00360

The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc/ B. Ed Degree Programme

Department	: Physics
Level	: 05
Name of the Examination	: Final Examination
Course Title and - Code	: Astronomy – PYU3172/PHE5172/PHU5311
Academic Year	: 2019/2020
Date	: 07.02.2021
Time	: 9.30 a.m. – 11.30 a.m.
Duration	: 02 hours

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of (06) questions in (04) pages.
3. Answer any Four (04) questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Draw fully labelled diagrams where necessary
6. Involvement in any activity that is considered as an exam offense will lead to punishment
7. Use blue or black ink to answer the questions.
8. Clearly state your index number in your answer script

The Open University of Sri Lanka
B.Sc. Degree Programme - Level 05
Final Examination – 2019/2020
PYU3172/PHU5311/PHE5311- Astronomy
Duration: Two (02) hours

Date: 07.02.2021 **Time: 9.30 a.m. to 11.30 a.m.**

Electronic calculators are allowed.
(Useful information: Radius of the Sun $R_\odot = 6.960\times10^8$ m, Speed of Light $c = 2.9979\times10^8$ ms^{-1}, Universal gravitational constant $G = 6.6726 \times 10^{-11}$ m^3 kg^{-1} s^{-2}, 1 AU = 1.5×10^{11} m, Stefan-Boltzmann constant $\sigma = 5.6704\times 10^{-8}$ J s^{-1} m^{-2} K^{-4})

Answer four (04) questions only

1. (a) Answer all parts.

   i. Write down the Kepler's laws on planetary motion.

   ii. An asteroid orbiting around the Sun has a perihelion distance of 2.0 A.U. and an aphelion distance of 6.0 A.U. Compute its orbital parameters: (a) semi-major axis, (b) eccentricity, and (c) period.

   iii. Given that the orbital speed of earth as 30 km/s and distance between the Earth and the Sun as 1.5 x 10^{11} m, calculate the mass of the Sun (Useful information: Universal gravitational constant G = 6.67×10^{-11} m^3 kg^{-1} s-^{2}).

   (b) If B_m and B_n, $(n > m)$ are the brightnesses of two stars having magnitudes m and n respectively, show that the relationship between their brightnesses and magnitudes can be given as

$$\frac{B_m}{B_n} = 10^{0.4(n-m)}$$

   Hence or otherwise show that the relationship between absolute magnitude M, apparent magnitude m and the distance to a star d in parsecs can be expressed as

$$M = m + 5 - 5 \log d$$

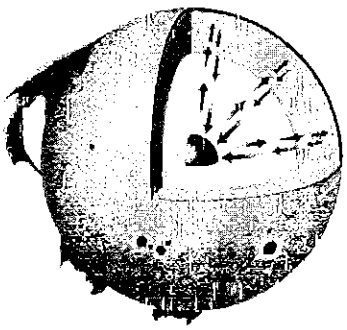
2. Answer all parts

i. Give an account on the origin of the solar system.

ii. Explain how the Sun generates energy (p-p chain reaction).

iii. Identify the followings by labeling the solar diagram given below.

(a). Nuclear burning core, (b). Prominence, (c). Convective zone, (d). Flare, (e). Radiative zone, and (f). Sunspots (You may re-draw the given diagram roughly or copy it down in your answer script.)



iv. Give a brief description on the Convective Zone and Photosphere of the Sun.

v. Show that the equation for hydrostatic equilibrium of a Sun-like star in the main sequence can be given as

$$\frac{\Delta P}{\Delta r} = -\rho \frac{GM_r}{r^2}$$

Here symbols are in their standard notation.

vi. Using a diagram, indicate the layers of H, He, C and other elements up to Fe seen in an old dying star at the collapsing state.

3. i. Study of asteroids is important to protect mankind from asteroid hits and to get fertilizer and metallic resources (for space mining) that are depleting due to increased population and increased consumption. Answer the following questions on asteroids.

   ii. Starting from the Titius-Bode law, describe briefly the discovery of the asteroid belt.

   iii. Explain and discuss the classification of asteroid types, based on their composition.

   iv. The distribution plot of radii of orbits of asteroids in the asteroid belt does not give a smooth bell-curve shape, but shows certain gaps known as 'Kirkwood gaps'. Explain why the distribution is discontinuous.

   v. Write short notes on Trojen, Apollo, Amor and Hirayama/Koronis families of asteroids.

   vi. A spacecraft is landed on the surface of a spherical asteroid having a negligible rotation, a diameter of 2.2 km and an average density of 2.2 g cm^{-3}. Can the astronaut complete a circle along the equator of the asteroid on foot within 2.2 hrs?

4. a. Describe the optical parts of a slit spectrograph fitted to a Cassegrain reflecting telescope. Discuss the main advantages of the slit spectrograph and its main drawback. Explain how you could use this instrument to find: (i) the elements present in a distant star and (ii) the radial velocity of the star.

   b. Describe the Parallax method of measuring the distance to a star and the definition of parsec.

   For a star, the trigonometric parallax was measured to be 0.04 arc seconds. What is the distance to the star in parsec?

   What would be the trigonometric parallax of the same star mentioned in the above problem if it was observed form the moon Titan of the planet Saturn? (You may assume that the distance to the Saturn from the Sun as 10 AU).

5. a. Explain briefly the nature of the Milky Way Galaxy and the Hubble's Classification of Galaxies.

   b. Give an account on the formation of Milky Way Galaxy and its stellar populations.

c. Write an explanatory note on how the death of a massive star (mass > 25 solar masses) would take place after consumption of all its hydrogen fuel at the end, leading to a supernova core explosion.

6. Write short notes on any three (03) of the following questions.

a. The Solar wind, Heliosphere and the Heliopause.
b. Interstellar Medium and Interstellar Extinction.
c. Obler's Paradox on the nature of the Universe.
d. Neutron stars, pulsars and black holes
e. The Hertzsprung-Russel (H-R) diagram and the location of the Sun and the regions where one could find main sequence stars, red giants, blue giants, white dwarfs and red dwarfs in the H-R diagram (you may draw the diagram).

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