

-TWO MARKS-**UNIT-III NUCLEAR POWER PLANTS:****1. What is meant by radioactivity?**

It refers to the German name of Radio-Activitat. Radioactivity is the spontaneous disintegration of atomic nuclei. The nucleus emits particles or electromagnetic rays during this process.

2. What is the unit of Radioactivity?

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| 1. Roentgen | 2. RAD (Radiation Absorbed Dose) |
| 3. RBE (Relative Biological Effectiveness) | 4. REM (Roentgen Equivalent in Man) |
| 5. Gray (GY)-100 rads | 6. Sievert (SV) |

3. What are the types of Radioactive decay?

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|---------------------|--|
| 1. Alpha decay | 2. Beta decay |
| 3. Gamma decay | 4. Positron emission (Beta positive decay) |
| 5. Electron capture | |

4. Define-Decay timing.

The number of decay events – dN expected to occur in a small interval of time dt is proportional to the number of atoms present. If N is the number of atoms, then the probability of decay ($-dN/N$) is proportional to dt .

5. What is Uranium enrichment?

In most types of reactor, a higher concentration of uranium is used to make fuel rod. This is produced by a process termed enrichment. The enriched uranium containing more than natural 0.7% U-235.

6. What are the two ways of uranium enrichment?

1. Gas centrifuge process
2. Gas diffusion

7. What is the purpose of reprocessing of nuclear waste?

The used fuel contains 96% uranium, 1% plutonium and 3% radioactive wastes.

Reprocessing is used to separate the waste from the uranium and plutonium which can be recycled into new fuel. The reprocessing effectively reduces the volume of waste and limits the need to mine new supplies of uranium, so that extending the time of resources.

8. Define Nuclear Fission.

An atom's nucleus can be split apart. When this is done a tremendous amount of energy is released. The energy is both heat and light energy. This energy, when let out slowly can be harnessed to generate electricity.

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9. Define Nuclear Fusion.

Fusion means joining smaller nuclei to make a larger nucleus. The sun uses nuclear fusion of hydrogen atoms into helium atoms. This gives off heat and other radiation.

10. What is Neutron life time?

The prompt neutron lifetime, is the average time between the emission of neutrons and either their absorption in the system or their escape from the system. The term lifetime is used because the emission of a neutron is often considered its birth, and the subsequent absorption is considered its death.

11. What is Uranium-235 chain Reactor?

In a chain reaction, particles released by the splitting of the atom go off and strike other uranium atoms splitting those. Those particles given off split still other atoms in a chain reaction. If at least one neutron from U-235 fission strikes another nucleus and causes it to fission, then the chain reaction will continue.

12. What is four factor formula?

The four factor formula is used in nuclear engineering to determine the multiplication of a nuclear chain reaction in an infinite medium. The formula is:

- Reproduction Factor
- The thermal utilization factor
- The resonance escape probability
- The fast fission factor

13. List the four types of radiation associated with nuclear fission.

1. Alpha radiation
2. Beta radiation
3. Gamma radiation
4. Neutron radiation

14. Define Alpha radiation.

This is basically the atomic nucleus of the element (He) consisting of two protons and two neutrons. It is not very penetrative and the danger to man arises if an alpha emitting element, such as plutonium, then the alpha radiation can be very damaging.

15. Define Beta radiation.

Beta radiation consists of electrons or their positively charged counterparts. This can penetrate the skin, but not very far.

16. Define Gamma radiation.

Gamma radiation is penetrative in a manner similar to X-rays and has similar physical properties. It can be stopped only by thick shields of lead or concrete.

17. Define Neutron radiation.

Neutron radiation consists of the neutrons emitted during the fission process. Neutrons are also very penetrative, but less so than gamma-radiation.

18. Define water as moderator.

Neutrons from fission have very high speeds and must be slowed greatly by water moderation to maintain the chain reaction. The Uranium-235 is enriched to 2.5-3.5% to allow ordinary water to be the moderator. Enough spontaneous events occur to initiate a chain reaction if the proper moderation and fuel density is provided.

19. List the types of Nuclear reactors.

The reactors are classified based on the following:

1. Type of fuel used
2. Neutron flux spectrum
3. The coolant

20. List the various widespread power plant reactor types.

1. Pressurized water reactor (PWR)
2. Boiling water reactor (BWR)
3. Pressurized Heavy water reactor (PHWR)
4. Liquid metal fast Breeder Reactors (LMFBR)
5. High temperature Gas cooled reactors (HTGCR)

21. What is pressurized water reactors (PWR)?

The PWR belongs to the light water type. The moderator and the coolant are both light water (H₂O). The cooling water circulates in two loops, which are fully separated from one another. PWR keeps water under pressure, so the water heats but does not boil even at the high operating temperature.

22. What is boiling water reactor (BWR)?

In a boiling water reactor, light water plays the role of moderator and coolant as well. Part of the water boils away in the reactor pressure vessel, thus a mixture of water and steam leaves the reactor core.

23. What is Molten Salt Reactor (MSR)?

A molten salt reactor is a type of nuclear reactor where the primary coolant is a molten salt. Molten salt refers to a salt that is in the liquid phase that is normally a solid at standard temperature ionic liquid, although technically molten salts are a class of ionic liquids.

24. Nuclear Powerplant safety.

Radiation doses can be controlled through the following procedures:

1. The handling of equipment via remote in the core of the reactor
2. Physical shielding
3. Limit on the time a worker spends in areas with significant radiation levels
4. Monitoring of individual doses and of the working environment
5. Safety mechanism of a Nuclear power reactor

25. List the Nuclear power plants in India.

1. Kaiga (3*22MWPWR), Karnataka
2. Kakrapar (2*22MWPWR), Gujarat
3. Kudankulam (2*100MWPWR), Tamilnadu

4. Madras(2*17MWPWR), Tamilnadu

26. Define mean generation time.

It is the average time from a neutron emission to a capture results in fission. The mean generation time is different from prompt neutron lifetime because the mean generation time only includes neutron absorption that leads to fission reaction.

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REVIEW QUESTIONS:

1. Explain in detail about the nuclear radioactivity and its effects.
2. Derive the expression of the radioactivity decay rate
3. With relevant diagram explain the nuclear life cycle
4. Explain the nuclear fission and nuclear fusion
5. List out the various components of nuclear power plant and explain briefly
6. What is the purpose of nuclear power reactor? List the types of nuclear power reactor and explain any one in detail.
7. Explain the following:
 1. Pressurized water reactor
 2. Boiling water reactor
 3. Gas-cooled, Graphite moderated reactor
8. Comparison of nuclear power reactors

9. Explain the nuclear power plant challenges.

10. List out the advantages and disadvantages of the nuclear power plant.

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