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OLLSCOIL NA hÉIREANN
GAILLIMH

NATIONAL UNIVERSITY OF IRELAND,
GALWAY

SUMMER EXAMINATIONS 2001

B.Sc PHYSICS AND ASTRONOMY

AT101 : ASTRONOMY I

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Time Allowed: TWO hours

Answer any THREE questions. All questions carry equal marks.

Q.1 *Answer all parts. For parts (a) to (f) indicate which statements are True or False.*

(a) Kepler's 3rd Law states that the period T (years) of revolution of a planet around the sun is related to the distance D (AU) from the Sun according to:
- i) $D^2 = T^3$
- ii) $D^2 = T^{-3}$
- iii) $T^2 = D^3$
- iv) $T = D^{-2}$

(b) Venus has the following characteristics:
- i) oxygen atmosphere
- ii) volcanoes
- iii) greenhouse effect
- iv) oceans

(c) Jupiter has the following characteristics:
- i) an ocean of liquid hydrogen
- ii) a rocky/metallic core
- (iii) basalts and andesites
- (iv) a moon called Io.

(d) Earth has the following characteristics:
- i) a crust with an average density of ~5517 kg m^{-3}
- ii) a magnetic field that dips downward in the southern hemisphere
- iii) a temperature that decreases with depth
- iv) a mantle which is composed almost entirely of Iron

(e) Seismic waves in the Earth consist of:

i) P waves that generate particle motion perpendicular to their direction of travel
ii) S waves that do not travel in fluids
iii) Rayleigh waves that penetrate the core
iv) P waves from an earthquake arriving at the epicentral angle of 103° that have traversed the whole mantle

(f) The Earth's core:

i) is solid in its outer region and fluid in its inner region
ii) is where the Earth's magnetic field is generated
iii) has a density of 1300 kg m^{-3}
iv) is about 250 km below the Earth's surface.

(g) Give three reasons why the small terrestrial planets have lost most of their lighter elements

(h) Explain, with the help of a sketch, why the sidereal day is shorter than the solar day.

(i) Write a half page summary of the green house effect.

Q.2 *Answer parts (a) and (b):*

(a) Draw a rough graph of the spectra of radiation emitted by blackbodies at different temperatures. State the Stefan-Boltzmann law and Wien's displacement law.
What is the ratio of the power per unit area radiated by a sunspot and by a typical region of the Sun's surface? Assume the sunspot temperature is 4500 K and the typical surface temperature is 6000 K.

(b) Draw sketches of the layout of a Newtonian and a Cassegrain reflecti telescopes
Explain what is meant by the resolution of a telescope.
Estimate the aperture of a telescope, which is required to be able to observe the Moon's surface from the Earth, with a resolution of 1 km. Assume λ = 500 nm and perfect "seeing".

Q.3 *Answer parts (a), (b) and (c):*

(a) Briefly explain the following terms: latitude, altitude, declination.
A star with a declination of +82.3° is observed from a latitude of +55.1°. Calculate its altitude at upper culmination.

(b) State Bode's Rule and use it to predict the orbital radii of the four terrestrial planets.

(c) Outline how observations of the Transits of Venus can be used to measure the Astronomical Unit (AU)

Q.4 *Answer parts (a) and (b):*

(a) Describe the fusion cycle by which energy is produced in the Sun. Outline the processes by which the energy liberated is transferred to the surface. Draw a rough sketch of the regions in which the principal processes occur.

(b) Outline how parallax is used to measure the distance to nearby stars.
Define what are meant by the apparent magnitude and the absolute magnitude of a star. Derive an expression that relates the absolute magnitude, the apparent magnitude, and the distance to a star.
What is the absolute magnitude of the star Betelgeuse if its parallax is 0.00763" and its apparent magnitude is 0.45.

Q.5 *Answer parts (a) and (b):*

(a) Discuss the evolution of a solar mass star into a red giant and white dwarf. Show how this evolution is be represented on a Hertzsprung-Russell diagram.

(b) Explain what is meant by a neutron star and outline how it is formed. State what might be typical values for the mass and radius of a neutron star and use these values to make a rough estimate of the neutron star density.