg

Average radius of the Earth (r) = 6371 km g = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ m/s2

In gravity exploration, we study very small variations in g, so it is convenient to use a smaller unit – the **milligal**.

**1 mgal = 10-5 m s-2**

Note that textbook uses the unit gu (“gravity unit”):

1 gu = 1 μm s-2 = 10-6 m s-2 = 0.1 mgal

**Question3:** What is the expected value of gravity at the front doors of the CEB building (latitude 53.52589ºN)?

From GRS67: g = 978031.846 ( 1 + 0.003442594 – 0.000005393 )

= 981393.538 mgal

= 9.8139 m s-2

**Question4:** How does gravity change as you go from the ground level to the 5th floor of the CEB building – a change in height of 15 m? (ignore the effects of the building on the gravity).

Δg = \_\_\_\_\_\_\_\_\_\_\_\_ mgal

Does gravity increase or decrease?

**Question5**: What are the external factors changes in the magnetic fields?

The external factorschanges in the magnetic field are:

**1) Diurnal variations** – solar wind bombards the side of the Earth facing the sun. The

rotation of the Earth means that a given site on the Earth’s surface will experience a

variation in the intensity of the solar wind over the timescale of a day. The fluctuations

are smooth and regular and on a typical day (called a **quiet day** or Q day) have

amplitudes of 10-80 nT, with a maximum at high latitudes.

**2) Lunar variations** – the moon orbits around the Earth and interferes with the solar

wind. This results in small variations in surface magnetic field with a period of **25 days**.

**3) Magnetic storms** – days when the solar wind is more active than normal are called

**disturbed days** (or D days). Large, short-term disturbances (magnetic storms) in the

surface magnetic field with a magnitude of 100-1000 nT are observed. Storms can last

several hours to days.

**4) Sunspots and solar flares** – Sunspots are dark regions on the Sun that represent

disturbances in solar activity. Solar flares are associated with sunspots – the flares

release large volumes of charged particles into the solar wind, which then affects the

Earth’s magnetic field. Sunspot activity follows an 11 year cycle.