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VI Semester B.Sc. Degree Examination, August/September - 2023

PHYSICS

Atmospheric Physics, Relativity and Astrophysics
(CBCS Semester Scheme : Freshers - 2020-21 Onwards)

**Paper : VII****Time : 3 Hours****Maximum Marks : 70****Instructions to Candidates:**

1. All Multiple-Choice Questions in Part A are to be compulsory answered in page 1
2. Use of Non-Programmable scientific calculator is allowed.

PART - A**Answer All questions. Each question carries 1 mark.****(10×1=10)**

1. The Percentage of nitrogen in the earth's atmosphere is
a) 21 b) 2 c) 78 d) 1
2. Which of the following statements about the ionosphere is correct?
I It is the uppermost layer of the atmosphere
II The molecules and atoms of nitrogen and oxygen in this layer absorb some of the solar radiation and become ionized
III This layer is responsible for reflecting back the radio wave transmitted from the earth.
a) I and II b) I and III c) II and III d) I II and III
3. A device used to measure atmospheric humidity is
a) Hygrometer b) Anemometer c) Lysimeter d) Hydrometer
4. An aerosol is a
a) Suspension of liquid or solid particles in a gas
b) Suspension of only solid particles in a gas
c) Suspension of only liquid particles in a gas
d) Suspension of gas molecules in a liquid.

[P.T.O.]



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5. As the speed of a particle approaches the speed of light, the mass of the particle
- a) Increases
 - b) Decreases
 - c) Remains the same
 - d) Approaches zero
6. The length of a moving object relative to a stationary observer
- a) appears to be shorter when it approaches the speed of light
 - b) appears to be longer when it approaches the speed of light
 - c) appears to be shorter when its speed is far less than that of light
 - d) appears to be longer when its speed is far less than that of light.
7. The parallax angle for a star is 0.02 seconds of arc. The distance in parsec of the star from the earth is
- a) 50
 - b) 5
 - c) 500
 - d) 100
8. One astronomical unit is the average distance between
- a) earth and sun
 - b) earth and moon
 - c) Jupiter and sun
 - d) Pluto and sun
9. The constellations of stars appear at different positions in the sky at different times during night mainly because of
- a) earth's rotation about its axis
 - b) earth's revolution around the sun
 - c) optical illusion
 - d) their rotation.
10. Energy production in a star is due to
- a) Nuclear fission
 - b) Magnetic storms
 - c) Chemical reaction
 - d) Nuclear fusion.

PART - B

Answer any Five questions. Each question carries 2 marks.

(5×2=10)

- 11. Mention any two differences between climate and weather.
- 12. Explain the greenhouse effect.
- 13. Name any two factors on which pressure of the atmosphere depends.
- 14. What is atmospheric stability? Explain.



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15. State Einstein's postulates of special theory of relativity.
16. Explain twin paradox.
17. What are solar and sidereal time scales?
18. How do white dwarfs attain stability? Explain.

PART - C

Answer any Five questions. Each question carries 6 marks.

(5×6=30)

19. Explain the vertical structure of atmosphere on the basis of variation of temperature. (6)
20. Discuss the thermodynamics of dry and moist air and hence obtain the expression for virtual temperature. (6)
21. Obtain Lorentz transformation equations. (6)
22. a) What is proper time?
b) Arrive at the expression for time dilation based on special theory of relativity. (1+5)
23. Deduce mass energy relation from Einstein special theory of relativity. (6)
24. Obtain an expression for core pressure of a star on the basis of linear density model. (6)
25. a) What is H - R diagram? How are the stars in space classified on the basis of H - R diagram?
b) Explain how the surface temperature of a star is related to its colour. (4+2)

PART - D

Answer any Four questions, Each question carries 5 marks.

(4×5=20)

26. A building is 400 m tall. Assuming that the density of air from the top of the building to the bottom is a constant equal to 1 kg m^{-3} , compute the pressure change from the bottom to the top of the building. Given $g = 9.81 \text{ ms}^{-2}$.
27. Compute the scale height of atmosphere (H). Assume that the temperature of air is 300 K and the average mass of an air molecule is $4.78 \times 10^{-23} \text{ g}$. $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$, $g = 9.81 \text{ ms}^{-2}$.
28. How fast a rocket would have to go relative to an observer on earth for its length to be contracted to 50% of its length at rest? Given : $c = 3 \times 10^8 \text{ ms}^{-1}$.
29. A spaceship moving away from the earth at a velocity of $0.75c$ with respect to the earth launches a rocket in the direction away from the earth with a velocity of $0.75c$ with respect to the spaceship. What is the velocity of the rocket with respect to the earth? Given : $c = 3 \times 10^8 \text{ ms}^{-1}$.

[P.T.O.]



30. Calculate the mass of an electron when it is moving with a kinetic energy of 20 MeV. Given : Rest mass of electron is $9.1 \times 10^{-31} \text{ kg}$, $c = 3 \times 10^8 \text{ ms}^{-1}$.
31. In the Orion constellation the luminosity of the star is 10000 times that of sun and its surface temperature is 3000K. Calculate radius of the star. Given : surface temperature of the sun is 6000K. $R_{\odot} = 6.97 \times 10^8 \text{ m}$.
32. Apparent magnitude of stars Sirius and Regulus are -1.44 and +1.36 respectively on magnitude scale of stars. Calculate the relative brightness of the star Sirius with respect to Regulus.
33. Calculate gravitational potential energy of a star using linear density model. Given : $R = 7 \times 10^8 \text{ m}$, $M = 3 \times 10^{30} \text{ kg}$, and $G = 6.673 \times 10^{-11} \text{ Nm}^2 \text{ kg}^{-2}$.
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VI Semester B.Sc. Degree Examination, August/September - 2023

PHYSICS

Nano Physics, Material Science and Elementary Particles (Theory)

(CBCS Scheme Freshers - 2020-21 Onwards)

Paper : VIII(603)



Time : 3 Hours

Maximum Marks : 70

Instructions to Candidates:

1. All Multiple-Choice Questions in Part A are to be **compulsory** answered in page 1.
2. Use of Non-Programmable scientific calculators is allowed.

