Rayat Shikshan Sanstha's
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Department of Physics

Question Bank

Paper **XIII**- DSE-F1 **Nuclear and Particle Physics**

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Unit I- Chapter I- General Properties of Nuclei and Nuclear Model

- **Multiple Choice Questions (Correct answer is shown in red color)**

1. The nucleus contains

A) protons and electrons

B) protons and neutrons

C) neutrons and electrons

D) neutrons and a-particles

2. Isobars are the nuclides with same..... but different.....

A) A-values, Z-values B) A-values, N-values

C) Z-values, A-values D) N-values, Z-values

3. Protons and neutrons have intrinsic spin equal to

A) $\hbar$ B) $2\hbar$ C) $\frac{\hbar}{2}$ D) $\frac{\hbar}{2\pi}$

4. Nuclear binding energy is

A) Mass defect x c^2

B) Mass difference x c^2

C) Mass defect / c^2

D) Mass difference/ c^2

5. Binding energy per nucleon is almost constant for.....

A) very light nuclides B) all nuclides

C) very heavy nuclides D) moderate mass nuclides

6. …….model is used to obtain semi-empirical mass formula.

A) liquid drop model

B) shell model

C) a-particle model

D) single particle model

7. Magnetic moment (μ_n,) of neutron is.....

A)zero B) 2.793 μ_n C) -1.913 μ_β D) -1.913 μ_n

8. Nuclear radius is proportional to

A) A B) $A^{1/3}$ C) $A^{2/3}$ D) Z

9. Most stable nuclide is

A) ${}^{16}_{8}O$ B) ${}^{41}_{20}Ca$ C) ${}^{206}_{82}Pb$ D) ${}^{3}_{1}H$

10. One atomic mass unit (amu) is equal to

A) 931 g B) 931 kg C) 931Mev D) 931eV

Short Answer Questions

1. What are nucleons? Explain their intrinsic properties.

2. What is the shape and size of nucleus ?

3. Discuss different methods used to measure nuclear radius.

4. What is binding energy of a nucleus? Explain.

5.Write a note on 'magic numbers'

6. Discuss applications of semi-empirical mass formula.

- **Long Answer Questions**

1. What is binding energy curve? Discuss its nature and applications.

2.Explain liquid drop model for a nucleus.

3.Derive semi-empirical mass formula.

Unit I- Chapter-II- Particle Accelerators

- **Multiple Choice Questions (Correct answer is shown in red color)**

1. In particle accelerators..... particles are accelerated.

A) positively charged

B) negatively charged

C) charged (+vely or -vely)

D) neutral

2. In resonance orbital accelerators the frequency of revolution of particles is..... frequency of accelerating potential.

A) equal to the B)greater than

C)smaller than D)not related to the

3. Cyclotron is suitable to accelerate.....

A) neutrons B) protons C) electrons D) positrons

4. Betatron is specially designed to accelerate....

A) electrons B) positrons

C) both electrons and positrons D) protons

5. The period of revolution of particle in cyclotron is.

A) independent of velocity of proton

B) independent of radius of orbit

C) independent of both velocity of particle and radius of orbit

D) proportional to the energy of the proton

6. The first orbital resonance accelerator built was.....

A) cyclotron B synchrocyclotron

C)) betatron D proton synchrotron

7. The phase stable orbit condition in synchrocyclotron is that the instantaneous P. D. across dees is……and …….

A) zero, about to become accelerating

B) zero, about to become decelerating

C) positive, very large

D) negative, very large

8. .....accelerator provides maximum energy particles.

A) cyclotron B) betatron C) synchrocyclotron D) proton synchrotron

9. The magnetic pole-pieces are just above and below the donut tube in.....

A) cyclotron B) betatron C) synchrocyclotron D) electron-synchrotron

10. Acceleration of ……is not feasible in cyclotron

A) protons B)electrons C)deuterons D) α-articles

11. A frequency modulated supply is employed in…

A) cyclotron B) synchrocyclotron C)betatron D) electon-synchrotron

- **Short Answer Questions**

1. What is the need of particle accelerates?
2. Explain the principle of betatron.
3. Obtain an expression for the maximum energy obtainable using betatron.
4. What are synchrotrons?
5. Explain the principle of electron-synchrotron with special reference to two-step acceleration

- **Long Answer Questions**

1. Explain theory, construction and working of a cyclotron.
2. Obtain an expression for maximum energy obtainable from a cyclotron. Discuss the limitations of a cyclotron.
3 Explain the phase-stable-orbit condition in details. 6. Discuss the construction, working and advantages of synchrocyclotron.
4 Discuss the construction, working of betatron.
5 Give construction and working of electron-synchrotron.
6. Discuss the principle of proton-synchrotron with a special reference to two step acceleration.
7. Explain construction and working of proton-syncrotron.

