

Roll No.

E-754

**M. Sc. (Third Semester)
EXAMINATION, Dec.-Jan., 2020-21**

PHYSICS

Paper Fourth (A)

(Astronomy and Astrophysics-I)

Time : Three Hours]

[Maximum Marks : 80

Note : Attempt all Sections as directed.

Section—A

1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

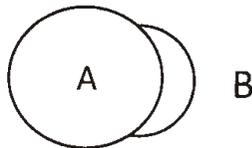
1. A star is a body that :
 - (a) is bound by self-gravity
 - (b) shines bright in the sky and is bound by self-gravity
 - (c) is not bound by self-gravity
 - (d) burns nuclear fuel and is bound by self-gravity
2. Which of the following statements is correct ?
 - (a) Proper motion is due to the annual motion of the Earth around the Sun.

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- (b) Parallax is the peculiar velocity due to the stellar motion in space.
 - (c) Both parallax and proper motions are due to stellar motion in space.
 - (d) Parallax is due to annual motion of Earth around the Sun.
3. A star has magnitude of zero :
- (a) It will not be visible.
 - (b) It is a black hole.
 - (c) We need a telescope to see this.
 - (d) We don't need a telescope to see this.
4. Neutron Star will be found in :
- (a) Center of the Galaxy
 - (b) Supernova remnants
 - (c) Planetary nebula
 - (d) Molecular clouds
5. Two white dwarfs A and B have masses $1 M_{\odot}$ and $1.2 M_{\odot}$, respectively. Then :
- (a) A and B are equal size
 - (b) A is smaller than B
 - (c) B is small than A
 - (d) A can become bigger in size if it acquires additional $0.3 M_{\odot}$

6. Consider two stars of spectral types A5 and K3. Then :
- (a) Both will have Hydrogen lines of same strength
 - (b) Hydrogen lines are stronger in A5 star
 - (c) Hydrogen lines are stronger in K3 star
 - (d) Hydrogen lines will not be seen in them
7. HR diagram is a plot of :
- (a) Absolute magnitude vs. Colour
 - (b) Absolute magnitude vs. Apparent magnitude
 - (c) Luminosity vs. Size of stars
 - (d) Effective temperature vs. Distance
8. A star with $3.5 M_{\odot}$ will die as a :
- (a) Supernova
 - (b) White dwarf
 - (c) Black hole
 - (d) Neutron star
9. Two stars P and Q have spectral class M3V and A7II respectively :
- (a) P is hotter and larger than Q
 - (b) P is cooler and larger than Q
 - (c) P is cooler and smaller than Q
 - (d) P is hotter and smaller than Q

10. The $H\alpha$ line from a star is observed at 6500 \AA . What does this tell ?
- (a) The star is moving away from us.
 - (b) The star is moving towards us.
 - (c) The star is moving perpendicular to us.
 - (d) The star is not moving w.r.t. us.
11. In a close binary system, one star has filled its Roche lobe and the other is well within its Roche lobe. The system will be called as :
- (a) Spectroscopic Binary
 - (b) Detached Binary
 - (c) Semi-detached Binary
 - (d) Contact Binary
12. The free-fall time scale/dynamical time scale of the Sun is :
- (a) 30 min.
 - (b) 24 hours
 - (c) 30 days
 - (d) 1 year
13. Assuming stars A and B have same temperature. The current scenario will give :



- (a) Primary minimum
- (b) Secondary minimum
- (c) Tertiary minimum
- (d) Main minimum

14. The presently used MK spectral classification is based on :

- (a) Effective temperature
- (b) Strength of hydrogen lines
- (c) Luminosity
- (d) Effective temperature and luminosity

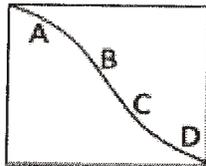
15. The mass of metals present in the Sun is :

- (a) 2×10^{33} kg
- (b) 2×10^{30} kg
- (c) 1.2×10^{29} kg
- (d) 4×10^{28} kg

16. Consider an HR diagram of a star cluster.

- (a) Cluster is young if Main sequence is short.
- (b) Cluster is old if Main sequence is long.
- (c) Cluster is young if Main sequence is long.
- (d) Cannot be predicted on the basis of size of Main sequence.

17. Locations of stars in the HR diagram are shown. Which star will die first ?



- (a) A
- (b) B
- (c) C
- (d) D

18. The evolution of high mass main-sequence stars takes place :
- (a) at same rate as low mass stars
 - (b) at slower rate than low mass stars
 - (c) independent of mass of stars
 - (d) at higher rate than low mass stars
19. Degeneracy pressure is a consequence of :
- (a) Pauli's exclusion principle
 - (b) Uncertainty principle
 - (c) Pauli's exclusion principle and Uncertainty principle
 - (d) Quantum mechanical tunneling
20. White dwarf will be found in :
- (a) Center of the Galaxy
 - (b) Supernova remnants
 - (c) Planetary nebula
 - (d) Molecular clouds

Section—B

2 each

(Very Short Answer Type Questions)

Note : Attempt all questions.