PART - A

Answer All the questions. Each question carries 1 mark.

(10×1=10)

1. At nano dimensions, which of the following property changes as compared to the material in bulk.
 - a) Physical
 - b) Chemical
 - c) Optical
 - d) All the above
2. The materials in which all the three dimensions are in nanoscale are called ----- nanomaterials.
 - a) 3-dimensional
 - b) 2-dimensional
 - c) 1-dimensional
 - d) 0-dimensional.
3. Synthesis of nano materials by chemical method is known as
 - a) Bottom up approach
 - b) Top down approach
 - c) Arc discharge approach
 - d) Ion sputtering approach.

[P.T.O.]



4. Heat capacity of a substance depends on
 - a) Only Mass
 - b) Only Specific heat of the material
 - c) Both mass and specific heat of the material
 - d) None of the above.
5. Heat conduction in ceramics occurs mainly due to
 - a) Lattice vibration of atoms
 - b) Electron diffusion
 - c) Photo conduction
 - d) Electron - hole pair formation
6. Expulsion of magnetic field lines from the interior of a superconducting material at transition temperature is called.
 - a) Meissner effect
 - b) Joule's effect
 - c) Josephson's effect
 - d) Thomson's effect
7. Optical properties of metals are associated with
 - a) High reflectivity and low transmission
 - b) High transmission and low reflectivity
 - c) High reflectivity and high transmission
 - d) Low reflectivity and low transmission.
8. Photon is a -----
 - a) Boson
 - b) Lepton
 - c) Muon
 - d) Baryon
9. The lightest particle is
 - a) Meson
 - b) Lepton
 - c) Baryons
 - d) Hyperons
10. Baryon number for protons and neutrons is
 - a) +1
 - b) -1
 - c) 0
 - d) 2



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PART - B**Answer any FIVE of the following. Each question carries 2 marks.****(5×2=10)**

11. What are quantum Dots? Explain.
12. Mention any two structural properties of C_{60} -Fullerene.
13. State Dulong - Petits law
14. What are cooper pairs? Explain.
15. What is Luminescence? Explain.
16. What are Hadrons? Explain.
17. Which are the force mediators for nucleon and quarks?
18. Name the different types of interactions in nature.

PART - C**Answer any FIVE of the following. Each question carries 6 marks.****(5×6=30)**

19. a) Distinguish between top-down and bottom up method of obtaining nanomaterials.
b) Briefly explain sol gel method of synthesizing nanomaterials. **(3+3)**
20. What is graphene? Write any five properties of graphene: **(1+5)**
21. a) Write a note on carbon nano tubes.
b) Mention any three applications of nanomaterials. **(3+3)**
22. a) Distinguish between elastic and plastic deformations.
b) What is deformation by slip? **(4+2)**
23. a) What is critical field in superconductivity? Explain.
b) Mention any four applications of superconductors. **(2+4)**
24. Explain the classification of elementary particles based on spin. **(6)**
25. Write a note on :
a) Leptons
b) Anti quarks. **(3+3)**

PART - D**Answer any FOUR of the following. Each question carries 5 marks.****(4×5=20)**

(Use : $h = 6.625 \times 10^{-34}$ J s, $m_e = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^8$ ms⁻¹, $R = 8311$ JK mol⁻¹ K⁻¹, $1\text{amu} = 931.5$ MeV, $m_p = 1.66 \times 10^{-27}$ kg, $N = 6.023 \times 10^{23}$, $K = 1.381 \times 10^{-23}$ JK⁻¹)

26. Calculate the original and new surface to volume ratio of a cube of side length of 5 cm, when its side length is reduced to 5nm.
27. Considering the confinement of energy levels in its first quantum state, determine the length of quantum confinement of a nanoparticle of effective mass 10×10^{-28} Kg possessing energy value of 3.4 eV.

[P.T.O.]



28. Determine the energy equivalent in eV for a nanoparticle of mass 10^{-25} Kg. Determine its equivalent wavelength if it were to be a wave.
29. Calculate the Debye's specific heat of copper at 30K. Take the characteristic frequency of copper as 6.5×10^{12} Hz.
30. Determine the work done per unit volume in deforming a material longitudinally, due to a force of 4000N, resulting in a strain of 4×10^{-4} . Take the area of cross section of the material as $2 \times 10^{-6} \text{ m}^2$ and elastic constant of the material as $4 \times 10^{10} \text{ Nm}^{-2}$.
31. Debye's temperature of carbon is 1800K. Calculate the specific heat per kilo mole for carbon at 30K. Also calculate the highest lattice frequency.
32. Check for the conservation of
- i) Charge
 - ii) Baryon number
 - iii) Strangeness for the following interaction
- $$P + P^- \rightarrow 2\pi + 2\pi^- + 2\pi^0$$
33. Σ and Δ particle are made of three quarks (uus) and (udd) respectively determine the charge and the exact particle.
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