MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCE

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

SPH 237: GEOPHYSICS

DATE: 6/12/2021 **TIME: 8:30 – 10:30 AM**

***INSTRUCTIONS*:**

Constants

Universal gravitational constant G = 6.674 x 10^{-11} $N.m^2/kg^2$. Mass of the earth is 5.98 x10^{24} kg. Earth radius 6.4 x 10^6 metres

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Geoids are lumpy because gravity varies from place to place. Give two reasons why gravity varies from place to place. (3 marks)

b) List five geophysical exploration techniques (5 marks)

c) Explain the working principle of a gravimeter (3 marks)

d) Using a well labelled diagram, define prehelion and aphelion (4 marks)

e) The shape of the earth's path around the sun varies with time of the year. Give a reason that makes this change to happen (2 marks)

f) Ozone prevents most of the sun's harmful ultraviolet radiation from reaching Earth's surface, where it can damage and mutate life. How was ozone layer created (3 marks)

g) Existence earth magnetic field is well known. Explain what causes this magnetic field (2 marks)

h) Define the equation of time

i) Green house effect, which is not runaway, somehow makes the earth habitable. Explain how this is achieved on the earth (3 marks)

j) Sometimes of the year days are shorter and sometimes they are longer. Give to reasons that lead to this behavior (3 marks)

k) Define the International Gravity formula (2 marks)

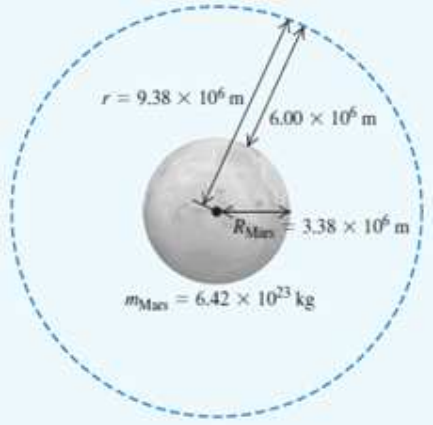
QUESTION TWO (20 MARKS)

a) Explain how density of the earth varies from the earth surface to the earth centre (4 marks)

b) Calculate the average density of the earth, assume the earth is a perfect sphere (5 marks)

Suppose acceleration due to gravity g at a point on the earth surface 6.4 x 10^3m from the earth centre is 9.78 m/m^2. Suppose also that the angular velocity of the earth is 18 m/s. calculate the apparent acceleration due to gravity. (6 marks)

c) A satellite orbits the planet mars at 6.0 x 10^6 m above its surface. If force exerted by the planet on the satellite is 1.5 x 10^4 N, calculate mass of the satellite. Note universal gravitational constant is same everywhere. (5 marks)



QUESTION THREE (20 MARKS)

a) Calculate the radius of the earth at point on the earth surface where acceleration due to gravity is 9.6 m/s^2. (6 marks)

b) About 300 years ago, Newton discovered that gravitation—the force that makes an apple fall out of a tree—also keeps the planets in their nearly circular orbits around the sun.

i) state the law of gravitation by giving a statement and a mathematical formula (4 marks)

ii) Show that $g = \frac{GM_E}{R_E^2}$ (5 marks)

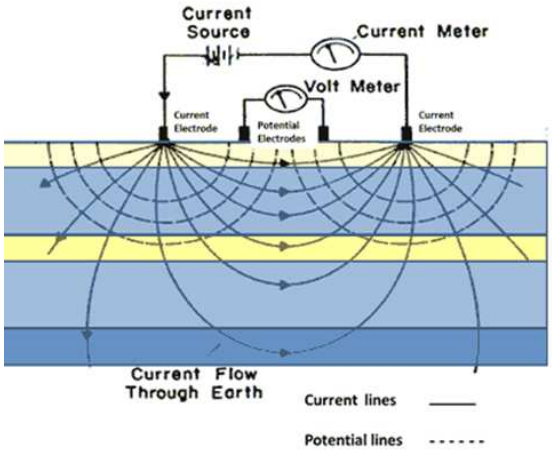
iii) Calculate radius of the earth.

(5 marks)

QUESTION FOUR (20 MARKS)

a) State and explain using a diagram, the Kepler's 2nd law of the solar system (4 marks)

b) The figure shows one of geophysical exploration methods. Explain its working principle (4 marks)



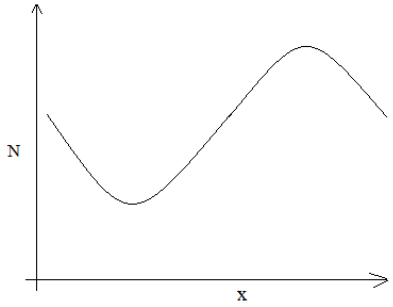
b) Geophysicits carrying out a exploration survey using the method in question 4 a) to identify how deep the ground water was in an area estimated as 120 m^2. Obtained the following data, I = 9 A V= 240 V $\rho = 12\ \Omega$. Calculate how deep the water aquifer is likely to be. (6 marks)

c) The time it takes a planet to make one complete orbit around the sun T (one planet year) is related to its average distance from the sun R by $T^2 = R^3$. Show that this is true

(6 marks)

QUESTION FIVE (20 MARKS)

a) The figure shows a sketch obtained from readings of a gravimeter in Kitulini, Machakos. Use the sketch to reconstruct the earth sub surface (3 marks)



b) Using the International Gravity formula, compute the latitude at which gravitational acceleration is 9.9 m/s^2 (5 marks)

c) Define a black hole (3 marks)

d) State in which method and how the following two instruments are used. i) magnetometer ii) geophone (4 marks)

e) Show that the velocity required by a satellite to orbit the earth is given by $v = \sqrt{\frac{Gm_E}{r}}$ where r-earth radius, m_E - mass of the earth and G- universal gravitational field

(5 marks)