1. The star Bellatrix in the constellation of Orion is found to have parallax measurement of 12.92 milli-arcseconds. Calculate the distance of Bellatrix star.
2. The distance modulus of a globular cluster is 15.56 mag. How much is the distance to the cluster ?
3. Two stars have same temperature but have different luminosities. What will be the difference seen in the spectral lines and why ?

4. What is the spectral class of the Sun and what does this tell about the Sun ?
5. A star is having same temperature as that of the Sun but 10000 times more luminous. Find the radius, mass and absolute magnitude of that star ?
6. How the colour of a star is related to its temperature ? Give some values to explain this. State whether colour index of the Sun will be + ve, - ve or zero.
7. Light cannot come from a black hole, then how the presence of a black is inferred ?
8. If you know the distance to the Sun from Earth, then how will you estimate the mass of the Sun ?

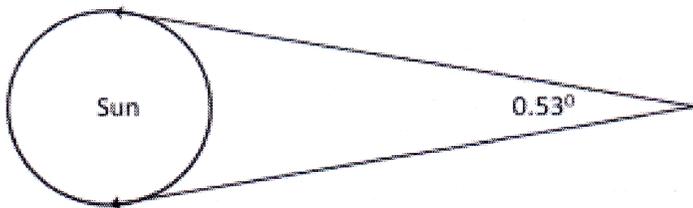
Section—C

3 each

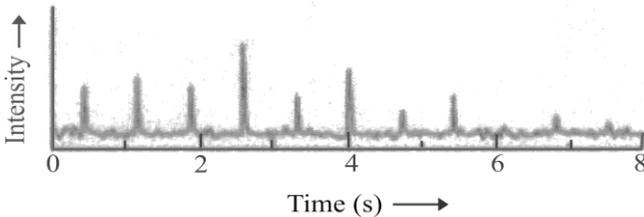
(Short Answer Type Questions)

Note : Attempt all questions.

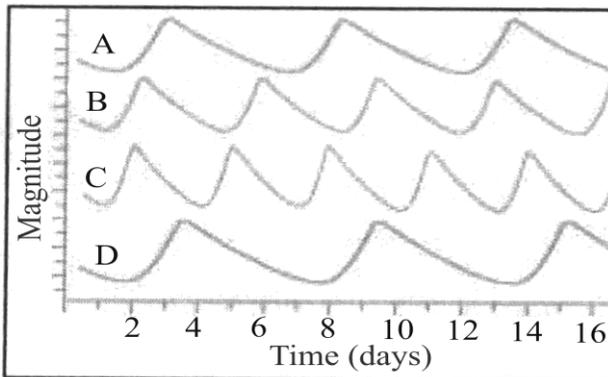
1. What are the apparent and absolute magnitudes ? How are they related to brightness and luminosities, respectively ? Just write a formula (do not derive) connecting both these magnitudes to the distance.
2. Briefly explain the HR diagram. Why this diagram is important in Astronomy ?
3. If the angular size of the Sun is 0.53° and the light from the Sun takes 8 minutes and 10 seconds to reach us, then find the radius of the Sun in kilometre :

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4. The magnitudes of two close by stars are 6.7 and 8.3. Find the combined brightness of the stars in magnitude scale.
5. A star at Main Sequence phase has weaker magnetic field and but when it becomes a Neutron Star, then why its Magnetic field becomes very strong ?
6. A star cannot be formed below a certain mass, why ? Similarly a star cannot be formed above certain mass, why ? Write approximate values of these lower and upper mass limits.
7. Name the astronomical object from which you could get this data. What kind of parameters / information of that object you could derive from this data and how ?



8. A graph/plot of four objects is shown in the figure. What is this graph called in Astronomy ? Name the object from which you could get this graph. Arrange the objects in increasing order of luminosity. Give explanation for this.



Section—D

5 each

(Long Answer Type Questions)

Note : Attempt all questions.

1. What are the methods used in Astronomy for distance measurements ? Discuss any *two* methods.

Or

Derive the 1st two equations of stellar interior. Obtain the Virial Theorem from these and state its significance.

2. Discuss the evolution of solar type stars and show the evolutionary track in HR diagram.

Or

Obtain the expression for pressure exerted by fully degenerate electrons. State the astrophysics circumstances where the role of this pressure becomes important.

3. What are the close binary systems ? Discuss any *one* such system in detail.

Or

Obtain the Chandrasekhar mass limit from the basics of stellar structure.

4. Discuss some important physical characteristics of the Sun.

Or

Discuss the two-dimensional spectral classification of stars and display this in the HR diagram with suitable examples.