

Please furnish the following information before the commencement of the examination	
Full Name of the Candidate:	
Colombo/Peradeniya/Kelaniya/Ruhuna/Batticaloa/Jaffna	
Date of Birth:	Signature of the Candidate :

INSTITUTE OF PHYSICS, SRI LANKA  
jointly with  
ARTHUR C. CLARKE INSTITUTE FOR MODERN TECHNOLOGIES

**THE 1<sup>ST</sup> NATIONAL OLYMPIAD ON ASTRONOMY AND ASTROPHYSICS - 2007**

(Duration : One Hour)

*Answer all the questions and submit this paper to the supervisor at the end of the examination.*

This paper consists of 24 questions in two parts(A &B) printed in Four (04) pages.

Electronic calculators are allowed.

**PART A**

(Answers to Part A should be made by circling or underlining the correct answer on the question paper)

1. Solar atmosphere can be divided into three major parts based on temperature. They are photosphere, chromosphere and corona. The most suitable answer for the average temperature of the corona is
  - a) 6000 K
  - b) 10000 K
  - c) above 100000 K
  - d) 3500 K
  
2. The sidereal day is 3 minutes and 56 seconds less than a solar day. This time difference is due to
  - a) Earth's rotation
  - b) Sun's rotation
  - c) Sun's motion around the galactic center
  - d) Earth's revolution around the Sun
  
3. The Polaris will not always be the North star due to
  - a) The sidereal day being shorter than the solar day
  - b) Due to the precession of the Earth's axis.
  - c) The Earth's period being slightly longer than 365 days.
  - d) The Solar wind blowing the Earth away from the sun.
  
4. An observer standing  $30^\circ$  north from equator observes a star at zenith (right above the head). If the observer moves along the same longitude,  $90^\circ$  to the south from where he is, what could be the new altitude of the star?
  - a)  $0^\circ$
  - b)  $30^\circ$
  - c)  $60^\circ$
  - d)  $90^\circ$

5. Red shift of the spectral lines show the distance galaxies are moving away from us. The receding speed is given by  $V = \left( \frac{\Delta\lambda}{\lambda} \right) C$ . A spectrum of certain galaxy is observed in the H $\alpha$  region and found wavelength of H $\alpha$  absorption line is 6564.64  $\text{\AA}$ . If the laboratory wavelength ( $\lambda$ ) of H $\alpha$  is 6563  $\text{\AA}$  and the speed of light (C) is 300,000 km s $^{-1}$  find the receding speed of the galaxy.  
 a) 35 km s $^{-1}$     b) 50 km s $^{-1}$     c) 65 km s $^{-1}$     d) 75 km s $^{-1}$
6. The different bands of electromagnetic radiation consist of little packets of energy, called photons traveling through space. The amount of energy this packet possess is directly proportionate to their frequency. Find energy of such electromagnetic wave which has the wavelength of 5000 $\text{\AA}$  ( $5 \times 10^{-7}$  m). The speed of light  $3 \times 10^8$  m s $^{-1}$  and Plank constant  $6.625 \times 10^{-34}$  J s .  
 a)  $39.75 \times 10^{38}$  J    b)  $39.75 \times 10^{-20}$  J    c)  $39.75 \times 10^{-20}$  J s    d)  $30.34 \times 10^{30}$  J s
7. The hydrogen in interstellar medium is generally quite cold (if it is not in the vicinity of warm stars) and found in its atomic or neutral ground state. Such clouds are called HI regions. Cold interstellar hydrogen emits radiation in radio region at the wavelength of  
 a) 26 cm    b) 21 cm    c) 5910  $\text{\AA}$     d) 1000 nm
8. The term “Hot Jupiters” is a commonly used word among the planetary scientists in the world. This explains  
 a) The Jupiter formed much closed to the Sun few billions years ago.  
 b) Volcanic eruptions heat up the Jupiter’s surface.  
 c) Discovered some Jupiter size extra-solar planets are closer to the parent star than the distance between the Sun and Jupiter.  
 d) The Jupiter becomes a star in the future.
9. Stars are born, evolve and die. The primary mass of the star decides the way it destroys. A star which is comparable to the Sun’s mass destroys as  
 a) Supernovae    b) Novae    c) Planetary nebulae    d) X-ray burst
10. A, B, and C are three stars with temperatures of 6000K, 24000K, and 3500K, respectively. What is the possible colour sequence of those stars A, B and C, respectively.  
 a) Yellowish, Bluish, Reddish    b) Reddish, Bluish, Yellowish  
 c) Bluish, Yellowish, Reddish    d) Yellowish, Reddish, Bluish
11. The brightest star of the Scorpion constellation is  
 a) Sirius    b) Regulus    c) Antares    d) Polaris
12. There a two stars A and B with apparent magnitudes 1 and 3, respectively. The correct expression about their apparent brightness is  
 a). Star A is 6 times brighter than the star B.  
 b). Star A is 6 times fainter than the star B.  
 c). Star A is 6.310 times brighter than the star B.  
 d). Star A is 2.512 times brighter than the star B.
13. The weight of a man on Earth’s surface is 60 kg. If he goes to the planet Mars, his weight at the Martian surface would be  
 a) 20 kg    b) 10 kg    c) 60 kg    d) 120 kg