Unit II- Chapter I- Nuclear Detectors

- **Multiple Choice Questions (Correct answer is shown in red color)**

1. The following detector use the principle of ionization of gas by the energetic particle.

A) ionization chamber B)GM-counter C) cloud chamber D)all the above

2. The following detector do not use the principle of ionization of gas by energetic ionizing particle

A) semiconductor detector B) ionization chamber

C) GM-counter D) cloud chamber

3. Heart of Scintillation counter is.....

A) MgO-coating B) photomultiplier tube

C) phosphor D) light guide

4. Cerenkov radiations are emitted by a particle moving with a velocity..... medium. the phase velocity of light in the same transparent

A) half B) less than

C) greater than D) equal to

5. The total number of ion-pairs produced by an ionizing particle depends upon its.....

A) mass B) charge C) initial energy D) final energy

6. Quenching gas in GM-tube is….

A)air B)Argon C) Bromine Vapour D) Water Vapour

7. Gas amplification in ionization chamber is.....

A) initial energy B) final energy C) 10^{-3} D) 10^{-8}

8. Faithful counter is one which produces….for every particle passing through the counter.

A) one pulse B)one and only one pulse

C)pulses one after another D) continuous discharge

9. The electron multiplication is achieved in…….

A)GM-Counter B)photomultiplier tube

C)Scintillation detector D) Cerenkov detector

10. Gas amplification in GM-Counter is.....

A) initial energy B) final energy C) ~10^{3} D) ~10^{8}

11. The sensitive period of cloud chamber is that when .....

A) air in the chamber, (is clean i.e.) has no dust particles

B) air in the chamber has no ions

C) air in the chamber contains saturated vapour

D) air in the chamber contains super saturated vapour

- **Short Answer Questions**

1. Explain the principle of ionization chamber.
2. What do you mean by quenching of GM-tube? Explain the self quenching mechanism.
3. How working potential for GM-tube is decided? 7. What is dead time of GM-counter? How a correction can be applied to it?
4. What is Scintillation detector?

- **Long Answer Questions**

1. Discuss construction and working of ionization chamber.
2. With the help of block diagram, explain the GM-counter.
3. Explain the construction and working of a Scintillation counter. What are advantages of it over GM-counter.
4. What do you mean by Cerenkov radiations? How this principle can be used to detect or count fast moving charged particle?
5. Explain the theory, construction and working of semiconductor detector. Compare the maximum count rate of semiconductor detector with other counters.
6. Explain variation of effective mass of an electron with a wave vector.
7. Explain how energy gap is formed between allowed energy bands.
8. Distinguish between metal, semiconductor and insulator on the basis of their energy band structure.

Unit II- Chapter II- Particle Physics

- **Multiple Choice Questions (Correct answer is shown in red color)**

1. …….force is not an interaction.

A) gravitational B) electromagnetic C) strong nuclear D) centrifugal

2. …….force is an interaction.

A) centrifugal B) frictional C) electromagnetic D) viscous

3. ..... interactions are very strong, but have very short range.

A) strong B) electromagnetic C) weak D) gravitational

4. ..... interactions are very weak, but have very large range.

A) strong B) electromagnetic C) weak D) gravitational

5. Rest mass of ..... bosons is non-zero.

A) gluon B) photon C) *w*eak (W) D) graviton

6. . ….are elementary particles which are not constituted of quarks.

A) Leptons B) Mesons C) Baryons D) Nucleons

7. ..... elementary particle are composites of three up (u) and down (d) quarks.

A) Leptons B) Mesons C) Baryons D) Nucleons

8. ..... elementary particle are composites of a quark (u or d) and an antiquark ($\bar{u}$ & $\bar{d}$)

A) Leptons B) Mesons C) Pions D) Hyperons

9..... are composites of up (u), down (d) and strange (s) quarks.

A) Leptons B) Nucleons C) Mesons D) Hyperons

10. ..... elementary particles have spin half and positive parity.

A) Baryons B) Pions C) Kaons D) Photons

11. Elementary particles with zero spin and negative parity are

A) Baryons B) Pions C) Kaons D) both (b) and (c)

12. An abstract spin called isospin (T) is postulated to explain.

A)singlets B) bosons C) multiplets D) fermions

13. Parity is not conserved in..... interactions.

A) gravitational B)electromagnetic C)weak D)strong

14. Quarks have..... electronic charges.

A)zero B)One unit of positive

C) One unit of negative D)fractional

15……...have not been observed physically

A)Leptons B) Quarks C)Bosons D)Hadrons

- **Short Answer Questions**

1. What are interactions and how they are mediated in different type of interactions.
2. Explain gravitational and electromagnetic interactions.
3. Discuss the weak and strong interactions.
4. What are hadrons? Discuss their properties.
5. Write a short note on symmetries in elementary particles. 8. Discuss 'the basic conservation laws'.
6. Explain the invariance of space inversion and also discuss in which interactions it is violated.

- **Long Answer Questions**

1. Give the classification of the fundamental particles.
2. Write a note on quark-model.