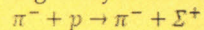


10. The flowing decay is forbidden:



The conservation law violated here is:

- a. conservation of parity
 b. conservation of strangeness
 c. conservation of charge
 d. conservation of lepton number

11. The quark content of the Ω^- particle is:

- a. uds
 b. dss
 c. ddd
 d. sss

12. At $q^2 \rightarrow 0$ the value of the proton form factor $F(q)$ becomes:

- a. 1
 b. 0
 c. $q^2/2$
 d. \sqrt{q}

13. The parallax (θ) of a distant star, 'd' AU away from the sun is given by:

- a. $\theta = \frac{1}{d} AU$
 b. $\theta = \frac{4\pi}{d} AU$
 c. $\theta = \frac{d}{\pi} AU$
 d. $\theta = \frac{d}{\pi} AU$

14. The celestial equator and elliptic are inclined at about:

- a. 5°
 b. 13.5°
 c. 23.5°
 d. 43.5°

15. The solar system moves around the center of the Milky Way Galaxy with a velocity:

- a. c/2
 b. 600 km/s
 c. 250 km/s
 d. 11.2 km/s

16. Identify the process that dominates the energy liberation in Sun.

- a. Nuclear fusion
 b. Nuclear fission
 c. Gravitational contraction
 d. Gravitational differentiation

17. The super-cluster present in Pisces constellation, containing 43 galaxies, has been discovered by Indian scientists in 2017, named as:

- a. Lakshmi
 b. Durga
 c. Swaraswati
 d. Parvati

18. Acceleration due to gravity (g_{ns}) of a neutron star of mass $1.44M_\odot$ and radius 10 km is:

- a. 9.8 m/s^2
 b. $1.86 \times 10^{12} \text{ m/s}^2$
 c. $11.2 \times 10^{12} \text{ m/s}^2$
 d. 250 m/s^2

19. Escape velocity of a neutron star of mass $1.44M_\odot$ and radius 10 km is:

- a. $1.93 \times 10^8 \text{ m/s}$
 b. $2.99 \times 10^8 \text{ m/s}$
 c. $11.2 \times 10^3 \text{ m/s}$
 d. 299 m/s

20. The lightest elements are built up in:

- a. the early universe
 b. the main sequence stars
 c. the white dwarfs
 d. the neutron stars

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(PART-B : Descriptive)

Time: 2 hrs. 40min.

Marks: 50

[Answer question no.1 & any four (4) from the rest]

1. a. What do you mean by elementary or fundamental particle? List all the fundamental entities of the standard model of particle physics. 6+4=10
 b. Construct the baryon octet putting the symbols of the baryons in appropriate places in the octet according to their charge and strangeness.
2. a. Explain briefly the CP violation in the neutral kaon system. 5+5=10
 b. Calculate the color factor for the interaction between a red and a blue (R-B) quark.
3. a. Discuss elaborately the deep inelastic scattering process of neutrino and quark. 8+2=10
 b. Express Dirac equation for spin $\frac{1}{2}$ particles in covariant form. What are the eigen values of the Dirac traceless matrices α_i and β ?
4. a. Show that the scattering cross section for an extended object (say a hadron) can be expressed as: 8+2=10

$$d\sigma(\theta) = d\sigma_{pt} |F(Q^2)|^2$$
 where $F(Q^2)$ is the hadron form factor.
 b. Write a short note on quark confinement.
5. a. Find the neutrinos involved in the following decays: 2+2+2+4=10
 (i) $\pi^- \rightarrow \mu^- + ?$
 (ii) $\mu^- \rightarrow e^- + ? + ?$
 b. Draw the Feynmann diagram for charged current vertex of leptons for weak interaction. Give an example.
 c. Analyze the following reactions in terms of constituent quarks:
 (i) $\pi^- + p \rightarrow K^0 + \Lambda^0$
 (ii) $K^- + p \rightarrow K^+ + K^0 + \Omega^-$
 d. A photon with energy $E_\gamma = 2.09 \text{ GeV}$ creates a proton-antiproton pair in which the proton has a kinetic energy of 95 MeV. Calculate the kinetic energy of the antiproton.
6. Explain the Apparent and Absolute magnitudes of a star. 4+6=10
 Draw the H-R diagram and discuss its three main regions.
7. Calculate the amount of energy released when H fuses to produce He in stars. 2+4+4=10
 Discuss the steps of the fusion reactions below:
 (a) Proton-Proton chain reaction.
 (b) Carbon-Nitrogen-Oxygen reaction.
8. Explain briefly how white dwarf forms. 5+5=10
 What role does electron degeneracy plays in the interior of a white dwarf?
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