



MACHAKOS UNIVERSITY

University Examinations 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

SPT 210: GEOPHYSICS TECHNOLOGY

DATE:13/4/2023

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).

Answer any **two** questions from section **B** (each 20 marks)

Useful constants

Name	value
Earth radius	$R_E = 6.380 \times 10^6 \text{ m}$
Universal Gravitation constant	$G = 6.672 \times 10^{-11} \text{ Nm}^2/\text{kg}$
mass of the earth	$m_E = 5.98 \times 10^{24} \text{ kg}$
Gravitation acceleration on the sun's surface	274 m/s^2
mass of the sun	$1.9891 \times 10^{30} \text{ kg}$
Distance of the moon from the earth	$3.844 \times 10^5 \text{ Km}$
mass of the moon	$7.34767309 \times 10^{22} \text{ Kg}$
radius of the sun	$6.96 \times 10^8 \text{ m.}$

SECTION A

QUESTION ONE (30 MARKS)

- a) Explain variation of the density of the earth from the earth surface to the earth centre (4 marks)
- b) There are times of the year when days are shorter or longer than 24 hours, the times of sunrise and sunset appear to drift earlier or later in the day. Account for this behaviour (4 marks)
- c) Calculate the difference between mean solar time (as shown by clocks) and apparent solar time (indicated by sundials) on 25th dec 2023. (4 marks)
- d) Compare and contrast a sphere and a geoid (3 marks)
- e) Calculate the acceleration due to gravity between the earth and the moon. (4 marks)
- f) Given that gravitational acceleration on the earth surface is 9.8 m/s^2 , find gravitation acceleration on a spaceship 3 Km above the earth surface (4 marks)
- g) Draw a graph showing how gravitational acceleration varies inside and outside the earth. surface. (3 marks)
- h) Explain how gravitational acceleration varies from equator towards the poles. (2 marks)
- i) The sun is a dense gaseous star, given the constants calculate mass of the star. (2 marks)

SECTION B

QUESTION TWO (20 MARKS)

- a) By the use of an illustration, describe how the gravimeter is used in exploring the earth's sub surface, stating clearly its principle of application. (5 marks)
- b) Show that 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 $T^2 = R^3$. (6 marks)
- c) A scientist drops a stone from the top of a tall building where its acceleration due to gravity just before it drops is g is 9.2 m/m^2 . Calculate the height of the building. (5 marks)
- d) Explain how the earth's magnetic field is generated and state one important function it performs. (4 marks)

QUESTION THREE (20 MARKS)

- a) Acceleration (g) due to gravity varies on the earth surface because of two reasons. Explain the two reasons. (4 marks)
- b) Using a diagram, describe the two step process of putting a satellite in orbit. (4 marks)
- c) Calculate the escape velocity of a rocket of mass $2.0 \times 10^3 \text{ kg}$ from the earth's surface. (4 marks)
- d) Describe how magnetic geophysical exploration survey is conducted and interpreted. (4 marks)
- e) The Earth was formed at roughly the same time as the sun and other planets some 4.6 billion years ago. Explain how this happened. (4 marks)

QUESTION FOUR (20 MARKS)

- a) State and explain Kepler's Solar system 2nd law using a diagram. (3 marks)
- b) Calculate the radius of the earth at point on the earth surface where acceleration due to gravity is 9.6 m/s^2 . (4 marks)
- c) Describe how seismic survey is conducted and interpreted (4 marks)
- d) Define International Gravity formula, hence calculate the latitude on the earth surface at which $g = 9.9 \text{ m/s}^2$ (5 marks)
- e) Explain how the uninhabitable conditions in planet Venus came into being. (4 marks)

QUESTION FIVE (20 MARKS)

- a) If M is the mass of the earth and R its radius, G universal gravitation constant and g gravitation acceleration on its surface, proof that $g = \frac{GM}{R^2}$ (3 marks)
- b) Suppose acceleration due to gravity g at a point on the earth surface that is $6.4 \times 10^3 \text{ m}$ from the earth centre is 9.78 m/s^2 . Suppose also that the angular velocity of the earth is 18 m/s . calculate the apparent acceleration due to gravity. (5 marks)
- c) Acceleration due to gravity g on the surface of a newly discovered planet of radius $r = 1.267 \times 10^7 \text{ m}$ is 16.5 m/s^2 . Calculate the mass of a planet. (4 marks)
- d) Describe how resistivity geophysical survey is conducted and interpreted (5 marks)
- e) Using equation of time, Calculate the time variation on 16th July 2020 (3 marks)