14. The escape velocity ( $V$ ) of an object (at its surface) depends on its mass ( $M$ ) and radius ( $R$ ), and is given by  $V = \sqrt{2GM/R}$ . (Here, universal gravitational constant  $G = 6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$ ). Suppose a star with a escape velocity of  $1800 \text{ km s}^{-1}$  subsequently becomes a neutron star having a radius  $10^5$  times smaller than the original star, the escape velocity of the neutron star would be
- a)  $200,000 \text{ km s}^{-1}$     b)  $180,000 \text{ km s}^{-1}$     c)  $180,000 \text{ m s}^{-1}$     d)  $569210 \text{ km s}^{-1}$
15. An observer who is on the  $15^\circ$  northern latitude observed a star in the Ursa Minor constellation at 9.00 p.m. local time. The star has  $25^\circ$  angular separations with bottom star of the pointer stars of the Ursa Major constellation. What would be the altitude of the observed star after a time lapse of 3 hours.
- a)  $37.5^\circ$     b)  $12^\circ$     c)  $25^\circ$     d)  $15^\circ$
16. A comet orbiting around the Sun has a perihelion distance of 2.0 A.U. and an aphelion distance of 6.0 A.U. Eccentricity ( $e$ ) of its elliptical orbit is
- a) 0.4    b) 0.5    c) 0.7    d) 1.0.
17. Using the Kepler's third law compute the period of an asteroid orbiting around the Sun having a semi-major axis of 4.0 AU (astronomical Units). The answer in Earth years is
- a) 3    b) 4    c) 8    d) 76
18. If the orbital speed of earth as  $30 \text{ km/s}$  and distance between the Earth and the Sun as  $1.5 \times 10^{11} \text{ m}$ , the mass of the Sun would be (Useful information: Universal gravitational constant  $G = 6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$ ).
- a)  $1.9 \times 10^{30} \text{ kg}$ ,    b)  $2.0 \times 10^{30} \text{ kg}$ ,    c)  $2.1 \times 10^{30} \text{ kg}$ ,    d) Non of the above answers are correct.
19. If the focal length of the objective of a telescope is 1 m and the focal length of its eye piece is 10 mm, the magnification of the telescope is
- a) 10    b) 100    c) 200    d) 1000.
20. A star gives a parallax of  $0.29''$  when observed from the earth with a time gap of 6 months. The distance to that star in light years is
- a) 3.26    b) 5.62    c) 11.24    d) 22.48.

### PART B

**(Please provide your answers to this part in the space provided in page 4)**

21. Describe the Titius Bode law and estimate the distance to planet Saturn from the Sun in Astronomical Units (AU).
22. Draw a sketch of the celestial sphere and label i) ecliptic, ii) celestial equator, iii) Vernal and Autumnal equinoxes. On the same diagram or a separate diagram indicate the equatorial coordinate system: Right Ascension and Declination.
23. Draw the H-R diagram and indicate the regions where you could find main sequence stars, red giants, blue giants, white dwarfs and red dwarfs.
24. Draw a sketch of Saturn and label the main belts and zones of the Saturnian southern hemisphere, its ring system and divisions .

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Name of the candidate :

Please use the following space to provide answers to the questions 21 to 24.

(21)

(22)

(23)

(24)